PRESIDENCY UNIVERSITY

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PROGRAMME REGULATIONS & CURRICULUM

2024-28

PRESIDENCY SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

B.TECH. - CIVIL ENGINEERING

PRESIDENCY UNIVERSITY

Presidency University Act, 2013 of the Karnataka Act No. 41 of 2013 | Established under Section 2(f) of UGC Act, 1956
Approved by AICTE, New Delhi | Approved By BCI

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Program Regulations and Curriculum

2024-2028

BACHELOR OF TECHNOLOGY (B.Tech.) in

CIVIL ENGINEERING

based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(As amended up to the 24th Meeting of the Academic Council held on 3rd August 2024. This document supersedes all previous guidelines)

Regulations No.: PU/AC-24.7/CIV18/CIV/2024-28

Resolution No.7 of the 24th Meeting of the Academic Council held on 3rd August 2024 and ratified by the Board of Management in its 24th Meeting held on 05th August 2024.

AUGUST-2024

Table of Contents

PART A – PROGRAM REGULATIONS

1. Vision & Mission of the University and the School / Department

1.1 Vision of the University

To be a Value-driven Global University, excelling beyond peers and creating professionals of integrity and character, having concern and care for society.

1.2 Mission of the University

- Commit to be an innovative and inclusive institution by seeking excellence in teaching, research and knowledge-transfer.
- Pursue Research and Development and its dissemination to the community, at large.
- Create, sustain and apply learning in an interdisciplinary environment with consideration for ethical, ecological and economic aspects of nation building.
- Provide knowledge-based technological support and services to the industry in its growth and development.
- To impart globally-applicable skill-sets to students through flexible course offerings and support industry's requirement and inculcate a spirit of new-venture creation.

1.3 Vision of Presidency School of Engineering

To be a value based, practice-driven School of Engineering and Technology, committed to developing globally-competent Engineers, dedicated to transforming Society.

1.4 Mission of Presidency School of Engineering

- Cultivate a practice-driven environment with a contemporary Learning-pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the field of Core Engineering.
- Establish state-of-the-art facilities for effective Teaching and Learning-experiences.
- Promote Interdisciplinary Studies to nurture talent and impart relevant skill-sets for global impact.
- Instil Entrepreneurial and Leadership Skills to address Social, Environmental, and Community-needs.

1.5 Vision of Department of Civil Engineering

To be a value-based, industry driven Civil Engineering Department committed to develop globally competent Civil Engineering professionals dedicated to transform the society.

1.6 Mission of Department of Civil Engineering

- Committed to inculcate application of Engineering knowledge, develop problem analysis and solving skills to be able to investigate complex engineering problems with modern tools.
- Create value-driven engineering professionals who are sensitive to societal concerns of environmental sustainability through ethical conduct.
- Develop excellent communication abilities with core skills of project management and team work.
- Imbibe passion for lifelong learning with individual growth path.
- Commitment towards excellence in Civil Engineering education through advancements in research and innovation.
- Design flexible course contents in disciplinary, interdisciplinary and research areas to enhance student's competitiveness.

2. Preamble to the Program Regulations and Curriculum

This is the subset of Academic Regulations and it is to be followed as a requirement for the award of B.Tech. degree.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Social Project Based Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

In exercise of the powers conferred by and in discharge of duties assigned under the relevant provision(s) of the Act, Statutes and Academic Regulations of the University, the Academic Council hereby makes the following Regulations.

3. Short Title and Applicability

a. These Regulations shall be called the Bachelor of Technology Degree Program Regulations and Curriculum 2024-2028.
b. These Regulations are subject to, and pursuant to the Academic Regulations.
c. These Regulations shall be applicable to the ongoing Bachelor of Technology Degree Programs of the 2024-2028 batch, and to all other Bachelor of Technology Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Bachelor of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2024-2025

4. Definitions

In these Regulations, unless the context otherwise requires:

a. "Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;

b. "Academic Council" means the Academic Council of the University;

c. "Academic Regulations" means the Academic Regulations, of the University;

d. "Academic Term" means a Semester or Summer Term;

e. "Act" means the Presidency University Act, 2013;

f. "AICTE" means All India Council for Technical Education;

g. "Basket" means a group of courses bundled together based on the nature/type of the course;

h. "BOE" means the Board of Examinations of the University;

i. "BOG" means the Board of Governors of the University;

j. "BOM" means the Board of Management of the University;

k. "BOS" means the Board of Studies of a particular Department/Program of Study of the University;

l. "CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;

m. "Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;

n. "COE" means the Controller of Examinations of the University;

o. "Course In Charge" means the teacher/faculty member responsible for developing and organising the delivery of the Course;

p. *"Course Instructor" means the teacher/faculty member responsible for teaching and evaluation of a Course;*

q. *"Course" means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;*

r. *"Curriculum Structure" means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the Curriculum structure of the specific program and relevant approvals should be taken from the BOS and Academic Council at that time.*

s. *"DAC" means the Departmental Academic Committee of a concerned Department/Program of Study of the University;*

t. *"Dean" means the Dean / Director of the concerned School;*

u. *"Degree Program" includes all Degree Programs;*

v. *"Department" means the Department offering the degree Program(s) / Course(s) / School offering the concerned Degree Programs / other Administrative Offices;*

w. *"Discipline" means specialization or branch of B.Tech. Degree Program;*

x. *"HOD" means the Head of the concerned Department;*

y. *"L-T-P-C" means Lecture-Tutorial-Practical-Credit – refers to the teaching – learning periods and the credit associated;*

z. *"MOOC" means Massive Open Online Courses;*

aa. *"MOU" means the Memorandum of Understanding;*

bb. *"NPTEL" means National Program on Technology Enhanced Learning;*

cc. *"Parent Department" means the department that offers the Degree Program that a student undergoes;*

dd. *"Program Head" means the administrative head of a particular Degree Program/s;*

ee. *"Program Regulations" means the Bachelor of Technology Degree Program Regulations and Curriculum, 2024-2028;*

ff. *"Program" means the Bachelor of Technology (B.Tech.) Degree Program;*

gg. *"PSOE" means the Presidency School of Engineering;*

hh. *"Registrar" means the Registrar of the University;*

ii. *"School" means a constituent institution of the University established for monitoring, supervising and guiding, teaching, training and research activities in broadly related fields of studies;*

jj. *"Section" means the duly numbered Section, with Clauses included in that Section, of these Regulations;*

kk. *"SGPA" means the Semester Grade Point Average as defined in the Academic Regulations;*

ll. *"Statutes" means the Statutes of Presidency University;*

mm. *"Sub-Clause" means the duly numbered Sub-Clause of these Program Regulations;*

nn. *"Summer Term" means an additional Academic Term conducted during the summer break (typically in June-July) for a duration of about eight (08) calendar weeks, with a minimum of thirty (30) University teaching days;*

oo. "SWAYAM" means Study Webs of Active Learning for Young Aspiring Minds.

pp. "UGC" means University Grant Commission;

qq. "University" means Presidency University, Bengaluru; and

rr. "Vice Chancellor" means the Vice Chancellor of the University.

5. Program Description

The Bachelor of Technology Degree Program Regulations and Curriculum 2024-2028 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the following ongoing Bachelor of Technology (B.Tech.) Degree Programs of 2024-2028 offered by the Presidency School of Engineering (PSOE):

1. Bachelor of Technology in Civil Engineering, abbreviated as B.Tech. (Civil Engineering)
2. Bachelor of Technology in Electronics and Communication Engineering, abbreviated as B.Tech. (Electronics and Communication Engineering)
3. Bachelor of Technology in VLSI, abbreviated as B.Tech. (VLSI)
4. Bachelor of Technology in Electrical and Electronics Engineering, abbreviated as B.Tech. (Electrical and Electronics Engineering)
5. Bachelor of Technology in Mechanical Engineering, abbreviated as B.Tech. (Mechanical Engineering); and
6. Bachelor of Technology in Petroleum Engineering, abbreviated as B.Tech. (Petroleum Engineering)

5.1 These Program Regulations shall be applicable to other similar programs, which may be introduced in future.

5.2 These Regulations may evolve and get amended or modified or changed through appropriate approvals from the Academic Council, from time to time, and shall be binding on all concerned.

5.3 The effect of periodic amendments or changes in the Program Regulations, on the students admitted in earlier years, shall be dealt with appropriately and carefully, so as to ensure that those students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised Program Regulations, without any undue favour or considerations.

6. Minimum and Maximum Duration

6.1 Bachelor of Technology Degree Program is a Four-Year, Full-Time Semester based program. The minimum duration of the B.Tech. Program is four (04) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the B.Tech. program is eight (08) Semesters.

6.2 A student who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.

6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause **Error! Reference source not found.** of Academic R egulations), shall be counted in the permissible maximum duration for completion of a Program.

6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as certified through hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.

6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.**Error! Reference source not found.** of A cademic Regulations) in the prescribed maximum duration (Sub-Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7. Programme Educational Objectives (PEO)

After four years of successful completion of the program, the graduates shall be:

PEO1. The graduates shall acquire core competence in basic science and civil engineering.

PEO2. The graduates shall constantly pursue the professional growth with multidisciplinary outlook.

PEO3. The graduates shall work with high professionalism and ethical standards.

PEO4. Graduates shall be responsive to societal needs for sustainable development.

8. Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

8.1 Programme Outcomes (PO)

On successful completion of the Program, the students shall be able to:

PO1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

8.2 Program Specific Outcomes (PSOs):

On successful completion of the Program, the students shall be able to:

PSO1. Use technical, teamwork and communication skills along with leadership principles, to pursue civil engineering courses in area such as structural, transportation, geotechnical, materials, environment, construction and water resources engineering fields.

PSO2. Understand and apply the mathematical and scientific concepts for analytical and design skills concerned with civil engineering practice.

PSO3. Engage in life-long learning through independent study and by participating in professional conferences, workshops, seminars, or continuing education by post graduate degree and research

PSO4. Sensitizing towards contemporary issues, societal needs with professionalism and ethics for sustainable development.

9. Admission Criteria (as per the concerned Statutory Body)

The University admissions shall be open to all persons irrespective of caste, class, creed, gender or nation. All admissions shall be made on the basis of merit in the qualifying examinations; provided that forty percent of the admissions in all Programs of the University shall be reserved for the students of Karnataka State and admissions shall be made through a Common Entrance Examination conducted by the State Government or its agency and seats shall be allotted as per the merit and reservation policy of the State Government from time to time**.** The admission criteria to the B.Tech. Program is listed in the following Sub-Clauses:

9.1 An applicant who has successfully completed Pre-University course or Senior Secondary School course (+2) or equivalent such as (11+1), 'A' level in Senior School Leaving Certificate Course from a recognized university of India or outside or from Senior Secondary Board or equivalent, constituted or recognized by the Union or by the State Government of

that Country for the purpose of issue of qualifying certificate on successful completion of the course, may apply for and be admitted into the Program.

9.2 Provided further, the applicant must have taken Physics and Mathematics as compulsory subjects in the Pre-University / Higher Secondary / (10+2) / (11+1) examination, along with either Chemistry / Biology / Electronics / Computer Science / Biotechnology subject, and, the applicant must have obtained a minimum of 45% of the total marks (40% in case of candidates belonging to the Reserved Category as classified by the Government of Karnataka) in these subjects taken together.

9.3 The applicant must have appeared for Joint Entrance Examinations (JEE) Main / JEE (Advanced) / Karnataka CET / COMED-K, or any other State-level Engineering Entrance Examinations.

9.4 Reservation for the SC / ST and other backward classes shall be made in accordance with the directives issued by the Government of Karnataka from time to time.

9.5 Admissions are offered to Foreign Nationals and Indians living abroad in accordance with the rules applicable for such admission, issued from time to time, by the Government of India.

9.6 Candidates must fulfil the medical standards required for admission as prescribed by the University.

9.7 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation and any other falsification, the Registrar shall report the matter to the Board of Management (BOM), recommending revoking the admission of the candidate.

9.8 The decision of the BOM regarding the admissions is final and binding.

10. Lateral Entry / Transfer Students requirements

10.1 Lateral Entry

The University admits students directly to the second year (3rd Semester) of the B.Tech. Degree program as per the provisions and/or regulations of the Government of Karnataka pertaining to the "Lateral Entry" scheme announced by the Government from time to time. Further, the general conditions and rules governing the provision of Lateral Entry to the B.Tech. Program of the University are listed in the following Sub-Clauses:

10.1.1 Admission to 2nd year (3rd Semester) of the B.Tech. Degree program shall be open to the candidates who are holders of a 3-year Diploma in Engineering (or equivalent qualification as recognized by the University), who have secured not less than forty-five percentage (45%) marks in the final year examination (5th and 6th Semesters of the Diploma Program) in the appropriate branch of Engineering. Provided that, in case of SC / ST and OBC candidates from Karnataka the minimum marks for eligibility shall be forty percent (40%).

10.1.2 Provided further that, candidates seeking Lateral Entry may be required to complete specified bridge Courses as prescribed by the University. Such bridge Courses, if any, shall not be included in the CGPA computations.

10.1.3 All the existing Regulations and Policies of the University shall be binding on all the students admitted to the Program through the provision of Lateral Entry.

10.1.4 The Course requirements prescribed for the 1st Year of the B.Tech. Program shall be waived for the student(s) admitted through Lateral Entry and the duration of

the B.Tech. Program for such students is three (03) years, commencing from the 3rd Semester (commencement of the 2nd Year) of the B.Tech. Program and culminating with the 8th Semester (end of the 4th Year) of the B.Tech. Program.

10.1.5 Provided that, if a Lateral Entry student misses any mandatory program specific courses that are typically offered in the 1st year (1st or 2nd semesters), then those courses must be cleared by the students as soon as possible, preferably during the Summer Term.

10.1.6 The existing Program Regulations of the concerned Program to which the student is admitted through the provision of Lateral Entry shall be binding on the student with effect from the 3rd Semester of the Program. i.e., the Program Structure and Curriculum from the 3rd to 8th Semesters of the Program concerned shall be binding on the student admitted through Lateral Entry. Further, any revisions / amendments made to the Program Regulations thereafter, shall be binding on all the students of the concerned Program.

10.1.7 All the Courses (and the corresponding number of Credits) prescribed for the 1st Year of the concerned B.Tech. Program shall be waived for the student(s) admitted to the concerned B.Tech. Program through Lateral Entry. Further, the *Minimum Credit Requirements* for the award of the B.Tech. Degree in the concerned Program shall be prescribed / calculated as follows:

The ***Minimum Credit Requirements*** for the award of the Bachelor of Technology (B.Tech.) Degree prescribed by the concerned Bachelor of Technology Degree Program Regulations and Curriculum, 2024-2028, minus the number of Credits prescribed / accepted by the Equivalence Committee for the 1st Year (1st and 2nd Semesters) of the B.Tech. Program.

For instance, if the *Minimum Credit Requirements* for the award of the Bachelor of Technology (B.Tech.) Degree as prescribed by the Regulations for B.Tech. (Mechanical Engineering) is "N" Credits, and, if the total credits prescribed in the 1st Year (total credits of the 1st and 2nd Semesters) of the Program concerned is "M" Credits, then the *Minimum Credit Requirements* for the award of the B.Tech. in Mechanical Engineering for a student who joins the Program through the provision of the Lateral Entry, shall be "N – M" Credits.

10.1.8 Further, no other waiver except the Courses prescribed for the 1st year of the B.Tech. Program of the University shall be permissible for students joining the B.Tech. Program through the provision of Lateral Entry.

10.2 Transfer of student(s) from another recognized University to the 2nd year (3rd Semester) of the B.Tech. Program of the University

A student who has completed the 1st Year (i.e., passed in all the Courses / Subjects prescribed for the 1st Year) of the B.Tech. / B.E. / B.S., Four-Year Degree Program from another recognized University, may be permitted to transfer to the 2nd Year (3rd Semester) of the B.Tech. Program of the University as per the rules and guidelines prescribed in the following Sub-Clauses:

10.2.1 The concerned student fulfils the criteria specified in Sub-Clauses 10.1.1, 10.1.2 and 10.1.3.

10.2.2 The student shall submit the Application for Transfer along with a non-refundable Application Fee (as prescribed by the University from time to time) to the University no later than July 10 of the concerned year for admission to the 2nd Year (3rd Semester) B.Tech. Program commencing on August 1 on the year concerned.

10.2.3 The student shall submit copies of the respective Marks Cards/ Grade Sheets/ Certificates along with the Application for Transfer.

10.2.4 The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the B.Tech. / B.E. / B.S. Four Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the B.Tech. Program of the University.

10.2.5 The Branch / Discipline allotted to the student concerned shall be the decision of the University and binding on the student.

11. Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the B.Tech. Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch, or not to provide the option for a change of Branch, at the end of 1st Year of the B.Tech. Program to eligible students in accordance with the following rules and guidelines: framed by the University from time to time.

11.1 Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the B.Tech. Program and obtained a CGPA of not less than 6.50 at the end of the 2nd Semester, shall be eligible for consideration for a change of Branch.

11.2 Change of Branch, if provided, shall be made effective from the commencement of the 3rd Semester of the B.Tech. Program. There shall be no provision for change of Branch thereafter under any circumstances whatsoever.

11.3 The student provided with the change of Branch shall fully adhere to and comply with the Program Regulations of the concerned Branch of the B.Tech. Program, the Fee Policy pertaining to that Branch of the B.Tech. Program, and, all other rules pertaining to the changed Branch existing at the time.

11.4 Change of Branch once made shall be final and binding on the student. No student shall be permitted, under any circumstances, to refuse the change of Branch offered.

11.5 The eligible student may be allowed a change in Branch, strictly in order of *inter se* merit, subject to the conditions given below:

11.5.1 The actual number of students in the 3rd Semester in any particular Branch to which the transfer is to be made, should not exceed the intake fixed by the University for the concerned Branch;

11.5.2 The actual number of students in any Branch from which transfer is being sought does not fall below 75% of the total intake fixed by the University for the concerned Branch.

The process of change of Branch shall be completed within the first five days of Registration for the 3rd Semester of the B.Tech. Program.

12. Specific Regulations regarding Assessment and Evaluation (including the Assessment Details of NTCC Courses, Weightages of Continuous Assessment and End Term Examination for various Course Categories)

12.1 The academic performance evaluation of a student in a Course shall be according to the University Letter Grading System based on the class performance distribution in the Course.

12.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given

to each component of Continuous Assessments (refer Clause 8.8 of Academic Regulations) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.

12.3 Format of the End-Term examination shall be specified in the Course Plan.

12.4 Grading is the process of rewarding the students for their overall performance in each Course. The University follows the system of Relative Grading with statistical approach to classify the students based on the relative performance of the students registered in the concerned Course except in the following cases:

- Non-Teaching Credit Courses (NTCC)
- Courses with a class strength less than 30

Absolute grading method may be adopted, where necessary with prior approval of concerned DAC.

Grading shall be done at the end of the Academic Term by considering the aggregate performance of the student in all components of Assessments prescribed for the Course. Letter Grades (Clause **Error! Reference source not found.** of Academic Regulations) s hall be awarded to a student based on her/his overall performance relative to the class performance distribution in the concerned Course. These Letter Grades not only indicate a qualitative assessment of the student's performance but also carry a quantitative (numeric) equivalent called the Grade Point.

12.5 Assessment Components and Weightage

Table 1: Assessment Components and Weightage for different category of Courses

Nature of Course and Structure	Evaluation Component	Weightage
Lecture-based Course L component in the L-T-P Structure is predominant (more than 1) (Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)	Continuous Assessments	50%
	End Term Examination	50%
Lab/Practice-based Course P component in the L-T-P Structure is predominant (Examples: 0-0-4; 1-0-4; 1-0-2; etc.)	Continuous Assessments	50%
	End Term Examination	50%
Skill based Courses like Industry Internship, Capstone project, Research Dissertation, Integrative Studio, Interdisciplinary Project, Summer / Short Internship, Social Engagement / Field Projects, Portfolio, and such similar Non-Teaching Credit Courses, where the pedagogy does not lend itself to a typical L-T-P structure	Guidelines for the assessment components for the various types of Courses, with recommended weightages, shall be specified in the concerned Program Regulations and Curriculum / Course Plans, as applicable.	

The exact weightages of Evaluation Components shall be clearly specified in the respective Course Plan.

Normally, for Practice/Skill based Courses, without a defined credit structure (L–T–P) [NTCC], but with assigned Credits (as defined in Clause **Error! Reference source not f ound.** of the Academic Regulations), the method of evaluation shall be based only on Continuous Assessments. The various components of Continuous Assessments, the distribution of weightage among such components, and the method of

evaluation/assessment, shall be as decided and indicated in the Course Plan. The same shall be approved by the respective DAC.

12.6 Minimum Performance Criteria:

12.6.1 **Theory only Course and Lab/Practice Embedded Theory Course**
A student shall satisfy the following minimum performance criteria to be eligible to earn the credits towards the concerned Course:

a. A student must obtain a minimum of 30% of the total marks/weightage assigned to the End Term Examinations in the concerned Course.

b. The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of the components of Continuous Assessments, Mid Term Examinations and End Term Examinations in the concerned Course.

12.6.2 **Lab/Practice only Course and Project Based Courses**
The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of all assessment components in the concerned Course.

12.6.3 A student who fails to meet the minimum performance criteria listed above in a Course shall be declared as "Fail" and given "F" Grade in the concerned Course. For theory Courses, the student shall have to re-appear in the "Make-Up Examinations" as scheduled by the University in any subsequent semester, or, re-appear in the End Term Examinations of the same Course when it is scheduled at the end of the following Semester or Summer Term, if offered. The marks obtained in the Continuous Assessments (other than the End Term Examination) shall be carried forward and be included in computing the final grade, if the student secures the minimum requirements (as per Sub-Clauses 8.9.1 and 8.9.2 of Academic Regulations) in the "Make-Up Examinations" of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

13. Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc. – Note: These are covered in Academic Regulations

The University allows students to acquire credits from other Indian or foreign institutions and/or Massive Open Online Course (MOOC) platforms, subject to prior approval. These credits may be transferred and counted toward fulfilling the minimum credit requirements for the award of a degree. The process of transfer of credits is governed by the following rules and guidelines:

13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer **Error! Reference source not found.** of Academic Regulations) and approved by t he Dean - Academics.

13.2 Students may earn credits from other Indian or foreign Universities/Institutions with which the University has an MOU, and that MOU shall have specific provisions, rules and guidelines for transfer of credits. These transferred credits shall be counted towards the minimum credit requirements for the award of the degree.

13.3 Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules

and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:

13.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 17.3 (as per Academic Regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

13.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 17.3(as per Academic Regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

13.3.3 Parent Departments may release a list of SWAYAM/NPTEL/other approved MOOCs for Pre-Registration as per schedule in the Academic Calendar or through University Notification to this effect.

13.3.4 Students may Pre-Register for the SWAYAM/NPTEL/other approved MOOCs in the respective Departments and register for the same Courses as per the schedule announced by respective Online Course Offering body/institute/ university.

13.3.5 A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 13.3.2 above.

13.3.6 SWAYAM/NPTEL/other approved MOOCs Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM/NPTEL/other approved MOOCs and obtained a certificate of successful/satisfactory completion.

13.3.7 A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall forwarded to the COE for processing of results of the concerned Academic Term.

13.3.8 The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in Academic Regulations.

Table 2: Durations and Credit Equivalence for Transfer of Credits from SWAYAM-NPTEL/ other approved MOOC Courses

Sl. No.	Course Duration	Credit Equivalence
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

13.3.9 The maximum permissible number of credits that a student may request for credit transfer from MOOCs shall not exceed 20% of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree.

13.3.10 The University shall not reimburse any fees/expense; a student may incur for the SWAYAM/NPTEL/other approved MOOCs.

13.4 The maximum number of credits that can be transferred by a student shall be limited to forty percent (40%) of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree. However, the grades obtained in the Courses transferred from other Institutions/MOOCs, as mentioned in this Section (13.**Error! Reference source not found.**), shall not be included in the c alculation of the CGPA.

14. Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements

The B.Tech. (Civil Engineering) Program Structure (2024-2028) totalling 160 credits. Table 3 summarizes the type of baskets, under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: B.Tech. (Civil Engineering) 2025-2029: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	Humanities and Social Sciences including Management Courses (HSMC)	09
2	Basic Science Courses (BSC)	17
3	Engineering Science Courses (ESC)	15
4	Professional Core Courses (PCC)	70
5	Professional Elective Courses (PEC)	24
6	Open Elective Courses (OEC)	09
7	Project Work (PRW)	16
8	Mandatory Audit Courses (MAC)	0
	Total Credits	**160 (Minimum)**

In the entire Program, the practical and skill based course component contribute to an extent of approximately 57% out of the total credits of 160 for B.Tech. (Civil Engineering) program of four years' duration.

15. Minimum Total Credit Requirements of Award of Degree

As per the AICTE guidelines, a minimum of 160 credits is required for the award of a B.Tech. degree.

16. Other Specific Requirements for Award of Degree, if any, as prescribed by the Statutory Bodies

16.1 The award of the Degree shall be recommended by the Board of Examinations and approved by the Academic Council and Board of Management of the University.

16.2 A student shall be declared to be eligible for the award of the concerned Degree if she/he:

a. Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets.

b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause a of Academic Regulations**;**

c. No dues to the University, Departments, Hostels, Library, and any other such Centers/ Departments of the University; and

d. No disciplinary action is pending against her/him.

17. Curriculum Structure – Basket Wise Course List

List of Courses Tabled – aligned to the Program Structure

Table 3.1: List of Humanities and Social Sciences including Management Courses (HSMC)						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	ENG1002	Technical English	1	0	2	2
2	ENG2001	Advanced English	1	0	2	2
3	PPS1001	Introduction to soft skills	0	0	2	1
4	PPS1012	Enhancing Personality through Soft Skill	0	0	2	1
5	MGTXXXX	Management Course *(Any one course from Management Basket-I)*	3	0	0	3
					Total No. of Credits	**09**

Table 3.2: List of Basic Science Courses (BSC)						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MAT1003	Applied Statistics	1	0	2	2
2	MAT1001	Calculus and Linear Algebra	3	1	0	4
3	MAT2501	Integral Transforms and Partial Differential Equations	3	0	0	3
4	MAT2502	Numerical Methods and Complex Variables	3	0	0	3
5	PHY1001	Material Physics	2	0	2	3
6	CHE1017	Applied Chemistry	1	0	2	2
					Total No. of Credits	**17**

Table 3.3: List of Engineering Science Courses (ESC)						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CIV1008	Basic Engineering Sciences	2	0	0	2
2	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4
3	CSE1004	Problem solving using C	1	0	4	3
4	MEC1006	Engineering Graphics	2	0	0	2
5	CSE1006	Problem solving using Java	1	0	4	3
6	ECE2010	Innovative Projects using Arduino	-	-	-	1
					Total No. of Credits	**15**

Table 3.4: List of Professional Core Courses (PCC)						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CIV1003	Elements of Engineering Mechanics	2	1	0	3
2	CIV2008	Engineering Geology	1	0	2	2
3	CIV2500	Strength of Materials	3	0	0	3
4	CIV2101	Surveying	2	1	0	3
5	CIV2102	Surveying Lab	0	0	2	1
6	CIV2100	Building Materials and Concrete Technology	3	0	0	3
7	CIV2501	Transportation Engineering	3	0	0	3
8	CIV2502	Infrastructure Materials Testing Lab	0	0	2	1
9	CIV2103	Building Planning and Drawing	0	0	2	1
10	CIV2503	Fluid Mechanics	3	1	0	4
11	CIV2504	Fluid Mechanics Lab	0	0	2	1
12	CIV2505	Hydrology and Irrigation Systems	3	0	0	3
13	CIV2506	Analysis of Determinate Structures	2	1	0	3
14	CIV2507	Analysis of Indeterminate Structures	3	0	0	3
15	CIV2508	Design of RCC Structural Elements	3	1	0	4
16	CIV2509	Analysis and Design of Pre-Stressed Concrete Elements	2	1	0	3
17	CIV2510	Design of Structural Steel Elements	3	0	0	3
18	CIV2511	Construction Materials Testing Lab	0	0	2	1
19	CIV2512	Geotechnical Engineering	3	0	0	3
20	CIV2513	Geotechnical Engineering Lab	0	0	2	1
21	CIV2514	Foundation Engineering	3	0	0	3
22	CIV2515	Water Infrastructure Systems	3	0	0	3
23	CIV2516	Waste Water Treatment and Disposal Systems	3	0	0	3
24	CIV2517	Environmental Engineering Lab	0	0	2	1
25	CIV2518	Quantity Surveying, Cost Estimation and Asset Valuation	3	1	0	4
26	CIV2519	Construction Project Management	2	0	0	2
27	CIV2520	Construction Project Management Lab	0	0	2	1
28	CIV2523	3D Building Modelling and BIM Lab	0	0	4	2
29	CIV2524	Structural Analysis and Detailing Lab	0	0	4	2
					Total No. of Credits	**70**

Table 3.5: List of course in Project Work basket (PRW)						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CIV7000	Internship	-	-	-	2
2	CIV7100	Minor Project (Extensive Survey Project)	-	-	-	4
3	CIV7300	Capstone Project	-	-	-	10
					Total No. of Credits	**16**

Table 3.6: List of Mandatory Aduit Courses (MAC)						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CHE1018	Environmental Science	1	0	2	-
2	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	-
3	PPS	Industry Preparedness Program	2	0	2	-

18. Practical / Skill based Courses – Internships / Thesis / Dissertation / Capstone Project Work / Portfolio / Mini project

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, are simply assigned the number of Credits based on the quantum of work / effort required to fulfill the learning objectives and outcomes prescribed for the concerned Courses. Such courses are referred to as Non-Teaching Credit Courses (NTCC). These Courses are designed to provide students with hands-on experience and skills essential for their professional development. These courses aim to equip students with abilities in problem identification, root cause analysis, problem-solving, innovation, and design thinking through industry exposure and project-based learning. The expected outcomes are first level proficiency in problem solving and design thinking skills to better equip B.Tech. graduates for their professional careers. The method of evaluation and grading for the Practical / Skill based Courses shall be prescribed and approved by the concerned Departmental Academic Committee (refer Annexure A of the Academic Regulations). The same shall be prescribed in the Course Plan.

18.1 Internship

A student may undergo an Internship for a period of 4-6 weeks in an industry / company or academic / research institution during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters, subject to the following conditions:

18.1.1 The Internship shall be in conducted in accordance with the Internship Policy prescribed by the University from time to time.

18.1.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Internship to a student;

18.1.3 The number of Internships available for the concerned Academic Term. Further, the available number of internships shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Internship, as stated in Sub-Clause 18.1.2 above.

18.1.4 A student may opt for Internship in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the Internship on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Internship confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

18.1.5 A student selected for an Internship in an industry / company or academic /

research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

18.2 Project Work

A student may opt to do a Project Work for a period of 4-6 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters or during the 5th / 6th / 7th Semester as applicable, subject to the following conditions:

18.2.1 The Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

18.2.2 The student may do the project work in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.2.1). Provided further, that the Industry / Company or academic / research institution offering such project work confirms to the University that the project work will be conducted in accordance with the Program Regulations and requirements of the University.

18.3 Capstone Project

A student may undergo a Capstone Project for a period of 12-14 weeks in an industry / company or academic / research institution in the 7th / 8th Semester as applicable, subject to the following conditions:

18.3.1 The Capstone Project shall be in conducted in accordance with the Capstone Project Policy prescribed by the University from time to time.

18.3.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Capstone Project to a student;

18.3.3 The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Capstone Project, as stated in Sub-Clause 2.6.3.2 above.

18.3.4 A student may opt for Capstone Project in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the I Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

18.3.5 A student selected for a Capstone Project in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Capstone Project Policy of the University.

18.4 Research Project / Dissertation

A student may opt to do a Research Project / Dissertation for a period of 12-14 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Capstone Project, subject to the following conditions:

18.4.1 The Research Project / Dissertation shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

18.4.2 The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.4.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

19. List of Elective Courses under various Specialisations / Stream Basket

Table 3.6: Professional Electives Courses/Specialization Tracks							
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Pre-requisites**
Track 1 – General							
1	CIV3111	Remote Sensing and Geographical Information System	2	0	2	3	-
2	CIV3112	Construction Technology and Processes	3	0	0	3	-
3	CIV3113	Advanced Concrete Technology	3	0	0	3	CIV2100
4	CIV3114	Alternative Building Materials	3	0	0	3	CIV2100
5	CIV3115	Design Concepts of Building Services	3	0	0	3	-
6	CIV3116	Integration of SDGs in Civil Engineering	3	0	0	3	-
7	CIV3117	Optimization methods for Civil Engineering	3	0	0	3	MAT2503
8	CIV3118	Development and Applications of Special Concretes	3	0	0	3	CIV2100
9	CIV3119	Safety in Construction	3	0	0	3	-
Track 2 – Structural Engineering							
1	CIV3400	Structural Dynamics	3	0	0	3	CIV2507
2	CIV3401	Advanced RCC structures	3	0	0	3	CIV2508
3	CIV3402	Design of Industrial structures	3	0	0	3	CIV2510
4	CIV3403	Repair and rehabilitation of structures	3	0	0	3	CIV2508
5	CIV3404	Matrix methods of structural analysis	2	1	0	3	CIV2507
6	CIV3405	Masonry structures	3	0	0	3	-
7	CIV3406	Advanced Design of Steel Structures	3	0	0	3	CIV2510
8	CIV3407	Design of Retaining Structures	3	0	0	3	CIV2508
9	CIV3408	Elements of Earthquake Engineering	3	0	0	3	CIV2508
10	CIV3409	Bridge Design	3	0	0	3	CIV2508
11	CIV3410	Stability of Structures	3	0	0	3	CIV2507
12	CIV3411	Pre-fabricated Structures	3	0	0	3	CIV2510
13	CIV3412	Finite Element Method	2	1	0	3	CIV3413
14	CIV3413	Theory of Elasticity	2	1	0	3	CIV2507
15	CIV3414	Advanced Prestressed Concrete Design	2	1	0	3	CIV2509
16	CIV3415	Earthquake resistant Design of Structures	2	1	0	3	CIV3408
17	CIV3416	Offshore structures	3	0	0	3	CIV2508
18	CIV3417	Structural Health Monitoring	3	0	0	3	CIV2508

Table 3.6: Professional Electives Courses/Specialization Tracks							
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Pre-requisites**
19	CIV3418	Glass in Buildings: Design and Applications	3	0	0	3	-
20	CIV3419	Design of Tall Buildings	3	0	0	3	CIV2508
21	CIV3420	Theory of Plates and Shells	3	0	0	3	CIV3413
22	CIV3421	Design of Steel Concrete Composite Structures	3	0	0	3	CIV2508 CIV2510
Track 3 - Transportation and Geotechnical Engineering							
1	CIV3422	Railway Engineering and Tunnelling	3	0	0	3	CIV2101 CIV2501
2	CIV3423	Airport Engineering and Harbour	3	0	0	3	CIV2101 CIV2501
3	CIV3424	Pavement Materials & Construction	3	0	0	3	CIV2101 CIV2501
4	CIV3425	Urban Transport Planning	3	0	0	3	CIV2101 CIV2501
5	CIV3426	Traffic Engineering	3	0	0	3	CIV2101 CIV2501
6	CIV3427	Advanced Geomatics	2	0	2	3	CIV2101
7	CIV3428	Highway Geometric Design	2	1	0	3	CIV2101 CIV2501
8	CIV3429	Pavement Design	2	1	0	3	CIV2101 CIV2501
9	CIV3430	Highway Construction and Maintenance	3	0	0	3	CIV2101 CIV2501
10	CIV3431	Environmental Geotechnics	3	0	0	3	CIV2512
11	CIV3432	Advanced Soil Mechanics	3	0	0	3	CIV2512
12	CIV3433	Stability of Slopes	3	0	0	3	CIV2514
13	CIV3434	Ground Improvement Techniques	3	0	0	3	CIV2512
14	CIV3435	Reinforced Earth Structures	3	0	0	3	CIV2514
15	CIV3436	Advanced Foundation Design	3	0	0	3	CIV2508 CIV2514
16	CIV3437	Earth and Earth Retaining Structures	3	0	0	3	CIV2508 CIV2514
17	CIV3438	Earthquake Resistant Design of Foundations	3	0	0	3	CIV2508 CIV2514
18	CIV3439	Pavement Management System	3	0	0	3	CIV2501
19	CIV3440	Design of Pile Foundations	3	0	0	3	CIV2508 CIV2514
20	CIV3441	Design of soil structures with Geosynthetics	3	0	0	3	CIV2514
21	CIV3442	Road Safety and Traffic Management	3	0	0	3	CIV2501
22	CIV3443	Unsaturated Soil Mechanics	3	0	0	3	CIV2512
Track 4 - Water Resources and Environmental Engineering							
1	CIV3444	Environmental Pollution and Control	3	0	0	3	-
3	CIV3445	Ground Water Hydrology	3	0	0	3	CIV2505

Table 3.6: Professional Electives Courses/Specialization Tracks							
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Pre-requisites**
4	CIV3446	Climate Change and Sustainable Development	3	0	0	3	-
5	CIV3447	Urban Waste Management	3	0	0	3	-
6	CIV3448	Urban Flooding: Analysis and Control	3	0	0	3	CIV2505
7	CIV3449	Integrated Watershed Management	3	0	0	3	CIV2505
8	CIV3450	Environmental Hydraulics	3	0	0	3	CIV2515
9	CIV3451	Industrial wastewater treatment	3	0	0	3	CIV2516
10	CIV3452	Open Channel Flow	3	0	0	3	CIV2505
11	CIV3453	Design of Hydraulic Structures	2	1	0	3	CIV2505
12	CIV3454	Water Resource Management	3	0	0	3	CIV2505
13	CIV3455	Advanced Fluid Mechanics	2	1	0	3	CIV2503
14	CIV3456	Soil and water conservation	3	0	0	3	-
15	CIV3457	Statistics in Hydrology	3	0	0	3	CIV2505
16	CIV3458	Environmental management Systems and Audits	3	0	0	3	-
Track 5 - Infrastructure Development							
1	CIV3459	Introduction to Infrastructure System and Planning	3	0	0	3	-
2	CIV3460	Urban Planning and Design	3	0	0	3	-
3	CIV3461	Construction Equipment and Machinery	3	0	0	3	-
4	CIV3462	Construction Quality and Safety	3	0	0	3	-
5	CIV3463	Project Management in Infrastructure Development	3	0	0	3	CIV2519
6	CIV3464	Construction Practices and Challenges in Infrastructure Projects	3	0	0	3	-
7	CIV3465	Applications of Remote Sensing and GIS in Infrastructure Development	3	0	0	3	CIV2101
8	CIV3466	Environmental Impact Assessment for Infrastructure Projects	3	0	0	3	-
9	CIV3467	Geospatial Analysis in Urban Planning	2	0	2	3	CIV2101
10	CIV3800	Construction Economics and Finance	3	0	0	3	-
11	CIV3801	Infrastructure Projects Financing	3	0	0	3	-
Track 6 – Smart Cities							
1	CIV3468	Built Environment Design	3	0	0	3	-
2	CIV3469	Fundamentals of Smart City	3	0	0	3	-
3	CIV3470	Urban Mobility	3	0	0	3	CIV2501
4	CIV3471	Urban sanitation and hygiene	3	0	0	3	CIV2516
5	CIV3472	Smart Materials and Structures	3	0	0	3	CIV2100 CIV2500
6	CIV3473	Urban Air Pollution and Control	3	0	0	3	-
7	CIV3474	Intelligent Transportation Systems	3	0	0	3	CIV2501
8	CIV3802	Smart City Energy systems and Management	3	0	0	3	EEE1200

Table 3.6: Professional Electives Courses/Specialization Tracks							
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Pre-requisites**
9	CIV3803	IoT in Construction	3	0	0	3	ECE1511
10	CIV3804	Construction Economics and Financing for Smart Cities	3	0	0	3	-
11	CIV3805	Big Data Analytics for Civil Engineers	1	0	4	3	-

20. List of Open Electives to be offered by the School / Department

Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Anti-requisites**
Chemistry Basket							
1	CHE3001	Smart Materials and 3D Printing	3	0	0	3	-
2	CHE3002	Energy and Sustainability	3	0	0	3	-
3	CHE3003	Nano technology and its applications	3	0	0	3	-
4	CHE3004	Corrosion and control	3	0	0	3	-
5	CHE3005	Green Chemistry and Sustainable Technology	3	0	0	3	-
6	CHE3006	Food Technology	3	0	0	3	-
Civil Engineering Basket (not to be offered for Civil Engineering Department students)							
1	CIV3100	Disaster mitigation and management	3	0	0	3	-
2	CIV3101	Sustainability Concepts in Engineering	3	0	0	3	-
3	CIV3102	Occupational Health and Safety	3	0	0	3	-
4	CIV3103	Sustainable Materials and Green Buildings	3	0	0	3	-
5	CIV3104	Integrated Project Management	3	0	0	3	-
6	CIV3105	Environmental Impact Assessment	3	0	0	3	-
7	CIV3106	Infrastructure Systems for Smart Cities	3	0	0	3	-
8	CIV3107	Geospatial Applications for Engineers	2	0	2	3	-
9	CIV3108	Environmental Meteorology	3	0	0	3	-
10	CIV3109	Project Problem Based Learning	3	0	0	3	-
11	CIV3110	Sustainability for Professional Practice	3	0	0	3	-
Commerce Basket							
1	MGT2015	Engineering Economics	3	0	0	3	-
2	MGT2020	Marketing Fundamentals for Engineers	3	0	0	3	-
3	MGT2021	Finance for Engineers	3	0	0	3	-
4	MGT2007	Digital Entrepreneurship	3	0	0	3	-
5	COM1020	Business Accounting & Financial Analysis	2	1	0	3	-
6	BBA2088	Management and Behavioural Practices	3	0	0	3	-
Design Basket							
1	DES2001	Design Thinking	3	0	0	3	-
Electrical and Electronics Basket							
1	EEE3100	IoT based Smart Building Technology	3	0	0	3	-
2	EEE3101	Basic Circuit Analysis	3	0	0	3	-
3	EEE3102	Fundamentals of Industrial Automation	3	0	0	3	-
4	EEE3103	Electric Vehicles & Battery technology	3	0	0	3	-
5	EEE3104	Smart Sensors for Engineering Applications	3	0	0	3	-

Sl. No.	Course Code	Course Name	L	T	P	C	Anti-requisites
Electronics and Communication Engineering Basket							
1	ECE3800	Fundamentals of Electronics	3	0	0	3	
2	ECE3801	Microprocessor based systems	3	0	0	3	
3	ECE3802	Artificial Neural Networks	3	0	0	3	
4	ECE3803	Smart Electronics in Agriculture	3	0	0	3	
5	ECE3804	Environment Monitoring Systems	3	0	0	3	
6	ECE3805	Consumer Electronics	3	0	0	3	
7	ECE3806	Product Design of Electronic Equipment	3	0	0	3	
8	ECE3807	Introduction to Data Analytics	3	0	0	3	
9	ECE3808	Machine Vision for Robotics	3	0	0	3	
English Basket							
1	ENG1906	Law and Crime in Popular Imagination	3	0	0	3	
2	ENG1909	Exploring Gender: Narratives from Campus to Community	3	0	0	3	
3	ENG1910	Trauma Narratives: From Page to Pixel	3	0	0	3	
4	ENG1911	'Nonsense' Across Media	3	0	0	3	
5	ENG1912	Language and Interpretation	3	0	0	3	
Law Basket							
1	LAW2015	Cyber Law	3	0	0	3	-
Mathematics Basket							
1	MAT3030	Optimization Techniques for Engineers	3	0	0	3	-
2	MAT3031	Basic Statistics & Data Analysis	3	0	0	3	-
3	MAT3032	Mathematics for Machine Learning	3	0	0	3	-
4	MAT3033	Bioinformatics & Computational Biology	3	0	0	3	-
5	MAT3034	Time-Frequency Transforms for Signal Analysis	3	0	0	3	-
6	MAT3035	Mathematical Modelling	3	0	0	3	-
7	MAT3036	Bio-Statistics and Bio-Modelling	3	0	0	3	-
8	MAT3037	Linear Algebra & Matrix Theory	3	0	0	3	-
9	MAT3038	Financial Mathematics	3	0	0	3	-
10	MAT3039	Fuzzy Logic & Neural Networks	3	0	0	3	-
11	MAT3040	Discrete Mathematics	3	0	0	3	-
Media Studies Basket							
1	BAJ3006	Brand Management	3	0	0	3	-
2	BAJ3007	Communication for Social Impact	3	0	0	3	-
3	BAJ3035	Business Journalism	3	0	0	3	-
4	BAJ3017	Political Communication	3	0	0	3	-
5	BAJ3042	Media Literacy Education	3	0	0	3	-
Mechanical Basket							
1	MEC3250	Engineering Drawing	1	0	4	3	-
2	MEC3251	Supply Chain Management	3	0	0	3	-
3	MEC3252	Six Sigma for Professionals	3	0	0	3	-
4	MEC3253	Fundamentals of Aerospace Engineering	3	0	0	3	-
5	MEC3254	Safety Engineering	3	0	0	3	-
6	MEC3255	Additive Manufacturing	3	0	0	3	-
7	MEC3256	Sustainable Technologies and Practices	3	0	0	3	-
8	MEC3257	Industry 4.0	3	0	0	3	-
Petroleum Basket							

Sl. No.	Course Code	Course Name	L	T	P	C	Anti-requisites
1	PET3301	Energy Industry Dynamics	3	0	0	3	-
2	PET3302	Energy Sustainability Practices	3	0	0	3	-
Management Basket – I (One Course to be opted as part of HSMC Basket)							
1	MGTXXXX	Managerial Economics and Finance	3	0	0	3	-
2	MGT2004	Development of Enterprises	3	0	0	3	-
3	MGT2010	Managing People and Performance	3	0	0	3	-
4	MGT2020	Marketing for Engineers	3	0	0	3	-

21. List of MOOC (NPTEL) Courses

21.1. NPTEL - Discipline Elective Courses for B.Tech. (Civil Engineering)

Sl. No.	Course ID	Course Name	Duration
1	noc25-ce06	Applied Seismology for Engineers	12 Weeks
2	noc25-ce19	Environmental Remediation of Contaminated Sites	12 Weeks
3	noc25-ce22	Free Surface Flows	12 Weeks
4	noc25-ce27	Geophysical Exploration Methods	12 Weeks
5	noc25-ce41	Modern Construction Materials	12 Weeks
6	noc25-ce51	Soil Dynamics	12 Weeks
7	noc25-ce52	Soil Structure Interaction	12 Weeks
8	noc25-ce57	Surface Water Hydrology	12 Weeks
9	noc25-ce61	Unsaturated Soil Mechanics	12 Weeks
10	noc25-ch24	Environmental Quality Monitoring & Analysis	12 Weeks

21.2. NPTEL - Open Elective Courses for B.Tech. (Civil Engineering)

Sl. No.	Course ID	Course Name	Duration
1	noc25-ce59	The Evolution of the Earth and Life	12 Weeks
2	noc25-ce71	Tectonics and Geodynamics	12 Weeks
3	noc25-cs43	Introduction To Industry 4.0 And Industrial Internet of Things	12 Weeks
4	noc25-de04	Strategies for Sustainable Design	12 Weeks
5	noc25-de07	Understanding Incubation and Entrepreneurship	12 Weeks
6	noc25-de08	Usability Engineering	12 Weeks
7	noc25-ge31	Rural Water Resources Management	12 Weeks
8	noc25-hs12	Education for Sustainable Development	12 Weeks
9	noc25-hs19	English language for competitive exams	12 Weeks
10	noc25-hs42	Introduction to Environmental Economics	12 Weeks
11	noc25-hs43	Introduction to Japanese Language and Culture	12 Weeks
12	noc25-hs59	Online Communication in the Digital Age	12 Weeks
13	noc25-hs61	Patent Law for Engineers and Scientists	12 Weeks
14	noc25-hs68	Psychology Of Stress, Health and Well-Being	12 Weeks
15	noc25-hs81	United Nations Sustainable Development Goals (UN SDGs)	12 Weeks
16	noc25-mg38	Leadership and Team Effectiveness	12 Weeks

17	noc25-mg51	Organizational Design Change and Transformation	12 Weeks
18	noc25-mg57	Safety and Risk Analytics	12 Weeks
19	noc25-mm04	Bulk Material Transport and Handling Systems	12 Weeks
20	noc25-mm18	Material Characterization	12 Weeks

* The NPTEL courses listed above are subjected to change based on the offering of NPTEL. The updated list of NPTEL courses shall be notified before the commencement of the semester after the same is approved by BoS.

22. Recommended Semester Wise Course Structure / Flow including the Programme / Discipline Elective Paths / Options

Semester 1										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	CSE1004	Problem Solving Using C	1	0	4	3	3	ESC		
2	ENG1002	Technical English	1	0	2	2	2	HSMC		
3	PPS1001	Introduction to soft skills	0	0	2	1	1	HSMC		HP
4	CHE1018	Environmental Science	1	0	2	0	0	MAC		
5	CIV1008	Basic Engineering Sciences	2	0	0	2	2	ESC		
6	MAT1003	Applied Statistics	1	0	2	2	2	BSC	S	
7	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4	4	ESC		
8	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	0	0	MAC		HP
9	CHE1023	Environmental Science	0	0	2	0	2	MAC		ES

Semester 2										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	CSE1006	Problem Solving using JAVA	1	0	4	3	3	ESC		
2	ENG2001	Advanced English	1	0	2	2	2	HSMC		
3	PPS1012	Enhancing Personality through Soft Skill	0	0	2	1	1	HSMC		HP
4	CIV1003	Elements of Engineering Mechanics	2	1	0	3	3	PCC	S	
5	MEC1006	Engineering Graphics	2	0	0	2	2	ESC	S	
6	MAT1001	Calculus and Linear Algebra	3	0	2	4	4	BSC		
7	CHE1017	Applied Chemistry	1	0	2	2	2	BSC		
8	ECE2010	Innovative Projects using Arduino	-	-	-	1	1	ESC		
9	CIV2008	Engineering Geology	1	0	2	2	2	PCC		

Semester 3										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	MAT2501	Integral Transforms and Partial Differential Equations	3	0	0	3	3	BSC		
2	PHY1001	Material Physics	2	0	2	3	4	BSC	S	
3	CIV2500	Strength of Materials	3	0	0	3	3	PCC	S	
4	CIV2501	Transportation Engineering	3	0	0	3	3	PCC		
5	CIV2503	Fluid Mechanics	3	1	0	4	4	PCC		
6	CIV2101	Surveying	3	0	0	3	3	PCC	S	
7	CIV2100	Building Materials and Concrete Technology	3	0	0	3	3	PCC	S	
8	XXXXXXX	Open Elective - I	3	0	0	3	3	OEC		
9	CIV2102	Surveying Lab	0	0	2	1	2	PCC	S/ EM	

Semester 4										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	MAT2502	Numerical Methods and Complex Variables	3	0	0	3	3	BSC		
2	CIV2506	Analysis of Determinate Structures	2	1	0	3	3	PCC	S	
3	CIV2512	Geotechnical Engineering	3	0	0	3	3	PCC	S	
4	CIV2505	Hydrology and Irrigation Systems	3	0	0	3	3	PCC	S	ES
5	CIV2515	Water Infrastructure Systems	3	0	0	3	3	PCC	S	ES
6	CIVXXXX	Professional Elective - I	3	0	0	3	3	PEC		
7	CIV2511	Construction Materials Testing Lab	0	0	2	1	2	PCC	S	
8	CIV2504	Fluid Mechanics Lab	0	0	2	1	2	PCC	S	

Semester 5										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	CIV2507	Analysis of Indeterminate Structures	3	0	0	3	3	PCC	S	
2	CIV2508	Design of RCC Structural Elements	3	1	0	4	4	PCC	S	
3	CIV2514	Foundation Engineering	3	0	0	3	3	PCC	S	
4	CIVXXXX	Professional Elective - II	3	0	0	3	3	PEC		
5	CIVXXXX	Professional Elective - III	3	0	0	3	3	PEC		
6	MGTxxxx	Management Course (Select any one course from Management Basket - I)	3	0	0	3	3	HSMC		
7	CIV2049	Geotechnical Engineering Lab	0	0	2	1	2	PCC	S	
8	CIV1007	Building Planning and Drawing	0	0	2	1	2	PCC	EM	
9	CIV7100	Minor Project (Extensive Survey Project)	-	-	-	4	-	PRW	EM/ EN	

* Note: Students will undergo Minor Project during the summer break between the fourth and fifth semesters and the credits earned will be accounted for in the fifth semester.

Semester 6										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	CIV2510	Design of Structural Steel Elements	3	0	0	3	3	PCC		
2	CIV2518	Quantity Surveying, Cost Estimation and Assest Valuation	3	1	0	4	4	PCC	EM	
3	CIV2516	Waste Water Treatment and Disposal Systems	3	0	0	3	3	PCC		ES
4	CIVXXXX	Professional Elective - IV	3	0	0	3	3	PEC		
5	CIVXXXX	Professional Elective - V	3	0	0	3	3	PEC		
6	XXXXXXX	Open Elective - II	3	0	0	3	3	OEC		
7	CIV2517	Environmental Engineering Lab	0	0	2	1	2	PCC	S	ES
8	CIV2502	Infrastructure Materials Testing Lab	0	0	2	1	2	PCC	S	
9	CIV2523	3D Building Modelling and BIM Lab	0	0	4	2	4	PCC	S	
10	PPS	Industry Preparedness Program	2	0	2	0	2	MAC	EM	

Semester 7										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	CIV2509	Analysis and Design of Pre-Stressed Concrete Elements	2	1	0	3	3	PCC	S	
2	CIV2519	Construction Project Management	2	0	0	2	2	PCC	EM	
3	CIVXXXX	Professional Elective - VI	3	0	0	3	3	PEC		
4	CIVXXXX	Professional Elective - VII	3	0	0	3	3	PEC		
5	CIVXXXX	Professional Elective - VIII	3	0	0	3	3	PEC		
6	XXXXXXX	Open Elective - III	3	0	0	3	3	OEC		
7	CIV2520	Construction Project Management Lab	0	0	2	1	2	PCC	S	
8	CIV2524	Structural Analysis and Detailing Lab	0	0	4	2	4	PCC	EM	
9	CIV7000	Internship	-	-	-	2	-	PRW	EM/ EN	HP

* Note: Students will undergo Internship during the summer break between the sixth and seventh semesters and the credits earned will be accounted for in the seventh semester.

Semester 8										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**					**Basket**	**Type of Skill**	**Course Addresses to**
			L	**T**	**P**	**C**	**Contact Hours**			
1	CIV7300	Capstone Project	-	-	-	10	0	PRW		

23. Course Catalogue

Course Code: MEC1006	Course Title: Engineering Graphics Type of Course: 1] Professional Core Course 2] Theory	L-T- P- C	2	0	0	2
Version No.	1.2					
Course Pre-requisites	NIL					
Anti-requisites	CAMD					
Course Description	The course is designed with the objective of giving an overview of engineering drawing with the help of software tools. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings with computerized drafting tools. Computerized drafting provides accurate and easily modifiable graphic entities, easy data storage, easy retrieval facility and it enhances creativity. It will expose students to the concept of engineering drawing and teach them to draw different views of planes and solids in different orientations. The course will teach students to use AutoCAD to produce engineering drawings. They will learn to create drawing layouts, dimensioning, the theory of projection, orthographic projection of points, lines, planes and solids, isometric projection and be introduced to the development of surfaces.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of " Engineering Graphics " and attain SKILL DEVELOPMENT through Problem solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: (1) Demonstrate competency using AutoCAD graphics software as per BIS conventions and standards. (2) Comprehend the theory of projection for drawing projections of Points, Lines and Planes under different conditions. (3) Prepare multiview orthographic projections of Solids by visualizing them in different positions. (4) Prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions.					
Course Content						
Module 1	Introduction to Drawing	Assignment	Standard technical drawing		02 classes	
Topics: Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Line conventions, dimensioning, Selection of drawing sheet size and scale. [02 Hours: Comprehension Level]						
Module 2	Orthographic projections of Points, Straight	Assignment	Projection methods Analysis		10 classes	

	Lines and Plane Surfaces			
Topics: Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points in all 4 quadrants. Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only. [10 Hours: Application Level]				
Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	10 classes
Topics: Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron in different positions (Problems resting on HP only and First angle projection). [10 Hours: Application Level]				
Module 4	Isometric Projections of Solids (Using isometric scale only)	Assignment	Spatial Visualization	8 classes
Topics: Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects. [8 Hours: Application Level]				
Targeted Application & Tools that can be used: Application Area is in understanding and interpreting an object in various positions and converting it into a technical drawing which can be universally accepted. Professionally Used Software: AutoCAD				
Text Book: 1.N. D. Bhatt, "Engineering Drawing: Plane and Solid Geometry," Charotar Publishing House Pvt. Ltd.				
References: 1. K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore. 2. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall. 3. D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill. 4. Engineering Graphics Manual provided by Instructor incharge. Web Resources : Knimbus - Your Library. Anywhere, Anytime.				
Topics relevant to "SKILL DEVELOPMENT":Projection in first and third angle for SKILL DEVELOPMENT through Problem Solving methodologies. This is attained through the assessment component mentioned in the course handout.				

Catalogue prepared by	Mr. Yeshwanth D
Recommended by the Board of Studies on	BOS NO: 15th BOS held on 27/8/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022.

Course Code: CIV1008	Course Title: Basic Engineering Sciences Type of Course: Theory Only	L-T- P- C	2	0	0	2
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering.					
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Recognize the significance of various disciplines in Civil Engineering 2] Discuss the recent evolutions in Civil Engineering 3] Explain various energies, energy generating machineries and energy consumption machineries 4] Describe the fundamental concept and terminology associated with the Petroleum Industry 5] Distinguish between conventional and modern manufacturing techniques.					
Course Content:						
Module 1	Introduction to various fields in Civil Engineering	Assignment	Case studies on different Civil Engineering Projects	6 Sessions		
Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure.						
Module 2	Current Trends and Evolution in Civil Engineering	Assignment	Article Review	6 Sessions		
Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities.						
Module 3	Power Production and Consumption Machinery	Assignment & Quiz	Data Collection	6 Sessions		
Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications.						
Module 4	Overview of Petroleum Engineering	Assignment & Quiz	Article Review	6 Sessions		

Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering				
Module 5	Industry 4.0	Assignment & Quiz	Data Collection	6 Sessions
Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process. Modern Manufacturing process: 3D Printing / Additive Manufacturing.				
Targeted Application & Tools that can be used: Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities				
Project work/Assignment:				
Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering Assignment 2: Review Articles on current evolutions in Civil Engineering. Assignment 3: Collect data related to renewable energy generation (Wind, Solar) Assignment 4: Prepare an energy consumption chart for a compressor or pumps. Assignment 5: Prepare a report on role of 3D printing across various industries. Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.				
Text Book: T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers T2. Elements of Mechanical Engineering, by VK Manglik T3. Fundamentals of Oil & Gas Industry for Beginners by Samir Dalvi, Notion Press; 1st edition				
References 1. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters and Publishers Pvt Ltd, Mumbai. 2. Nontechnical Guide to Petroleum Geology, Exploration, Drilling & Production by Norman J. Hyne, PennWell Books; 3rd Revised edition Web-resources: 1. Basic Civil Engineering https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2706932&site=ehost-live 2. Post-parametric Automation in Design and Construction https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live 3. Smart Cities : Introducing Digital Innovation to Cities https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live 4. Innovation Energy: Trends and Perspectives or Challenges of Energy Innovation https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2323766&site=ehost-live 5. Mechanical Engineering https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705 6. Additive Manufacturing: Opportunities, Challenges, Implications https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live 7. Society of Petroleum Engineers (SPE) https://www.spe.org/en/				

8. PetroWiki: A comprehensive online resource created by the Society of Petroleum Engineers that provides information on various aspects of petroleum engineering. https://petrowiki.spe.org/PetroWiki 9. Rigzone: A resource for news and information about the oil and gas industry, including job postings and industry trends. https://www.rigzone.com/	
Topics relevant to the development of SKILLS: Engines-Turbines and their applications. Mechanization in Construction. Digitization in Petroleum Industries	
Catalogue prepared by	Mr. Gopalakrishnan N/ Mr. Muralidhar/ Mr. Ajay H A/ Mr. Narendar Singh Tomar/Mr. Bhairab Jyoti Gogoi / Dr. Abhinav Kumar
Recommended by the Board of Studies on	18th BOS held on 05/07/2024
Date of Approval by the Academic Council	Academic Council Meeting No. 24, Dated 03/08/24

<table>
<tr><td>Course Code:
EEE1007</td><td colspan="3">Course Title: Basics of Electrical and Electronics Engineering.
Type of Course: Professional Core - Theory & Integrated Laboratory</td><td>L-T-P-C</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This is a fundamental Course which is designed to know the use of basics of electrical and electronics engineering principles occurs in various fields of Engineering. The course emphasises on the characteristics and applications of electrical and electronic devices. The course also emphasizes on the working, analysis and design of electrical circuits using both active & passive components. Additionally, this course creates a foundation for the future courses such as Electrical machines, power system, power electronics Linear Integrated Circuits, Analog Communication and Digital Communication etc.

The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance, using both hardware and simulation tools.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Basics of Electrical and Electronics Engineering and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:

1. Apply basic laws of Electrical Engineering to compute voltage, currents and other parameters in the circuits.
2. Discuss the performance characteristics and applications of various electrical Machines.
3. Discuss various fundamental parameters appearing in the characteristics of semiconductor devices and their applications.
4. Summarize the operations of different biasing configurations of BJTs and amplifiers.
5. Demonstrate the working of electrical machines to observe performance characteristics
6. Demonstrate the working of electronic circuits to obtain the V-I Characteristics of various semiconductor devices.
7. Sketch the characteristics and waveforms relevant to standard electrical and electronic circuits</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Electrical Circuits</td><td colspan="2">Assignment/ Quiz</td><td colspan="2">Numerical solving Task</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">DC Circuits: Concept of Circuit and Network, Types of elements, Network Reduction Techniques- Series and parallel connections of resistive networks, Star–to-Delta Transformations, Mesh Analysis, Nodal Analysis, Numerical examples.

AC Circuits: Fundamentals of single phase circuits - Series RL, RC and R-L-C Circuits, Concept of active power, reactive power and Power factor, Numerical examples.

Introduction to three phase system and relation between line and phase values in Star & Delta connection, Numerical examples.</td></tr>
</table>

Module 2	Fundamentals of Electrical Machines	Assignment/ Quiz	Numerical solving Task	10 Sessions
Electrical Machines: Single phase transformers: principle of operation and EMF equation, Numerical examples. DC Motor: principle of operation, Back EMF, torque equation, Numerical examples. AC Motor: Principle operation of Induction Motors and its Applications. Special Machines: Introduction to special electrical machines and its applications.				
Module 3	Semiconductor and Diode applications	Assignment/ Quiz	Memory Recall based Quizzes	10 Sessions
Mass Action Law, Charge densities in a semiconductor, Types of SC, Junction diodes -Ideal and practical behaviour, Modelling the Diode Forward Characteristic, and Diode applications like rectifiers, Clipping and clamping circuits. Zener diode, characteristics and its applications like voltage regulator.				
Module 4	Transistors and its Applications	Assignment/ Quiz	Memory Recall-based Quizzes	10 Sessions
Transistor characteristics, Current components, BJT Configurations (CB, CC, CE configurations) and their current gains. Operating point, Biasing & stabilization techniques: Fixed Bias, Voltage divider bias and its stability factor and load line analysis. Single and multistage amplifier, Darlington pair. JFET (Construction, principal of Operation and Volt –Ampere characteristics). Pinch- off voltage, Comparison of BJT and FET. MOSFET (Construction, principal of Operation and symbol), MOSFET characteristics in Enhancement and Depletion modes.				
List of Laboratory Tasks: Experiment No 1: Verification of KVL and KCL for a given DC circuit. Level 1: Study and Verify KVL and KCL for the given electrical Circuit. Level 2: For the same circuit considered in level 1, perform the simulation using NI LabVIEW/Multisim/MATLAB. Experiment No 2: Analyse AC series circuits – RL, RC and RLC . Level 1: Conduct an experiment to perform and verify the impedance, current and power of Series RL and RC circuits Level 2: Conduct an experiment to perform and verify the impedance and current of RLC series circuits. Experiment No 3: Calculation of power and power factor of the given AC Circuit. Level 1: Conduct an experiment to measure the power and power factor for given resistive load. Level 2: Conduct an experiment to measure the power and power factor for given inductive load. Experiment No 4: Perform the experiments on given Transformer. Level 1: Verify the EMF equation of a transformer and compute the voltage transformation ratio. Level 2: Study the effect of load on the secondary side of the transformer and verify the EMF equation under load conditions. Experiment No 5: Load test on DC shunt motor Level 1: Conduct load test on DC shunt motor and find its efficiency at different loads Level 2: Conduct load test on DC shunt motor and plot the performance characteristics.				

Experiment 6: Study of PN-Junction Diode Characteristics in Forward and Reverse Bias Conditions.
Level 1: Carry out an experiment to plot VI Characteristics and hence find the cut-in voltage on forward characteristics for the Silicon P-N Junction diode.
Level 2: Carry out an experiment to plot VI Characteristics of Zener diode and hence find the zener voltage on reverse characteristics for the Silicon P-N Junction zener diode.
Experiment No. 7: To observe the output waveform of half wave and full wave rectifier circuit and compute ripple factor and efficiency
Level 1: Identify the components required for a rectifier circuit, rig up the circuit, and sketch the output waveforms without filter.
Level 2: Rig up the rectifier circuit with RC filter, observe the output waveforms, determine the efficiency and ripple factor.
Experiment 8: To construct clipping and clamping circuits for different reference voltages and to verify the responses.
Level 1:Identify the components required for building a Clipper / Clamper circuit. Rig up the circuit according to the circuit diagram given and sketch the output waveform.
Level 2: Given a sinusoidal input of 10 V p-p, implement a positive / negative clipper with output clipped at 2 V.
Experiment 9: To calculate various parameters of emitter follower circuit using BJT
Level 1: Identify the components required to implement an emitter follower circuit. Rig up the circuit and observe the variations in output waveform with respect to the variations in input waveform.
Level 2: Determine the values of Z_{in} input impedance and Z_{out} output impedance for Emitter Follower.
Experiment 10: To Implement RC Coupled amplifier using a BJT and sketch the frequency response.
Level 1: Identify the components required to implement an RC coupled amplifier circuit. Rig up the circuit and sketch the frequency response.
Level 2: From the frequency response curve determine the value of the mid band gain and the bandwidth.

Targeted Application & Tools that can be used:

Targeted Applications: Application Area includes all electrical and electronic circuits (power supply unit, regulator unit, embedded devices, hardware electronics etc.). The students will be able to join a profession which involves basics to high level of electronic circuit design.

Professionally Used Software: Multisim/ P Spice

Besides these software tools hardware equipment such as Multimeters, Function Generators, Power Supplies, Oscilloscopes etc., can be used to perform component/circuit testing and analysis..

Project Work/ Assignment:

1. Article review: At the end, of course an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format.

3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.
4. Case Study: - At the end of the course students will be given a 'real-world' application based circuits like Power Amplifier, Signal/Function Generator etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format

Text Book(s):

1. Kothari D. P. & Nagrath I. J., "Basic Electrical and Electronics Engineering", Tata McGraw-Hill
2. Education

3. Theraja B.L. and Theraja A.K., "A Textbook of Electrical Technology: Basic Electrical Engineering" in S.I. System of Units, 23rd ed., New Delhi: S. Chand, 2002.
4. A.P.Malvino, Electronic Principles,7thEdition, Tata McGraw Hill,2007
5. J. Millman, C. C. Halkias and C. D. Parikh, "Millman's Integrated Electronics", McGraw Hill Education, 2nd Edition.
6. Basics of Electrical & Electronics Laboratory Manual.

Reference Book (s):

1. John Hiley, Keith Brown and Ian McKenzie Smith, "HUGHES Electrical and Electronic Technology", 10th Edition (Indian Edition published by Dorling Kindersley), Pearson,2011
2. Samarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, Prentice Hall India, 2007.
3. K Uma Rao, A Jaya Lakshmi, "Basic Electrical engineering" IK International publishing house Pvt. Ltd
4. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education India 7th Edition.
5. A K. Maini, V. Agrawal, "Electronic Devices & Circuits", Wiley, 2nd Edition
6. A.S Sedra, K. C. Smith, "Microelectronic Circuits", Oxford University Press, 6th Edition

Online Resources (e-books, notes, ppts, video lectures etc.):

1. https://presiuniv.knimbus.com/user#home
2. https://www.digimat.in/nptel/courses/video/108105112/L01 "Fundamentals of Electrical Engineering-Basic Concepts, Examples"
3. Seminar Topic: https://nptel.ac.in/courses/108/105/108105153/ "Electrical Measurements"
4. Video lectures on "Electronic Devices" by Prof. Dr. A. N. Chandorkar, IIT Bombay http://www.satishkashyap.com/2013/03/video-lectures-on-electron-devices-by.html
5. Video lectures on "Analog Electronics" by Prof. S.C. Dutta Roy, IIT Delhi https://nptel.ac.in/courses/108/102/108102095/
6. Video lectures on "Diodes", by Prof. Chitralekha Mahanta, IIT Guwahati, https://nptel.ac.in/courses/117/103/117103063/

E-content:

1. "Introduction to Electrical Machines https://nptel.ac.in/courses/108/102/108102146/"

M. -Y. Kao, H. Kam and C. Hu, "Deep-Learning-Assisted Physics-Driven MOSFET Current Voltage Modeling," in IEEE Electron Device Letters, vol. 43, no. 6, pp. 974-977, June 2022, doi: 10.1109/LED.2022.3168243
https://ieeexplore-ieee-org-resiuniv.knimbus.com/document/9758727

2. F. Bonet, O. Aviñó-Salvadó, M. Vellvehi, X. Jordà, P. Godignon and X. Perpiñà, "Carrier Concentration Analysis in 1.2 kV SiC Schottky Diodes Under Current Crowding," in IEEE Electron Device Letters, vol. 43, no. 6, pp. 938-941, June 2022, doi: 10.1109/LED.2022.3171112. https://ieeexplore-ieeeorg-presiuniv.knimbus.com/document/9764749
3. M. Chanda, S. Jain, S. De and C. K. Sarkar, "Implementation of Subthreshold Adiabatic Logic for Ultralow-Power Application," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. .23, no. 12, pp. 2782-2790, Dec. 2015.
https://ieeexplore.ieee.org/document/7018053
4. R. Raut and O. Ghasemi, "A power efficient wide band trans-impedance amplifier in submicron

CMOS integrated circuit technology," 2008 Joint 6th International IEEE Northeast Workshop on Circuits and Systems and TAISA Conference, 2008, pp. 113-116, doi: 0.1109/NEWCAS.2008.4606334. https://ieeexplore.ieee.org/document/4606334

Topics relevant to "SKILL DEVELOPMENT": Performing suitable experiments to compute the electric circuit parameters, performance operation of machines, and operation of semiconductor devices for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course plan.

Catalogue prepared by	Mr Sunil Kumar and Dr Ashutosh Anand
Recommended by the Board of Studies on	19th Bos held on 3rd July 2024
Date of Approval by the Academic Council	24th Academic Council Meeting held on 03/08/2024

Course Code: MAT1003	Course Title: Applied Statistics (Only Theory 3 hours) Type of Course: School Core	L T P C	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Applied Statistics" and attain Skill Development Through Problem Solving techniques.					
Expected Outcome:	At the end of this course, students will be in a position to 1. apply the techniques of descriptive statistics effectively 2. interpret the ideas of probability and conditional probability 3. demonstrate the knowledge of probability distributions 4. Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.					
Module 1	Descriptive Statistics	Assignment	Coding needed	10 classes		
Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson's Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression .						
Module 2	Probability			6 classes		
Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye's theorem with examples						
Module 3	Random Variables and Probability Distributions		Coding needed	14 classes		
Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, Negative Binominal (Self Study), Poisson, Normal and Exponential distributions						
Module 4	Sampling Theory		Coding needed	15 classes		
Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and Difference of Means (Self Study), Small Sample Tests: Student's t-Test for Single Mean and Difference of Means, F-Test, Chi-Square Test.						

Targeted Application & Tools that can be used:

The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems.

Tools used: R Software / MS-Excel

Text Book

1. Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016.

References

1. James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018.
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019.
4. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018.
5. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018.
6. Kishor S Trivedi, Probability and Statistics with reliability, Queuing and Computer Science Applications, John Wiley & Sons, 2008.

Topics relevant to SKILL DEVELOPMENT: The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Sathish S and Dr. Juliet Raja
Recommended by the Board of Studies on	13th BOS held on 04/01/2025
Date of Approval by the Academic Council	24th ACM held in 3rd August 2024

Course Code: MAT1001	Course Title: Calculus and Linear Algebra Type of Course:1] School Core Lab Integrated		L-T-P-C	3	1	0	4
Version No.	2.0					
Course Pre-requisites	Basic Concepts of Limits, Differentiation, Integration					
Anti-requisites	NIL					
Course Description	The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of "CALCULUS AND LINEAR ALGEBRA" and attain Skill Development through problem solving techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations.					
Course Content:						
Module 1	Linear Algebra				16 Classes	
Review: Types of matrices, elementary transformations, Linear Algebra: Echelon form, rank of a matrix, consistency and solution of system of linear equations - Gauss elimination method, Gauss-Jordan method. Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.						
Module 2	Partial Derivatives				14 CLASSES	
Review: Differential calculus with single variable. Differential Calculus: Partial differentiation, Homogeneous functions and Euler's theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor's series for functions of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers. Engineering Applications of partial derivatives.						
Module 3	Integral calculus				12 Classes	

Review: Integral calculus for single integrals.

Integral calculus:

Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates.

Beta and Gamma functions–inter-relation-evaluation of integrals using gamma and beta functions. Evaluate double & triple integrals.

Module 4	Differential Equations	Assignment	Programming	16 Classes

Definition, types of differential equations, order and degree, Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non - Exact Differential Equations.

Higher order Differential Equation with constant coefficients and with right hand side of the form eax, sinax, cosax, eaxf(x), xnf(x) etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, Method of Variation of Parameters.

Engineering applications of differential equations.

Targeted Application & Tools that can be used:
The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design.
Tools Used: Python.

Assignment:

1. List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using C Programming/Python.
2. Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.

Text Book

1. Sankara Rao, Introduction to Partial differential equations, Prentice Hall of India, edition, 2011
2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:

1. Victor Henner, Tatyana Belozerova, Mickhail Khenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013.
2. Walter Ledermann, Multiple integrals, Springer, 1st edition
3. Lay, Linear Algebra ansd its applications, 3rd Ed., 2002, Pearson Education India.
4. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition
5. MatLab usage manual

E-resources/ Web links:
1. https://nptel.ac.in/courses/109104124
2. https://nptel.ac.in/courses/111106051
3. https://nptel.ac.in/courses/111102137
4. https://www.cuemath.com/learn/mathematics/algebra-vs-calculus/
5. https://stanford.edu/~shervine/teaching/cs-229/refresher-algebra-calculus
6. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/linear-algebra/
7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
8. https://www.scu.edu.au/study-at-scu/units/math1005/2022/

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to

use the MATLAB software. for Skill Development through Experiential Learning methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr Veeresh A, Sajjanara and Dr V Nagendramma
Recommended by the Board of Studies on	13th BOS held on 04/01/2025
Date of Approval by the Academic Council	24th ACM held in 3rd August 2024

Course Code: MAT2501	Course Title: Integral Transforms and Partial Differential Equations Type of Course:1] School Core	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Calculus and Differential Equations					
Anti-requisites	**NIL**					
Course Description	This course aims to introduce various transform techniques such as Laplace transform, Fourier transform and Z-transform in addition to expressing functions in terms of Fourier series. The course covers applications of Laplace transform to LCR circuits and solutions of different equations using Z-transform. The course also deals with the analytical methods for solving partial differential equations and the classical applications of partial differential equations.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Transform Techniques, Partial Differential Equations**" and attain **Skill Development through Problem Solving Techniques**.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1 - Express functions in terms of uniformly convergent Fourier series. CO2 - Apply Laplace transform technique to solve differential equations. CO3 - Employ Z-transform techniques to solve difference equations. CO4 - Solve a variety of partial differential equations analytically.					
Course Content:						
Module 1	**Laplace Transforms**			**(12 Classes)**		
Definition and Laplace transform of elementary functions. Properties of Laplace transform, and Laplace transform of periodic function, unit-step function and Impulse function – related problems. Inverse Laplace transform of standard functions - problems, initial and final value theorem. Convolution theorem, solution of linear and simultaneous differential equations and LCR Circuit.						
Module 2	**Fourier Series**	**Assignment**		**(8 Classes)**		
Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.						
Module 3	**Fourier Transforms and Z - Transforms**			**(13 Classes)**		
Fourier Transforms: Definitions, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms, Problems. **Difference equations and Z-transforms:** Z-transforms – Basic definitions, Standard Z-transforms, Linearity property, Damping rule, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-transforms. Difference equations – Basic definitions, Application of Z-transforms to solve difference equations.						
Module 4	**Partial Differential Equations**	**Assignment**		**(12 Classes)**		
Formation of PDE, Solution of non-homogeneous PDE by direct integration, Solution of homogeneous PDE involving derivative with respect to one independent variable only (Both types with given set of conditions) Method of separation of variables. (First and second order equations) Solution of Lagrange's linear PDE. of the type P p + Q q = R. Applications of PDE: Derivation of one-dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two-dimensional Laplace's equation – various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems).						
Targeted Application & Tools that can be used: The objective of the course is to familiarize students with a variety of numerical techniques and the theoretical concepts of probability and statistics to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.						
Assignment:						

Newton-Raphson Methods, Gauss-Seidel Method, LU Decomposition, Trapezoidal Rule, Simpson's rule, Runge-Kutta 4th Order.

Text Book

1. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition
2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:

1. Victor Henner, Tatyana Belozerova, Mickhail Khenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013.
2. Walter Ledermann, Multiple integrals, Springer, 1st edition

E-resources/ Web links:

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_140238
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_233298
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_204892
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_246791
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_223548
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_134719
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_32614
https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
https://www.scu.edu.au/study-at-scu/units/math1005/2022/

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Catalogue prepared by	**Dr. Husna**
Recommended by the Board of Studies on	**13th BOS held on 04/01/2025**
Date of Approval by the Academic Council	**24th ACM held in 3rd August 2024**

Course Code: MAT2502	Course Title: Numerical Methods and Complex Variables Type of Course:1] School Core	L-T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Calculus & Differential Equations					
Anti-requisites	**NIL**					
Course Description	Numerical methods contain solutions of system of linear equations, roots of non-linear equations, interpolation, numerical differentiation and integration. It plays an important role in solving various engineering sciences problems. Complex Variable is functions involving complex numbers as variables, exploring concepts like limits, continuity, differentiation, integration, and series within the complex plane, with a focus on key topics like Cauchy-Riemann equations, complex exponentials, contour integration, residues, and applications to solving real-world problems in physics and engineering.					
Course Objective	Numerical methods is to provide approximate, yet accurate solutions to complex mathematical problems that are often difficult or impossible to solve analytically, by using computational techniques to generate solutions through iterative processes, especially when dealing with real-world scenarios involving large datasets or intricate equations. Complex variable is to study the techniques of complex variables and functions together with their derivatives, Contour integration and transformations. To study complex power series, classification of singularities, calculus of residues and its applications in the evaluation of integrals, and other concepts and properties.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1 - Demonstrate the applications of numerical methods to find the roots of polynomial equations and eigen values of real symmetric matrices. CO2 - Interpret the fitted parameters and apply curve fitting techniques to real-world data analysis problems. CO3 - Apply various numerical methods for solving linear Ordinary & Partial differential equations arising in engineering field. CO4 - Apply the Cauchy-Riemann equations to identify analytic functions.					
Course Content:						
Module 1	**Solution of Linear Systems of Equation**					***(10 Classes)***
Solution of algebraic and transcendental equations: Various types of errors - Bisection method, Regula-Falsi method, Newton-Raphson method, Graffe's method - Bairstow's method - Newton's method for solving f(x,y) = 0 and g(x,y) = 0, secant method, Fixed point iteration method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel, Sufficient conditions for convergence - LU decomposition method, Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.						
Module 2	**Interpolation and Curve Fitting**	**Assignment**				***(10 Classes)***
Newton's forward and backward interpolation, Divided difference method, Lagrange's method. Method of least squares to fit equations of the form $y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$, $y = ab^x$ and $y = ax^b$.						
Module 3	**Numerical Differentiation and Integration**					***(10 Classes)***
Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Gaussian quadrature rule. Solution of ordinary differential equations: Taylor series method, modified Euler's method, Runge-Kutta method for 4th order. Euler's method - Taylor's method - Runge-Kutta method of fourth order - Numerical solution of Laplace equation - One-dimensional heat flow equation and wave equation by finite difference methods.						
Module 4	**Complex Variables**	**Assignment**				***(15 Classes)***

Introduction, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; Conformal mappings.
Complex Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Targeted Application & Tools that can be used:
Numerical methods are widely applied in various fields like engineering, physics, finance, and biology, primarily used to solve complex problems where analytical solutions are difficult or impossible to find, allowing for the approximation of solutions through computational algorithms.
Complex variable methods are applied to elliptical problems in fluid mechanics, and linear elasticity. The techniques presented for solving parabolic problems are the Laplace transform and separation of variables, illustrated for problems of heat flow and soil mechanics.

Assignment:

1. Calculate its absolute and relative errors for different input values using a numerical method like the Taylor series approximation.
2. Given sin 45° = 0.7071, sin 50° = 0.7660, sin 55° = 0.8192, sin 60° = 0.8660 find sin 57° *and sin* 52° using an appropriate interpolation formula.
3. Find the equation of the polynomial which passes through the points (4,-43), (7, 83), (9, 327), (12, 1053) using Newton's divided difference interpolation formula.

Text Book

1. Brown & Churchill, Complex Variables and Applications, McGraw Hill Higher Education; 9th edition.
2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, 6th Edition, New age Publishing House, 2015.
3. Carlos A. Berenstein & Roger Gay, Complex Variables - An Introduction, Springer-Verlag New York Inc.

E-resources/ Web links:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_166145
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_141727
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_135224
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_246791
5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_190270
6. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
7. https://www.scu.edu.au/study-at-scu/units/math1005/2022/

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Catalogue prepared by	**Dr. Chandni Kumar & Dr. Heena Firdose**
Recommended by the Board of Studies on	**13th BOS held on 04/01/2025**
Date of Approval by the Academic Council	**24th ACM held in 3rd August 2024**

<table>
<tr><td>Course Code: CHE1018</td><td colspan="3">Course Title: Environmental Science

Type of Course: School Core- Theory and Lab</td><td>L- T- P- C</td><td>1</td><td>0</td><td>2</td><td>0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education.

This course is designed to cater to Environment and Sustainability</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of “Environmental Science” and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:

1) Appreciate the historical context of human interactions with the environment and the need for eco-balance.
2) Describe basic knowledge about global climate change with particular reference to the Indian context.
3) Understand biodiversity and its conservation
4) Develop an understanding on types of pollution and ways to protect the environment
5) Learn about various strategies on Global environmental management systems</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Humans and the Environment</td><td>Assign ment</td><td colspan="2">Data Collection</td><td colspan="3">01 class</td></tr>
<tr><td colspan="9">Topics: The man-environment interaction: Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment.

Self-learning topics: Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Environmental Ethics and emergence of environmentalism.</td></tr>
<tr><td>Module 2</td><td colspan="2">Natural Resources and Sustainable Development</td><td>Assign ment</td><td colspan="2"></td><td colspan="3">03 Classes</td></tr>
<tr><td colspan="9">Topics:

Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. Water resources: Types of water resources- fresh water and marine resources;

Soil and mineral resources: Important minerals; Mineral exploitation Soil as a resource and its degradation.</td></tr>
</table>

Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Advantages and disadvantages.

Self- learning topics: Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges.; Environmental problems due to extraction of minerals and use; Sustainable Development Goals (SDGs)- targets, indicators, and challenges for SDGs.

Module 3	Environmental Issues: Local, Regional and Global	Case study		02 Classes

Topics:

Environmental Pollution: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Trans-boundary air pollution; Acid rain; Smog.

Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change

Self -learning topics: Environmental issues and scales

Module 4	Conservation of Biodiversity and Ecosystems	Assignment		02 Classes

Topics:

Biodiversity-Introduction, types, Species interactions, Extinct, endemic, endangered and rare species, Threats to biodiversity: Natural and anthropogenic activities.

Self-learning topics: Mega-biodiversity, Hot-spots, Major conservation policies. Biodiversity loss: past and current trends, impact.

Module 5	Environmental Pollution and Health	Case study		03 Classes

Topics:
Pollution, Definition, point and nonpoint sources of pollution, Air pollution- sources, major air pollutants, health impacts of air pollution.

Water pollution– Pollution sources, adverse health impacts on human and aquatic life and mitigation, Water quality parameters and standards.

Soil pollution and solid waste- Soil pollutants and their sources, solid and hazardous waste, Impact on human health.

Self-learning topics: Noise pollution, Thermal and radioactive pollution.

Module 6	Climate Change: Impacts, Adaptation and Mitigation		Assignment/case	02 Classes

Topics:
Understanding climate change: Natural variations in climate; Projections of global climate change with special reference to temperature, rainfall and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Impacts

Vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Indigenous knowledge for adaptation to climate change.

Self-learning topics: Mitigation of climate change: Synergies between adaptation and mitigation measures; National and international policy instruments for mitigation.

Module 7	Environmental Management	Case study	Data analysis	02 Classes

Topics:
Environmental management system: ISO 14001; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability.

Self-learning topics: Environmental audit and impact assessment; Eco labeling /Eco mark scheme

Module 8	Environmental Treaties and Legislation	Case study	Data analysis	01 Classes

Topics:

Major International Environmental Agreements: Convention on Biological Diversity (CBD), Major Indian Environmental Legislations: Environmental Protection Act, Forest Conservation Act, Public awareness.

Self-learning topics: Paris Agreement, Conference of the Parties (COP), India's status as a party to major conventions: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act.

1. List of laboratory tasks : Any eight experiments will be conducted
2. Determination of total alkalinity of a water sample (knowledge)
3. Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)
4. Estimation of copper from industrial effluents by colorimetric method (Comprehensive)
5. Estimation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)
6. Estimation of nickel from industrial effluents by titrimetric method (Comprehensive)
7. Estimation of chloride in drinking water by titrimetric method (Comprehensive)
8. Estimation of fluoride in ground water by colorimetric method (Comprehensive)
9. Determination of calcium in aqueous solution (Comprehensive)
10. Determination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)
11. Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)
12. Biological oxygen demand of waste water sample (Comprehensive)
13. Determination of dissolved oxygen of an industrial effluent (Comprehensive)
14. Quality monitoring analysis of a soil sample (knowledge)
15. Flame photometric estimation of Sodium and potassium (Application)
16. Gas Chromatographic analysis of volatile organic compounds (Application)

Targeted Application & Tools that can be used:
Application areas are Energy, Environment and sustainability
Tools: Statistical analysis of environmental pollutants using excel, origin etc.

Project work/Assignment:

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screenshot accessing the digital resource.)
- Lab evaluation/Assignment
- End Term Exam
- Self-learning

Assignment 1: Write a Statement of Environment report of your town/city/state/country
Assignment 2: Individual students will carry out the analyses of polluted solid, liquid, and gaseous samples and propose suitable mitigation measures. A detailed and in-depth report needs to be submitted for each case. This may include preparation of reagents, sample preparation (extraction), chemical analysis carried out, instruments and tools used, data collected and processed, inferences made and conclusions arrived at. Necessary support is given in the form of lab manual and reference links to e-books.

Text Book

1. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA
2. Krishnamurthy, K.V. (2003) Text book of Biodiversity, Science Publishers, Plymouth, UK.
3. Jackson, A.R. & Jackson, J.M. (2000), Environmental Science: The natural environment and human impact, Pearson Education.

Reference Books

7. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
8. William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.
9. Sinha N., (2020) Wild and Wilful. Harper Collins, India.
10. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/
11. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
12. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

E-resources:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_18126
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_8761
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_3333
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3063
5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_20719
6. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_16824
7. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3954
8. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_491
9. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488
10. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583
11. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SPRINGER_INDEST_1_171
12. https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129
13. https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979
14. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TEXTBOOK_LIBRARY01_06082022_395&xIndex=4
15. https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf

Topics relevant to Skill Development: Industrial revolution and its impact on the environment, Environmental impact of over-exploitation of water resources, pollution and ill effects, lab experiments for Skills development through Problem solving Techniques. This is attained through assessment component mentioned in course handout. All topics in theory component are relevant to Environment and Sustainability.	
Catalog prepared by	Faculties of Department of Chemistry
Recommended by the Board of Studies on	PU/SOE/CHE/BOS-07/2022-23 9th BOS held on 10/07/23
Date of Approval by the Academic Council	21st Academic council dated: 6th September 2023

Course Code: CHE1017	Course Title: Applied Chemistry Type of Course: Program Core- Lab embedded theory course	L- T-P- C	1	0	2	2
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The primary objective of the course is to emphasize the concepts and applications of chemistry in Engineering. The course also aims to enhance the knowledge of chemical composition and properties of chemical molecules. The course cultivates an ability to identify chemistry in each and every piece of smart engineered products used in households and industry. It targets to strengthen the fundamental concepts of chemistry and then builds an interface with their industrial applications. This course is designed to cater to Environment and Sustainability					
Course Objective	The objective of the course is to familiarize the learners with the concepts of 'Applied Chemistry' and attain 'SKILL DEVELOPMENT' through EXPERIENTIAL LEARNING techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 6) Identify the suitable polymers to replace the conventional materials 7) Summarize the importance of various electrochemical sources in energy systems 8) Describe the knowledge of electrochemistry principles for protection of different metals from corrosion. 9) Explain the fundamental principles in water treatment					
Course Content:						
Module 1	Polymers	Case study	Data Collection and analysis	4 Classes		
Polymers: Introduction, Types of Polymerization, Thermoplastics & Thermosetting Polymers. Preparation, Properties, and Applications of the Teflon, PVC, Nylon and Phenol Formaldehyde; Elastomers: Classification; Natural Rubber, Vulcanization of Rubber, Synthetic Rubber and Inorganic Rubbers, Polymer Composites- Properties and Advantages, Synthesis and Applications of Kevlar, Conducting Polymers						
Module 2	Battery Technology	Assignment	Data Collection	3 Classes		
Basics of Electrochemical Energy Systems, Construction, Working Mechanism and Applications of Primary (Dry Cell) and Secondary (Lead-Acid) Batteries, Lithium Batteries: Primary and Secondary. Fuel Cells: Hydrogen-Oxygen, Methanol-Oxygen: Principle, Working and Their Applications						
Module 3	Corrosion and its Control	Case study	Data analysis	3 Classes		
Definition, Dry and Wet Corrosion, Electrochemical Theory of Corrosion, Types of Wet Corrosion – Differential Aeration, Galvanic, and Stress Corrosion Cracking. Factors that Enhance Corrosion and Choice of Parameters to Mitigate Corrosion.						

Corrosion Control – Anodic and Cathodic Coating, Cathodic Protection- Sacrificial Anodic Protection, Electro Plating of Chromium, Electroless Plating of Copper on PCBs

Module 4	Water Technology	Case study	Data analysis	4 Classes

Degree of Hardness, Numerical Problems on Hardness Domestic Treatment, Desalination Techniques, Boiler Feed Water, External and Internal Treatments, Waste Water Treatment, Rain Water Harvesting

Laboratory experiments:

1. Estimation of Fe (II) in Mohr's salt using Std. Potassium permanganate solution.
2. Estimation of Calcium in cement solution sample by rapid EDTA method.
3. Estimation of Copper by Iodometry.
4. Determination of Acid number of an oil.
5. Synthesis of polyaniline.
6. Determination of pKa value of weak acid using pH meter
7. Potentiometric estimation of FAS using Std. Potassium dichromate solution
8. Estimation of strength of acid mixture by conductometric titration
9. Estimation of Copper by colorimetric method
10. Determination of Viscosity co-efficient of a liquid using Ostwald's viscometer.

Targeted Application & Tools that can be used:
Application areas are Polymer, oil and gas, Boiler, automotive and mechanical industries
Tools: Statistical analysis of Corrosion in materials using tools like Design expert software (ANOVA, RSM, etc.)

Project work/Assignment:

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)
- Quiz
- End Term Exam
- Self-Learning

Assignment: 1: Report writing on recycling plastic waste into plastic lumber
Assignment 2: Identify a corrosion problem encountered in your immediate surroundings and discuss your choice of mitigation

Text Book

4. Wiley, "Engineering Chemistry", Wiley.

Reference Books

1. Engineering Chemistry, Jain and Jain (18th Edition) Dhanpat Rai Publishing Company
2. Engineering Chemistry, Shika Agrawal (2018), Cambridge University Press

E resources

1. https://presiuniv.knimbus.com/user#/searchresult?searchId=Polymers%20from%20Renewable%20Resources&_t=1660212823387
2. https://presiuniv.knimbus.com/user#/searchresult?searchId=fuel%20an%20ecocritical%20history&_t=1660213039873
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=BOOKYARDS_1_13487
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_6676

5. https://nptel.ac.in/courses/113108051 6. https://www.youtube.com/watch?v=XuLT8i4g4Yw 7. https://www.youtube.com/watch?v=3QjwRqnquxA 8. https://www.youtube.com/watch?v=VxMM4g2Sk8U
The topics related to Skill Development Quantifying alkalinity in water sample, concentration of acid, pKa of acid, viscosity co-efficient, amount of Ca in cement solution for Skill Development through Experiential Learning Techniques. This is attained through assessment component as mentioned in course handout.

Catalogue prepared by	Department of Chemistry, SOE
Recommended by the Board of Studies on	7th BoS on 25 July 2022
Date of Approval by the Academic Council	18th BOS meeting held on 3rd August 2022

<table>
<tr><td>ENG2001</td><td>Advanced English</td><td>L- T- P- C</td><td>1</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Version No.</td><td colspan="6">2.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="6">ENG1002 Technical English</td></tr>
<tr><td>Anti-requisites</td><td colspan="6">NIL</td></tr>
<tr><td>Course Description</td><td colspan="6">This course is designed to equip students to enhance their communication abilities in Listening, Speaking, Reading, and Writing. The curriculum covers interpersonal communication principles, the art of speech writing and delivery (including impromptu speaking), strategic approaches to critical reading, the identification of logical fallacies, and persuasive writing. Furthermore, the course will introduce students to the potential of AI tools and the techniques of prompt engineering to elevate their communication skills in the digital age. Upon course completion, students will be well-prepared to communicate effectively and critically in both academic and professional environments.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On successful completion of the course the students shall be able to:
1. Recognize the elements of interpersonal and cross-cultural communication to address communication challenges effectively.
2. Demonstrate the ability to deliver structured and impromptu speeches using effective speaking techniques.
3. Interpret textual and visual materials using critical reading strategies to evaluate arguments, logic, and persuasion.
4. Produce persuasive and analytical essays using effective argumentation techniques and structured writing strategies.</td></tr>
<tr><td colspan="7">Course Content: Theory</td></tr>
<tr><td>Module 1</td><td>Foundations of Effective Communication</td><td>Case Studies/ Role play</td><td>Cross-Cultural Competency</td><td colspan="3">4 Classes</td></tr>
<tr><td colspan="7">Topics:
• Fundamentals of Interpersonal Communication
• Verbal, Non-verbal, and Paraverbal communication.
• Cultural dimensions theory (Hofstede’s Cultural Dimensions).
• Active Listening Techniques
• Common Errors in Communication</td></tr>
<tr><td>Module 2</td><td>Mastering Speech Delivery</td><td>JAM</td><td>Public Speaking Confidence</td><td colspan="3">4 Classes</td></tr>
<tr><td colspan="7">Topics:
• Introduction to Prompt Engineering
• Speech Preparation and Organization
• Techniques for Effective Impromptu Speaking
• Practice Speech Delivery</td></tr>
<tr><td>Module 3</td><td>Critical Reading and Logical Analysis</td><td>Worksheet</td><td>Critical Thinking and Analysis</td><td colspan="3">4 Classes</td></tr>
<tr><td colspan="7">Topics:
• Critical Reading Strategies: Contextualizing, Figurative Language, Evaluating Logic of an Argument, Recognizing Emotional Manipulation, Analysing Visuals</td></tr>
</table>

• Recognizing Logical Fallacies: Slippery Slope, False Dilemma, Post Hoc, Hasty Generalization, Ad Hominem, Straw Man, Bandwagon, No True Scotsman, Red Herring, Appeal to Authority, Sunk Cost, Appeal to ignorance				
Module 4	Writing Effective Arguments	Assignment	Clear and Coherent Writing	3 Classes
Topics: • Understanding Critical Writing • Building Arguments (Pathos, Ethos, Logos) • Techniques for Persuasion				
Course Content: Practical Sessions				
Module 1	Foundations of Effective Communication			8 Classes
1. Interpersonal Communication Charades with a Twist/Tone and Emotion Experiment/Mixed Messages Challenge/Role Reversal Conversations/Observation Exercise 2. Cross-cultural Communication Cultural Iceberg Analysis/Role-Play: Cross- Cultural Scenarios/Stereotypes vs Realities/Cross- /Cultural Negotiation Exercise/Cultural Sensitivity Case Studies 3. Active Listening Bingo TEDx/Story Building/Listening for Key Details/Interactive Podcast Listening/Fact or Opinion 4. Instagram/YouTube Vocabulary Activity				
Module 2	Mastering Speech Delivery			8 Classes
5. Speech Writing 6. Impromptu Speech JAM /"Would You Rather" Explainer/Picture Prompt Speech/Reverse Speech Crafting				
Module 3	Critical Reading and Logical Analysis			8 Classes
7. Critical Reading Strategies Critical Reading Worksheet/Identifying Bias in News Articles 8. Recognizing Logical Fallacies Debate Challenge with Fallacy Detection/ Fallacy Investigation with Podcasts or Social Media				
Module 4	Writing Effective Arguments			6 Classes
9. Building Arguments Causes or Effects/Appeal Mash-Up/Debates on Controversial Topics 10. Persuasive Writing Creative Persuasive Writing/Opinion Writing				
Targeted Application & Tools that can be used: Quizziz, Chatgpt, Gemini, Youtube, Instagram, Quillbot, Grammarly, Padlet				
References 1. Adler, R. B., Rodman, G., & DuPré, A. (2019). *Understanding human communication (14th ed.)*. Oxford University Press.				

<table>
<tr><td colspan="2">2. Moore, B. N., & Parker, R. (2020). Critical thinking (13th ed.). McGraw-Hill Education.
3. DeVito, J. A. (2019). The interpersonal communication book (15th ed.). Pearson.
4. Ting-Toomey, S., & Dorjee, T. (2018). Intercultural competence: A model for teaching and assessing cross-cultural communication. Journal of Intercultural Communication, 47(2), 213–229. https://doi.org/10.1016/j.jicc.2018.03.004
5. https://www.ted.com/</td></tr>
<tr><td colspan="2">Topics Relevant to “employability”: Teamwork and Collaboration, Critical Thinking and Problem-Solving

Topics Relevant to “Human Values and Professional Ethics”: Critical reasoning, Inclusivity and Fairness</td></tr>
<tr><td>Catalogue prepared by</td><td>Dr. Tychicus David, Dr. Jayalakshmi E</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>8th January 2025</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td></td></tr>
</table>

<table>
<tr><td>Course Code: ENG1002</td><td colspan="3">Course Title: Technical English
Type of Course:
1] School Core
2] Laboratory integrated</td><td>L-T-P-C</td><td>1-0-2-2</td></tr>
<tr><td>Version No.</td><td colspan="5">1.0 V. 3</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">Intermediate Level English</td></tr>
<tr><td>Course Anti-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Course Description</td><td colspan="5">Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The objective of this course is to develop the learners' EMPLOYABILITY SKILLS by using
EXPERIENTIAL LEARNING and PARTICIPATIVE LEARNING TECHNIQUES.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">On successful completion of the course, the students shall be able to:
1. develop proficiency in using technical vocabulary and terminology.
2. apply language skills for better speaking skills in technical fields.
3. write technical descriptions
4. demonstrate writing skills in writing technical documents such as reports, manuals, and articles.</td></tr>
<tr><td>Course Content:</td><td colspan="5"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Technical Communication</td><td>Worksheets& Quiz</td><td>Vocabulary building</td><td colspan="2">9 Classes</td></tr>
<tr><td colspan="6">• Introduction to Technical English
• Differences between Technical English and General English
• Technical Writing Basics
• Technical Vocabulary</td></tr>
<tr><td>Module 2</td><td>Technical Presentation</td><td>Presentations</td><td>Speaking Skills</td><td colspan="2">12 Classes</td></tr>
<tr><td colspan="6">Introduction
• Planning the Presentation
• Creating the Presentation
• Giving the Presentation</td></tr>
<tr><td>Module 3</td><td>Technical Description</td><td>Assignment</td><td>Group Presentation</td><td colspan="2">12 Classes</td></tr>
</table>

- Product Description
- Process Description
- User Manuals

- Transcoding: Diagrams, charts and images

Module 4	Technical Writing	Assignment	Writing Skills	12 Classes

Email Writing
Persuasive and Descriptive
Language Professional Email
Etiquette
Writing clear and concise technical
emails Communicating technical
information effectively Technical
Report Writing
Types of technical reports (Lab reports, research
reports, etc.) Components of technical reports
Writing an abstract and
executive summary
Structure and content
organization Transcoding:
diagrams, charts and images

List of Laboratory Tasks:

1. Module-1

Level 1: Worksheets
Level 2: Worksheets

2. Module 2

Level 1: Preparing Presentation
Level 2: Giving Presentation (Individual)

3. Module-3

Level 1: Product Description
& User Manual Level 2:
Process Description &
Transcoding

4. Module 4

Level 1:
Email Writing
Level 2:
Report
Writing

Targeted Applications & Tools that can be used:

1. Flipgrid
2. Quizzes
3. Youtube Videos
4. Podcast

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

1. Bring out the essence of technical communication with reference to the conventions of technical communication, with examples
2. Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.

The following individual, as well as group Assignments, will be given to the students.

1. Presentation
2. Describing a product/process
3. Individual Reports

Text Books

1. Kumar, Sanjay; Pushpalatha. *English Language and Communication Skills for Engineers.* Oxford University Press. 2018.
2. Brieger, Nick and Alison Paul. *Technical English Vocabulary and Grammar*. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf

Reference Book:

1. Chauhan, Gajendra Singh, and Kashmiramka, Smita, *Technical Communication.* Cengage Publication. 2018.
2. Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.
3. John Bowden. "Writing a Report: How to Prepare, Write & Present Really Effective Reports?". 9th Edition 2011 Comfort, Jeremy et. al. 1984. *Business Reports in English*. Cambridge University Press.

Sharma, R.C. and K. Mohan. 2011. Business Correspondence and Report Writing, Fourth Edition. Tata McGraw Hill.

Reference Book:

1. Chauhan, Gajendra Singh, and Kashmiramka, Smita, *Technical Communication.* Cengage Publication. 2018.
2. Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.
3. John Bowden. "Writing a Report: How to Prepare, Write & Present Really Effective Reports?". 9th Edition 2011 Comfort, Jeremy et. al. 1984. *Business Reports in English*. Cambridge University Press.

Sharma, R.C. and K. Mohan. 2011. Business Correspondence and Report Writing, Fourth Edition. Tata McGraw Hill.

Topics Relevant to the Development of Employability Skills:
Speaking Skills, Writing Skills, Critical Thinking and Critical Analysis, and Group Communication.

Catalogue prepared by	Dr. Vinodhini Chinnaswamy & Dr. T. Naresh Naidu
Recommended by the Board of Studies on	11th BoS on 05th July, 2024

Date of Approval by the Academic Council	

<table>
<tr><td>Course Code: PHY1002</td><td colspan="3">Course Title: Optoelectronics and Device Physics
Type of Course: 1] School Core & Laboratory integrated</td><td>L-P-C</td><td>2</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="7">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking, experimental and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.</td></tr>
<tr><td>Course Out Comes</td><td colspan="7">On successful completion of the course the students shall be able to:
CO1: Describe the concepts of semiconductors, magnetic materials and superconductors.
CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices.
CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers.
CO4: Explain the applications of lasers and optical fibers in various technological fields.
CO5: Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. [Lab oriented].</td></tr>
<tr><td>Course Objective</td><td colspan="7">The objective of the course is to familiarize the learners with the concepts of “Optoelectronics and device physics “and attain Skill Development through Experiential Learning techniques</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Materials.</td><td>Assignment</td><td colspan="3">Plotting of magnetization (M) v/s Magnetic field (H) for diamagnetic, paramagnetic and ferromagnetic materials using excel/ origin software.</td><td>Classes: 07</td></tr>
<tr><td colspan="8">Topics: Concept of energy bands, charge carriers, carrier concentration, concept of Fermi level, Hall effect, Superconductors: Josephson effect.</td></tr>
</table>

Module 2	Advanced Devices and applications	Assignment	Data collection on efficiency of solar cells.	Classes: 8
Topics: p-n junctions, Zener diode, transistor characteristics, Optoelectronic devices:, Solar cells, I-V characteristics, and LEDs				
Module 3	Quantum concepts and Applications	Term paper	Seminar on quantum computers.	classes: 8
Topics: Planck's quantum theory, applications of Quantum theory: de-Broglie hypothesis, matter waves, properties. de-Broglie wavelength associated with an electron. Heisenberg's uncertainty principle				
Module 4	Lasers and Optical fibers	Term paper	Case study on medical applications of Lasers.	classes :07
Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling. Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy.				
List of Laboratory Tasks: Experiment No. 1: Experimental errors and uncertainty using excel Level 1: Calculation of accuracy and precision of a given data Level 2: propagation of errors in addition, subtraction, multiplication and division. Experiment N0 2: To determine the wavelength of semiconductor diode Laser and to estimate the particle size of lycopodium powder using diffraction. Level 1: Determination of Wavelength of Laser Level 2: Finding the particle size of lycopodium powder. Experiment No. 3: To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier. Level 1: To determine the proportionality of Hall Voltage and magnetic flux density Level 2: To determine the polarity of Charge carrier. Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions. Level 1: To study I –V characteristics of the given Zener diode in reverse bias and to determine break down voltage. Level 2: To study I –V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance. Experiment No. 5: To study input and output characteristics of a given Transistor. Level 1: To determine the input resistance of a given transistor. Level 2: To determine current transfer characteristics and transistor parameters of a given transistor. Experiment No. 6: Determination of Fermi energy and Fermi temperature of a given metal and bimetallic wire. Level 1: Determination of Fermi energy and Fermi temperature of given metal wire. Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire.				

Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage.

Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.
Level 2: To measure the photo-current as a function of the irradiance at constant voltage.
Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance.
Level 1: To study the I-V characteristics
Level 2: I-R characteristics of a solar cell as a function of the irradiance.
Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. .
Level 1: Calculate the numerical aperture.
Level 2: study the losses that occur in optical fiber cable.
Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method.
Level 1: To determine the magnetic susceptibility of a given diamagnetic substance.
Level 2: To determine the magnetic susceptibility of a given paramagnetic substance.
Experiment No. 11: To study the hysteresis loop of an iron core and to find its coercivity and retentivity. To show the effect of varying voltage and frequency on hysteresis loop.
Level 1: To study the hysteresis loop of an iron core and to find its coercivity and retentivity.
.Level 2: To show the effect of varying voltage and frequency on hysteresis loop.
Experiment No. 12: Determining the wavelength of the electrons for different accelerator voltages by applying the Bragg condition and Confirming the de Broglie equation for the wavelength.
Level 1: Determining the wavelength of the electrons for different accelerator voltages by applying the Bragg condition.
Level 2: Confirming the de Broglie equation for the wavelength.
Experiment No. 13: To measure the transition temperature and resistivity of a high temperature superconductor.
Level 1: To measure the transition temperature.
Level 2: To determine the resistivity of a high temperature superconductor.
Experiment No. 14: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage.
Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs
Level 2: Determination of knee voltage.
Experiment No. 15: Determination of Stefan's constant and verification of Stefan-Boltzmann Law.
Level 1: Determination of Stefan's constant
Level 2: Verification of Stefan-Boltzmann Law

Targeted Application & Tools that can be used:

1. Areas of application are optoelectronics industry, Solar panel technologies, quantum computing software, electronic devices using transistors and diodes, memory devices, endoscopy, SQUIDS in MRI, Advanced material characterizations using SEM and STM.
2. Origin, excel and Mat lab soft wares for programming and data analysis.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)

- Quiz
- End Term Exam
- Self-Learning

1. Prepare a comprehensive report on non-conventional energy resources in Karnataka and their pros and cons.
2. Write a report on importance of quantum entanglement in supercomputers

Text Book

1. Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications,2018.

References: 1. Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002.
2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011.
3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017.
4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012.
5. Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019

E-Resourses:

1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live
3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live
4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live
5. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=486032&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Fundamentals of materials, Lasers and optical fibers.

for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.

Catalogue prepared by	Dr. Anindita, Dr. Sivasankar Reddy, Dr. Naveen C S, Dr. Mohan kumar Naidu, Dr. Deepthi P R, Dr. Mahaboob Pasha, Dr. Ranjeth Kumar Reddy, Dr. Pradeep Bhaskar, Dr. G. Srinivas Reddy, Dr. Saurav Kumar Kajli, Dr. Charan Prasanth
Recommended by the Board of Studies on	12th BOS conducted on 11th January 2025
Date of Approval by the Academic Council	

<table>
<tr><td>Course Code:
ECE2010</td><td colspan="3">Course Title: Innovative Projects using Arduino</td><td>L- T-P- C</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course is designed to provide an in-depth understanding of Arduino microcontrollers and their application in various real time projects involving sensors. Throughout the course, students will learn the fundamentals of Arduino programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Arduino boards, read sensor data, and use it to control various output devices This course is suitable for beginners who are interested in exploring the world of electronics and developing practical applications using Arduino and sensors.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is Employability Skills of student by using PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of the course the students shall be able to
1) Explain the main features of the Arduino prototype board
2) Demonstrate the hardware interfacing of the peripherals to Arduino system.
3) Understand the types of sensors and its functions
4) Demonstrate the functioning of live projects carried out using Arduino system.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td>Basic concepts of Arduino</td><td>Hands-on</td><td>Interfacing Task and Analysis</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, API’s , Introduction to Embedded C and Arduino platform, Arduino Datatypes and variables, Arduino i/o Functions, Arduino Communications, Arduino IDE, Various Cloud Platforms.</td></tr>
<tr><td>Module 2</td><td>Sensory Devices</td><td>Hands-on</td><td>Interfacing Task and Analysis</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switches and actuators, sensor interface with Arduino.
Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications.
Introduction to online Simulators: Working with Tinkercad Simulator.</td></tr>
<tr><td colspan="5">Topics: Types of Arduino boards, sensors, 3D Printer</td></tr>
</table>

Targeted Application & Tools that can be used:

Application Area:

Home Automation, Environmental Monitoring, Agriculture and Farming, Industrial Automation, Internet of Things (IoT), Robotics, Wearable Devices, Security Systems, Education and Learning. These are just a few examples of the many application areas where Arduino and sensors can be applied. The flexibility and affordability of Arduino, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: students can use open SOURCE Softwares Arduino IDE and Tincker CAD

Project work/Assignment:

1. Projects: At the end of the course students will be completing the project work on solving many real time issues.

2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .

3. Presentation: There will be a presentation from interdisciplinary students group, where the students will be given a project on they have to demonstrate the working and discuss the applications for the same

Textbook(s):

Monk Simon "Programming Arduino: Getting Started with Sketches", Mc Graw Hill Publications Second Edition

References
Reference Book(s)

1. Neerparaj Rai "Arduino Projects for Engineers" BPB publishers,first edition, 2016.

2. Ryan Turner "Arduino Programming " Nelly B.L. International Consulting Ltd. first edition,2019.

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Arduino trending Projects < https://www. https://projecthub.arduino.cc/>
2. Introduction to Arduino < https://onlinecourses.swayam2.ac.in/aic20_sp04/preview>
3. Case studies on Wearable technology< https://www.hticiitm.org/wearables>

E-content:

1. Cattle Health Monitoring System Using Arduino and IOT (April 2021| IJIRT | Volume 7 Issue 11 | ISSN: 2349-6002)

2. M H Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, Pragya Singh" IOT BASED SMART SECURITY SYSTEM USING ARDUINO" 2021 JETIR August 2021, Volume 8, Issue 8.

3. R. Maheswar, P. Jayarajan, S. Vimalraj, G. Sivagnanam, V. Sivasankaran and I. S. Amiri, "Energy Efficient Real Time Environmental Monitoring System Using Buffer

<table>
<tr><td colspan="2">Management Protocol," 2018, pp. 1-5, doi: 10.1109/ICCCNT.2018.8494144. https://ieeexplore.ieee.org/document/8494144.

Yaser S Shaheen,Hussam., " Arduino Mega Based Smart Traffic Control System ," December 2021 Asian Journal of Advanced Research and Reports 15(12): 43-52, 2021(15(12): 43-52, 2021):15(12): 43-52, 2021.</td></tr>
<tr><td colspan="2">Topics relevant to development of "SKILL": System design for achieving Sustainable Development Goals.</td></tr>
<tr><td>Catalogue prepared by</td><td>Dr. Divya Rani/Dr Ashutosh Anand</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BOS NO: 17Th BoS meeting held on 5th July 2023</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 21 dated on _____</td></tr>
</table>

<table>
<tr><td>Course Code:
CSE1006</td><td colspan="3">Course Title: Problem Solving using JAVA
Type of Course: Integrated</td><td>L-T- P- C</td><td>1</td><td>0</td><td>4</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">2.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">CSE1004 – Problem Solving Using C</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">Nil</td></tr>
<tr><td>Course Description</td><td colspan="8">This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real time secure applications by applying these concepts and also for effective problem solving. The students interpret and understand the need for object oriented programming to build applications.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
CO1: Describe the basic programming concepts. [Understand]
CO2: Apply the concept of classes, objects and methods to solve problems. [Application]
CO3: Apply the concept of arrays and strings. [Appy]
CO4: Implement inheritance and polymorphism building secure applications. [Apply]
CO5: Apply the concepts of interface and error handling mechanism. [Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Basic Concepts of Programming and Java</td><td>Assignment</td><td>Problem Solving</td><td colspan="4">15 Sessions
(L3 + P12)</td></tr>
<tr><td colspan="9">Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.</td></tr>
<tr><td>Module 2</td><td colspan="2">Classes, objects, methods and Constructors</td><td>Assignment</td><td>Problem Solving</td><td colspan="4">17 Sessions
(L3 + P14)</td></tr>
<tr><td colspan="9">Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods.
Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.</td></tr>
</table>

Module 3	Arrays, String and String buffer	Assignment	Problem Solving	13 Sessions (L3 + P10)
Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer.				
Module 4	Inheritance and Polymorphism	Assignment	Problem Solving	17 Sessions (L3 + P14)
Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.				
Module 5	Input & Output Operation in Java	Assignment	Problem Solving	13 Sessions (L3 + P10)
Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.				

P1: Programming Exercises on Basic Concepts.

LEVEL 1: Discuss about datatypes and variables.

LEVEL 2: Demonstrate a simple java program

P2: Programming Exercises on Basic Concepts.

LEVEL 1: Discuss about datatypes and variables.

LEVEL 2: Demonstrate a simple java program

P3: Programming Exercises on operators, expressions based on a given scenario.

LEVEL 1: Explain operators, expressions.

LEVEL 2: Demonstrate operators

P4: Programming Exercises Command Line Arguments based on a given scenario.

LEVEL 1: Explain command line arguments

LEVEL 2: Demonstrate command line arguments

P5: Programming Exercises on basic Input/ Output functions and Control Statements: Branching

LEVEL 1: Explain Input/ Output functions

LEVEL 2:Demonstrate Control Statements: Branching

P6: Programming Exercises on Control Statements: Looping

LEVEL 1: Explain variour loops.

LEVEL 2:Demonstrate Control Statements: Looping

P7: Programming Exercises on Creating Objects, classes on a given scenario.

LEVEL 1: Illustrate class, object and methods.

LEVEL 2: Execute java program using class and objects

P8: Programming Exercises on Adding methods and Constructors to the class based on a given scenario.

LEVEL 1: Illustrate methods and constructors

LEVEL 2: Execute java program using methods and constructors

P9: Programming Exercises on methods based on a given scenario.

LEVEL 1: Illustrate method overloading

LEVEL 2: Apply method overloading for the given scenario.

P10: Programming Exercises on methods based on a given scenario.

LEVEL 1: Illustrate constructors overloading

LEVEL 2: Apply constructor overloading for the given scenario

P11: Programming Exercises on methods for static members bassed on a given scenario.

LEVEL 1: Benefits of usage static members

LEVEL 2: Usage of Static Members for the given scenario

P12: Programming Exercises on static methods based on a given scenario.

LEVEL 1: Benefits of usage static methods

LEVEL 2: Usage of Static Methods for the given scenario.

P13: Programming Exercises on nested Classes based on a given scenario.

LEVEL 1: Benefits of usage nested classes

LEVEL 2: Apply the concept of usage of nested classes for the given scenario

P14: Programming Exercises on Arrays and its built-in functions based on a given scenario.

LEVEL 1: Illustrate one dimensional arrays and its functions.

LEVEL 2: Demonstrate programs with single-dimensional arrays and operations.

P15: Programming Exercises on Arrays and its built-in functions based on a given scenario.

LEVEL 1: Illustrate multi dimensional arrays and its functions.

LEVEL 2: Demonstrate programs with multi-dimensional arrays and operations.

P16: Programming Exercises on String Class and its built-in functions based on a given scenario.

LEVEL 1: Explain about String class and String methods.

LEVEL 2: Execute simple java applications for String and StringBuffer operations

P17: Programming Exercises on String Buffer Class and its built-in functions based on a given scenario.

LEVEL 1: Explain about StringBuffer class and String methods.

LEVEL 2: Execute simple java applications for String and StringBuffer operations

P18: Programming Exercises on String Builders and its built-in functions based on a given scenario.

LEVEL 1: Explain about String Builders.

LEVEL 2: Execute java applications for String Builders

P19: Programming Exercises on single, multi level Inheritance and super keyword based on given scenario.

LEVEL 1: Explain single and multi level inheritance.

LEVEL 2: Demonstrate simple applications for the different types of inheritance

P20: Programming Exercises hierarchical Inheritance and super keyword based on given scenario.

LEVEL 1: Explain hierarchical inheritance.

LEVEL 2: Demonstrate simple applications for hierarchical inheritance

P21: Programming Exercises on Overriding.

LEVEL 1: Differentiate method overloading and method overriding.

LEVEL 2: Demonstrate simple program with dynamic method dispatch.

P22: Programming Exercises on Final based on given scenario.

LEVEL 1: Implement programs using concept of final.

LEVEL 2: Use final keyword for the given problem

P23: Programming Exercises on Abstract keyword based on given scenario.

LEVEL 1: Implement programs using concept of Abstract.

LEVEL 2: Use abstract keyword for the given problem

P24: Programming Exercises on Interface based on a given scenario.

LEVEL 1: Differentiate abstract class about interface

LEVEL 2: Implement interfaces in the given problem

P25: Programming Exercises on Exception Handling based on a given scenario.

LEVEL 1: Explain exception handling

LEVEL 2: Solve the given problem using exception handling mechanism.

P26: Programming Exercises on Character Stream Classes based on a given scenario.

LEVEL 1: Explain Character Stream Classes

LEVEL 2: Solve the given problem using Character Stream Class.

P27: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

P28: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

P29: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

P30: Programming Exercises on Read/Write Operations with File Channel based on a given scenario.

LEVEL 1: Explain Read/Write Operations with File Channel

LEVEL 2: Solve the given problem using Read/Write Operations with File Channel.

Targeted Application & Tools that can be used : JDK /eclipse IDE/ net Beans IDE.

Text Book

T1 Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education, 11th Edition,2019.

References

R1. Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Tenth Edition, Pearson 2015.

R2: James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers.4th Edition, 2000.

R3. E. Balagurusamy, "Programming with Java", Tata McGraw Hill Education, 6th Edition, 2019.

E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf

E book link R2: Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub)

Web resources

https://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q

https://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to development of "Skill Development":

1. Static Polymorphism
2. Method overloading, constructors
3. constructor overloading
4. this keyword
5. static keyword and Inner classes
6. Inheritance and Polymorphism.

for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CIV1003	Course Title: Elements of Engineering Mechanics Type of Course: Program Core & Theory Only		L-T-P-C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	"Mechanics" is an area related to the motion of physical objects and "Engineering Mechanics" is an application of Mechanics used for solving problems involving common engineering elements. The purpose of this course is to expose the students to problems related to real-world scenarios. This course is both conceptual and analytical in nature that would help the student to predict the effects of forces and its motion while carrying out creative design functions.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Elements of Engineering Mechanics and attain Skill Development through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1]Recognize the significance of the principles of mechanics in the engineering context 2] Illustrate the fundamentals of equilibrium of forces acting on a body 3]Explain the effects of friction on a rigid body lying in different planes					
Course Content:						
Module 1	Fundamentals of Engineering Mechanics	Assignment	Numerical on Force System	12 Sessions		
Topics: Engineering Mechanics and its relevance. Force and its Characteristics: Laws of motion, Principle of superposition and transmissibility, Force system and its classification. Moment and Couple Composition of forces –Determination of Resultant for concurrent and non-concurrent co-planar force systems – Law of triangle, parallelogram and polygon of forces- Numericals on force system						
Module 2	Equilibrium of Forces	Assignment	Excel	12 Sessions		
Topics: Equilibrium and Equilibrant, Concept of Free-body diagram. Lami's theorem – statement and application for various engineering problems. Types of beam, supports and reactions (simple, hinged, roller and fixed) and loads acting on beam (vertical point load, uniformly distributed load).						
Module 3	Friction on Rigid bodies	Assignment	Programming/Data analysis task	12 Sessions		
Topics: Types of Friction, Laws of friction and its applications, sliding friction, wedge friction, body on inclined planes. Centroid of geometrical plane figures (square, rectangle, triangle and circle). Centre of gravity of Simple solid, Moment of inertia and related numericals						

Targeted Application & Tools that can be used:
Applications in Systems containing Multi-Force Members, Frames, Trusses, Machines, Cable Bridges etc.
Professionally used software – Staad Pro/ETABS

Text Book

T1. D.S. Bedi, '*Engineering Mechanics',* Khanna Publications, New Delhi.

T2. Kumar K.L, Kumar V, '*Engineering Mechanics',* Tata McGraw Hill, 2011.

T3. M.N. Shesha Prakash, Ganesh B. Mogaveer, 'Elements of Civil Engineering and Engineering Mechanics', PHI Learning.

References

R1. Timoshenko. S and Young D.H, '*Engineering Mechanics',* 5th Edition, Tata McGraw Hill, 2006.
R2. Shames I.H and Rao G.K.M, '*Engineering Mechanics – Statics and Dynamics',* Pearson Education-2009.
R3. Khurmi, R.S.,' *Applied Mechanics',* S. Chand & Co. New Delhi.

Weblinks:
W1. https://nptel.ac.in/courses/112/106/112106286/
https://www.youtube.com/watch?v=nGfVTNfNwnk&list=PLOSWwFV98rfKXq2KBphJz95rao7q8PpwT
W2. Engineering Mechanics, R K Bansal, Sanjay Bansal, Lakshmi Publications, 2016
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1223875&site=ehost-live
W3. A Textbook of Engineering Mechanics, SS Bhavikatti, New Age International Publishers, 2016
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2706929&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Engineering Mechanics and its relevance. Force and its Characteristic, Laws of Motion for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mrs. Divya Nair
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2008	Course Title: Engineering Geology Type of Course: Program Core/ Theory &integrated Laboratory	L-T-P-C	1	0	2	2
Version No.	1.0					
Course Pre-requisites	General idea about the various theories on the origin of Earth and its process. Basic understanding of contour maps.					
Anti-requisites	Nil					
Course Description	The main purpose of this course is to make students understand the basics of Earth Science / Engineering Geology subject and to know implications of geology in planning, designing and construction of large Civil engineering projects. Basically, the course focuses on topics – interior of the earth and structural geology. It also covers the physical properties and simple classification of minerals and rocks. Effects of rock structures on Civil Engineering projects. Hydrogeological components. Introduction to Remote Sensing, Geographic Information System & Global Positioning System and their role in Civil engineering applications. The related laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the realistic conditions.					
Course objective	The objective of the course is to familiarize the learners with the concepts of Engineering Geology and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Define geological activities of the earth. 2. Explain the identification of common minerals & rocks and their applications in civil engineering projects. 3. Discuss the engineering & construction problems, and appreciate the use of recent technologies associated with Earth processes. 4. Basic knowledge of hydrogeological components to understand and appreciate their significance to different types of engineering projects. 5. Distinguish contour maps and geological maps to solve field problems. 6. Basic knowledge about remote sensing and GIS					
Course Content:						
Module 1	Earth Science basics	Case Study and Assignment	Data Collection and analysis.	05 Sessions		
Topics: Introduction to the origin of earth and scope of Engineering Geology with regards to Civil engineers. Earthquake terminologies and earthquake recording instruments. Determination of earthquake epicentre. Seismic zoning map of India and its use. Measures for protection from earthquakes. Secondary effects of earthquakes and control measures.						
Module 2	Minerals & Rocks, Weathering and Groundwater aquifers.	Assignment	Data analysis	05 Sessions		
Topics: Introduction to minerals and rocks. Identification of minerals and rocks based on physical properties. Overview of rocks - Classification and distinguishing features of Igneous, Sedimentary, Metamorphic rocks. Groundwater – Aquifer & its types, Aquifuge, Aquiclude, Aquitard. A brief study on hydraulic property of rocks, controlling factors of porosity and permeability. General descriptions on distribution of groundwater, water table, movement of groundwater.						

Module 3	Structural Geology. Applications of recent techniques.	Assignment	Data analysis task	06 Sessions

Topics:
Structural Geology introduction, engineering importance folds & faults and their significance in Civil Engineering Projects. Geological considerations concerning design of subsurface and surface structures such as Dams and tunnels.
Applications of recent techniques: Remote Sensing, Geographic Information System & Global Positioning System – Overview and applications.

List of Laboratory Tasks:
Experiment No. 1: To determine the epicenter location of earth quake using travel - time curve. [Provide the data required in the processed form].
Level 1: For the data provided on P and S wave travel time, prepare the travel time curve to determine the epicenter location of earthquake using Microsoft office program [Provide data required in the processed form].
Level 2: For the data provided on P and S wave travel time, prepare the travel time curve to determine the epicenter location of earthquake using Microsoft office program [Provide the data required in the raw form].

Experiment No. 2: Location of earthquake epicenter by triangulation method using Microsoft office program [Provide the data required in the processed form].
Level 1: Seismic data will be provided to determine the exact location of epicenter on the globe using Adobe flash or any other related software would be used for the same.

Experiment No. 3: Megascopic identification of minerals based on their physical and special properties.
Level 1: To identify the given minerals (samples and some basic equipment will be provided).

Experiment No. 4: Megascopic identification of rocks based on their physical and special properties.
Level 1: To identify the given rocks (samples and some basic equipment will be provided)

Experiment No. 5: Preparation of profiles and interpretation using Geological maps
Level 1: To prepare the geological profiles and interpret for the given geological maps.

Targeted Application & Tools that can be used:
The primary application area is geological data collection, analysis and presentation. The information can be used by Government, private companies and other geoscientists to communicate and work effectively in multidisciplinary Projects.
Professionally used software like adobe flash / AutoCAD / GIS / MS Office.

Text Book
T1 S.K.Duggal, H.K.Pandey, N.Rawat, *Engineering Geology", Mc.Graw Hill, Tata McGraw-Hill, Fourth Edition, 2014.*
T2 Parbin Singh, *Engineering and General Geology, S.K. Kataria & Sons; Eighth Edition, 2017*

E-Resources:
Engineering Geology by F G Bell
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=186102&site=ehost-live
https://nptel.ac.in/courses/105/105/105105106/
https://onlinecourses.swayam2.ac.in/aic22_ge16/unit?unit=1&lesson=83
https://mg-nitk.vlabs.ac.in/mining-geology/
https://www.usgs.gov/science/science-explorer/Geology
https://geology.com/rocks/

Topics relevant to "SKILL DEVELOPMENT": Minerals and Rock Identification, classification, Uses. Preparation of profiles and interpretation of geological maps. for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

References
R1 P.C.Varghese, *Engineering Geology for Civil Engineers", PHI.*

R2 Judd and Krynine*, Principles of Engineering Geology and Geotechnics, McGraw-Hill Book Company* R3 N ChennaKesavulu, *Textbook of Engineering Geology, Trinity Press, Second Edition* R4 Lab Manual prepared by Civil Engineering Department, Presidency University, Bangalore	
Catalogue prepared by	Dr. Chandankeri G G
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code:
CIV2500</td><td colspan="5">Course Title: Strength of Materials
Type of Course: Program Core & Theory Only</td><td>L-T-P- C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="10">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="10">Engineering Mechanics
Principal of superposition, Moment, Equilibrium of forces, Centroid, and Moment of inertia of simple solid geometry</td></tr>
<tr><td>Anti-requisites</td><td colspan="10">NIL</td></tr>
<tr><td>Course Description</td><td colspan="10">The course deals with estimating the internal forces and deformations in a structural member produced by any combination of external loading. This course deals with behaviour of engineering materials subjected to axial forces, bending, shear and torsion. This course is completely conceptual and gives the real visualization of structural internal forces by simulation.</td></tr>
<tr><td>Course Objective</td><td colspan="10">The objective of the course is to familiarize the learners with the concepts of Strength of Materials and attain Skill Development through Problem Solving methodologies.</td></tr>
<tr><td>Course Out Comes</td><td colspan="10">On successful completion of the course the students shall be able to:
1. Predict the stress-strain behavior of various materials subjected to different loading conditions.
2. Sketch the Shear Force Diagram, Bending Moment Diagram and stress distribution along a c/s for statically determinate beams
3. Compute the torsional strength of the shaft.
4. Compute the load carrying capacity of axially loaded columns.</td></tr>
<tr><td>Course Content:</td><td colspan="10"></td></tr>
<tr><td>Module 1</td><td colspan="3">Stresses and Strains</td><td colspan="3">Term paper/ Assignment</td><td colspan="3">Simulation/ Data Analysis</td><td>15 Sessions</td></tr>
<tr><td colspan="11">Topics: Stress in Simple, compound and composite bars, Elastic constants and volumetric strains, Introduction to Principal stress and principal planes.</td></tr>
<tr><td>Module 2</td><td colspan="3">Shear Force, Bending Moments, Shear and Bending stresses</td><td colspan="3">Assignment</td><td colspan="3">Simulation</td><td>9 Sessions</td></tr>
<tr><td colspan="11">Topics: Definition of Shear force and bending moment at a section, the relationship between shear force, bending moment and loading, Shear force and bending moment diagram for statically determinate beams subjected to various loading conditions
Euler Bernoulli beam theory, Stress distribution at a cross-section due to Bending Moment and Shear force, Bending and shear stress distribution across the depth of a section for various loading conditions in statically determinate beams.</td></tr>
<tr><td>Module 3</td><td colspan="3">Torsion of Shafts</td><td colspan="3">Assignment</td><td colspan="3">Numerical from E-Reosurces</td><td>6 Sessions</td></tr>
<tr><td colspan="11">Topics: Theory of torsion - Torsion of circular and hollow circular shafts and shear stresses due to torsion.</td></tr>
</table>

Module 4	Columns and Struts	Assignment	Numerical from E-Reosurces	7 Sessions

Topics: Theory of columns- Axial load, Euler's theory, Rankine's formula, combined bending and axial load on Struts, Behavior of column using STAAD.Pro

Targeted Application & Tools that can be used:

The knowledge of this course can be applied in the design of structure elements, selection of engineering material, and design of pavements.
Professionally used software – MD Solids, STAAD.Pro, Etabs MS-Excel

Text Book

1. S. Ramamrutham, R Narayanan, "Strength of Materials", Dhanpat Rai Publishing
2. P. Beer, E. R. Johnston (Jr.) and J.T. DeWolf, "*Mechanics of Materials"*, Tata McGraw Hill

References

1. Egor Popov, "Mechanics of Materials", Pearson
2. Timoshenko, S.P. and Gere, "J.M. Mechanics of Materials", Tata McGraw Hill.
3. Kazimi, 'Mechanics of Solids", Tata McGraw – Hill.

E-Resources

1. R K Bansal, A Textbook of Strength of Materials (Mechanics of Solids), Laxmi Publications Pvt. Ltd.
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1227286&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Plotting Shear Force and Bending Moment Diagrams, estimating torsional strength of shafts and load carrying capacity of columns for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mr. Gopalakrishnan N
Recommended by the Board of Studies on	BOS Meeting No: 19
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2101	Course Title: Surveying Type of Course: Professional Core & Theory Only	L-T-P- C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	Nil					
Course Description	This course will introduce the fundamentals of surveying measurements to provide a broad overview of the surveying instrumentation, procedures, measurement corrections and reductions, survey datum's, and computations that are required to produce a topographical map or a site plan for engineering and design projects. The purpose of this course is to enable the students to appreciate the need of surveying and to develop the basic abilities to perform chain surveying, Compass surveying, theodolite, Levelling, Drone surveying, LIDAR, contouring and Plane table surveying.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Surveying and attain Skill Development through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Apply the knowledge of fundamental principles of surveying to establish points by predetermined linear and angular measurements. 2] Compute the distance and elevation using the concepts of levelling by direct or indirect method. 3] Interpreting the details of contouring, plane table survey, Drone and DGPS technologies for precise spatial data collection and mapping.					
Course Content:						
Module 1	Chain and Compass surveying	Assignment	Data Collection		12 Sessions	
Topics: Chain surveying: Introduction to survey, Objectives and importance of surveying, Classification of surveys,. Principles of surveying, conventional symbols. Measurement of Horizontal Distances: Direct and indirect methods of ranging, Booking of chain survey work, Obstacles in chain survey, Numerical problems. Compass surveying: Basic definitions; meridians, bearings, magnetic and true bearings. Prismatic and surveyor's compasses, temporary adjustments, declination. Quadrantal bearings, whole circle bearings, local attraction and related problems.						
Module 2	Levelling, Theodolite and Trigonometric Levelling:	Case Study	Data Collection and applications		12 Sessions	
Topics: Levelling: Definitions, Levelling instruments, Temporary adjustments, Reduction to levels, Classification of levelling, Profile Levelling, Differential levelling and Problems. Trigonometric Levelling: Determination of distance and elevation of objects when the base is accessible and inaccessible by single plane and double method, problems. Theodolite: Theodolite and types, Fundamental axes and parts of Transit theodolite, uses of theodolite, Temporary adjustments of transit theodolite, measurement of horizontal and vertical angles.						
Module 3	Contouring, Plane table surveying, and Drone surveying	Assignment	Data Collection and interpretation		12 Sessions	
Topics:						

Contouring: Contours, Methods of contouring, Interpolation of contours, characteristics of contours and uses. Plane table survey: Methods of orientation, methods of plotting – radiation, and intersection methods. Drone Surveying: Definitions, Benefits, limitations, data output, accuracy, Determination of distance and elevation of objects, and introduction to LIDAR in Remote sensing and applications. Introduction to DGPS in surveying.	
Targeted Application & Tools that can be used: Application area of surveying is for data collection for construction of various structures. Construction companies, Public works department, Irrigation department, Railway department and Survey of India etc. Professionally used software: AutoCAD Civil 3D, Google Earth Pro, Pix4D & Drone Deploy, ArcGIS/QGIS and E-survey.	
Text Book 1. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications-2009 2. Surveying and Levelling, Vol. I and Vol. II by T. P. Kanetkar and S.V.Kulkarni, Pune Vidyarthi Griha Prakashan	
References 1. Duggal, S.K., "Surveying Vol. I and II", Tata McGraw Hill-2009 2. Garvit Pandya, " Basics of Unmanned Aerial Vehicles: Time to start working on Drone Technology" nationpress-2021. 3. Gopi, "Advanced Surveying: Total Station, GIS and Remote Sensing" Pearson-2016. E book link R1: https://web.p.ebscohost.com/ehost/detail/detail?vid=3&sid=ef412d70-5458-4be4-b237-0014d31c40f7%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#	
Topics relevant to "SKILL DEVELOPMENT": Measurement of angles and elevation by using Total station and DGPS for Skill Development through Problem Solving methodologies. This is attained through the assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Shwetha A
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	

Course Code: CIV2102	Course Title: Surveying Lab Type of Course: 1]Professional Core/ 2]Laboratory only	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	Nil					
Course Description	This course delves into the fundamentals of surveying measurements to provide a broad overview of the surveying instrumentation. The course provides training on chain, Compass, theodolite, Levelling, Plane table and Drone surveying.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Surveying and attain Skill Development through Experiential Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Apply the basic principles of engineering surveying for carrying out linear and angular measurements using conventional and advanced instruments. 2] Compute Distance, Elevation and Area using advanced Surveying instruments by direct and indirect method.					
Course Content:						

List of Laboratory Tasks:
Experiment No 1: Chaining a line by ranging.
Level 1: Chaining a line by direct ranging.
Level 2: Chaining a line by indirect ranging.

Experiment No. 2: Measurement of area by chain surveying.
Level 1: Measurement of the given area by chain triangulation.
Level 2: Measurement of the given area of land by cross staff survey.

Experiment No. 3: To perform closed traverse by using prismatic compass.
Level 1: Setting out of geometrical figures (Rectangle or Pentagon or Hexagon) using compass.
Level 2: Closed traversing covering a given area.

Experiment No. 4: Determine the difference in elevation by levelling.
Level 1: Conduct fly levelling and profile levelling.
Level 2: Conduct profile levelling using dumpy level.

Experiment No. 5: Conduct total station surveying.
Level 1: Study of total station in detail and practice for taking measurements.
Level 2: Conduction of block levelling by DGPS.

Experiment No. 6: Measurement of angles and elevation by using Total station.
Level 1: Conduct fly levelling and profile levelling
Level 2: Measure horizontal and vertical angle by using Total station.

Experiment No. 7: Plotting of objects/features of field by plane table surveying.
Level 1: To locate points using radiation method of plane tabling.
Level 2: To find distance between two inaccessible points using Intersection method of plane tabling.
Experiment No. 8: Plotting of objects/features of field by plane table surveying.

Level 1: Study of survey Drone in detail for conducting Topographic Mapping & Land Surveying. Level 2: Study of survey Drone in for conducting flood zone mapping .	
Targeted Application & Tools that can be used: Application area of surveying is for data collection for construction of various structures. Construction companies, Public works department, Irrigation department, Railway department and Survey of India etc. Professionally used software: AutoCAD Civil 3D, Google Earth Pro, Pix4D & Drone Deploy, ArcGIS/QGIS and E-survey.	
Text Book 3. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications-2009 4. Surveying and Levelling, Vol. I and Vol. II by T. P. Kanetkar and S.V.Kulkarni, Pune Vidyarthi Griha Prakashan	
References 4. Duggal, S.K., "Surveying Vol. I and II", Tata McGraw Hill-2009 5. Garvit Pandya, " Basics of Unmanned Aerial Vehicles: Time to start working on Drone Technology" nationpress-2021. 6. Gopi, "Advanced Surveying: Total Station, GIS and Remote Sensing" Pearson-2016. E book link R1: https://web.p.ebscohost.com/ehost/detail/detail?vid=3&sid=ef412d70-5458-4be4-b237-0014d31c40f7%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#	
Topics relevant to "SKILL DEVELOPMENT": Measurement of angles and elevation by using Total station for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Shwetha A
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	

Course Code: CIV2100	Course Title: Building Materials and Concrete Technology Type of Course: Program Core	L-T-P-C	2	0	0	2
Version No.	1.1					
Course Pre-requisites	Pre Engineering Courses (Basics of Chemistry and Mathematics)					
Anti-requisites						
Course Description	The Course consists of the study of different building materials and their properties which are used in construction of civil engineering projects. This course includes basic properties of building materials such as Bricks, Stones, Paver blocks and constituents of concrete (cement, aggregates and water). It also includes various assessment tests to investigate quality of ingredients and Building materials as per IS codal provisions.The course can develop first-hand knowledge on types of Brick and stone masonry works, concrete production process including properties and uses of concrete, various plastering works and tile laying works. The knowledge about all the materials will help to gain the ability in making decision to select the suitable ingredient in required proportions for making appropriate concrete in the construction industry. This course will provide the opportunity to experience physical properties of all the building materials, behavior as well as construction methods in the form of demonstrations. Furthermore, material applications and detailing in structural and non-structural building components are explored.						
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Building Materials and Concrete Technology and attain Skill Development through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Know various engineering properties of building construction materials and suggest their suitability 2] Identify the functional role of ingredients of concrete and apply this knowledge to understand the properties of concrete 3] Design economic mix proportions for concrete mixes					
Course Content:						
Module 1	Introduction to Building Materials	Assignment	Data Collection	10 Sessions		
Topics: Stones - Classification of Stones – Properties of stones in structural requirements, Bricks-Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks. Field and laboratory tests on bricks; compressive strength, water absorption, efflorescence, dimension and warpage. Cement Concrete blocks, Autoclaved Aerated Concrete Blocks, Sizes, requirement of good blocks. Timber as construction material. Classification of aggregate, Bond, Strength and other mechanical properties of aggregate, Physical properties of aggregate.						
Module 2	Concrete – Fresh Properties	Assignment	Analysis of test results and also can be dealt with Lab	10 Sessions		
Portland Cement: Chemical composition, Hydration, Structure of hydrated cement – Setting of cement, Fineness of cement, Tests for physical properties – Different grades of cements, Properties of Mineral and Chemical admixtures.						

Fresh Concrete: Manufacture of concrete – Mixing and vibration of concrete, Workability – Segregation and bleeding – Factors affecting workability, Measurement of workability by different tests, Effect of time and temperature on workability – Quality of mixing water, Ready mix concrete, Shotcrete.				
Module 3	Concrete – Hardened Properties and Mix design concept	Assignment/ Case Study	MS Excel, Using Graphs and Pi Charts and tables for analysis	10 Sessions
Hardened Concrete: Grades of concrete, Water / Cement ratio, Gel space ratio, Gain of strength of concrete with age – Maturity concept, Various strength tests as per IS Code. Relation between compressive strength and tensile strength of concrete – Properties of Hardened Concrete – Creep and Shrinkage- types and factors. Mix design of concrete: Concept of Mix Design with and without admixtures, variables in proportioning and exposure conditions, Selection criteria of ingredients used for mix design, Procedure of mix proportioning. Numerical Examples of Mix Proportioning using IS-10262.				
Targeted Application & Tools that can be used: Application Area is Infrastructure developing companies, Design and Construction Companies, Structural Consultancy Servicing Firms, Central and State Public Works Department. Professionally Used Software: Excel, MATLAB, SAP 2000, STAAD Pro-RCDC, ETABS, ProConcrete, PRE-Stress, RAM, Concept and Auto CAD Software				
Text Book 1. S. K. Duggal, "Building Materials", (Fourth Edition)New Age International (P) Limited, 2016 National Building Code(NBC) of India 2. M.S Shetty, "Concrete Technology Theory and Practice", S.Chand & Company Pvt. Ltd.				
References 1. P.C Varghese, "A textbook Building Materials", Prentice-Hall of India Pvt. Ltd. 2. IS 10262: 2019: Concrete Mix proportioning and Guidelines Web resources: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2196240&site=ehost-live&ebv=EB&ppid=pp_x https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1558372&site=ehost-live				
Topics relevant to "SKILL DEVELOPMENT": Design mix of concrete, Tests on concrete and analysis of concrete properties for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Dayalan J			
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021			
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021			

Course Code: CIV2103	Course Title: Building Planning and Drawing Type of Course: 1] Program Core 2] Laboratory only	L-T-P-C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	This course delves into the fundamentals of architectural and structural drawings used to build components at a construction site. The course provides training on drafting software such as AutoCAD for structural detailing of beam. It also provides insights into designing and planning of a building's electrical and plumbing layouts.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Building Planning and Drawing and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: • Produce plan, section and elevation drawings for buildings using AutoCAD tools. • Sketch structural detailing for basic Structural Components. • Prepare layout drawing of utilities like water supply, sanitary and electrical connections.					
Course Content:	List of Laboratory tasks Task 01: Basics of AutoCAD – Tools for drawing and modifying in AutoCAD. Level No. 01: Tools for drawing and modifying in AutoCAD. Level No. 02: Advanced Modifications and tools in AutoCAD Task 02: Introduction to Building components & AutoCAD in Civil Engineering- (Detailed drawing and components of a masonry wall, Lintel & chajja) Level No. 01: Sectional elevation of masonry wall including footing, RCC Lintels & Chajjas (without RC details). Level No. 02: Sectional elevation of masonry wall including footing, RCC Lintels & Chajjas (with RC details). Task 03: Centerline Drawing- Developing a plan from a center line diagram Level No. 01: Development of plan from center line drawing for a storied building. Level No. 02: Development of plan from center line drawing for a storied building. Adopting appropriate Line weight and Line thickness etc. Task 04: Single storey house – Concept of plan, cross section, elevation, and schedule of opening of a single bed residential building- As per by-laws. Level No. 01: Plan layout of a single storey house with elevation and cross-section Level No. 02: Plan layout of a two storey house with elevation and cross-section Task 05: Office and School Building – Concept of plan, cross section, elevation, and schedule of opening for an office building and School.- as per by-Laws Level No. 01: Plan layout of an Office/Commercial Building with elevation and cross-section					

	Level No. 02: Plan layout of a Hospital/School Building with elevation and cross-section. Task 06: Sectional elevation of RC Beam - Study and learn types of beams and drawing the components of a Beam Level No. 01: Drawing beam with RC details Level No. 02: Drawing Cantilever beam incorporated with slab Task 07: Water Supply, and Sewage Layout- Mark water supply, and sewage layout on existing plan Level No. 01: Development of water supply, and sanitary drawing for a given residential building as a layer. Level No. 02: Development of water supply, and sanitary drawing for a given residential building as a layer Including Solar Hot water supply and Rainwater harvesting Task 08: Electrical Layout - Mark electrical layout on existing plan Level No. 01: Development of electrical drawing for a given residential building as a layer. Level No. 02: Development of electrical drawing for a given residential building as a layer along with alternative source of electricity (Generator and Un interrupted power supply –UPS connections) as a different layer.

Targeted Application & Tools that can be used:

Autocad is an essential tool and skill which is required by all the state of the art civil engineering establishments in the country and abroad. Student will learn to work with AutoCad Software and get exposed to various tools in the software which helps him/her to apply the gained knowledge in various Civil Engineering Businesses.

Professional Softwares: AutoCad , Revit

Text Book

1. Gurucharan Singh and Subash Chander, *Civil engineering drawing, 2014, English Standard Publishers and Dist., Delhi*
2. Sikka V B Kataria S K & Sons. *A Course in Civil Engineering Drawing*

References

1. Shah M H and Kale C M, *Building drawing, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi.*
2. Gurucharan Singh, *Building Construction, Standard publishers and distributors, New Delhi.*
3. *National Building Code, BIS, New Delhi.*
4. Sham Tickoo, *Understanding AUTOCAD 2004 A beginner's Guide,* Wiley Dreamtech India Pvt Ltd.
5. Jayaram M A., Rajendra Prasad D S., *A referral on CAD Laboratory,* Sapna Publications.

Additional Web Resources:

1. W1: PU E-Resource: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2422588&site=ehost-live
2. W2: NPTEL course – Building materials and Construction - Dr. B. Bhattacharjee https://nptel.ac.in/courses/105/102/105102088/
3. W3: NPTEL course – Principles and Applications of Building Science- Dr. E. Rajasekar https://nptel.ac.in/courses/105107156

Topics relevant to "SKILL DEVELOPMENT": Concept of plan, cross section, elevation, and schedule of opening of a single bed residential building- As per by-laws for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Harshith Jagadish Gupta / Ms. Divya Nair / Ms. Anju Mathew
Recommended by the Board of Studies on	BOS NO: 14th BOS, held on 30/7/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18.3, Dated 2/8/2022

Course Code: **CIV2503**	**Course Title:** **Fluid Mechanics** **Type of Course:** **Professional Core Theory Only**		**L-T-P-C**	3	1	0	4
Version No.	1.2						
Course Pre-requisites	[1] CIV1501 Elements of Engineering Mechanics [2] Calculus and Linear Algebra [3] Vector Calculus and Differential equations Basic concepts of engineering Mechanics, Fundamentals of Calculus and Vectors.						
Anti-requisites	NIL						
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Fluid Mechanics** and attain **Skill Development** through **Problem Solving** methodologies.						
Course Description	The purpose of this course is to introduce the students the fundamentals of fluid mechanics and to develop the understanding of fluid under static and dynamic conditions. The benefit of the course is to the students as they will be able to understand the concept through application based numerical problems. Fluid flow under different scenarios will give better insight into the subject. The nature of the course is theory, practical part will be covered in higher semester, this ensures better visualization and understanding of the topics covered in theory portions.						
Course Outcomes	On successful completion of this course the students shall be able to: 1) Explain the properties of fluid behavior under static conditions. 2) Apply Bernoulli's theorem for discharge measurement through pipes 3) Compute the Major and Minor losses in pipe systems						
Course Content:							
Module 1	**Fundamentals of Fluid Statics**	Assignment	Data Analysis task	**14 Sessions**			
Topics: Introduction to fluids and its properties, Continuum, Pressure and its variation, Pascal's law, Pressure measurement by simple, differential manometers, Hydrostatic forces acting on horizontal, vertical, Inclined and Curved surfaces, Archimedes principle, Buoyancy and Metacenter. Stability of floating bodies							
Module 2	**Fluid kinematics and Dynamics**	Quiz	Data Analysis Task	**11 Sessions**			
Topics: Introduction to Velocity of fluid particles and types of fluid flow, Basic principles of fluid flow, Continuity equation, Velocity potential and stream function. Units and dimensional analysis. Introduction to forces acting on Fluids in motion- Euler equation of motion, Bernoulli's principle of conservation of Energy, Applications of Bernoulli's theorem, Flow measurement devices. Forces acting on a control volume - The linear and angular momentum equation Application of Manning's equation and chezy equation.							
Module 3	**Flow through pipe systems**	Assignment	Simulation	**10 Sessions**			

Topics: Introduction to flow through pipes, Laminar flow, Reynold's experiment, Calculation of energy losses: Darcy's Weisbach equation, Pipe networks, Pipes in series and Parallel, Hardy cross Method. Solving pipe network systems and estimation of losses in EPANET software.
Targeted Application & Tools that can be used: Application Area is Hydraulic modelling, hydraulic design, Water supply and distribution network design. Professionally Used Software: PCSWMM, EPANET, WaterCAD, CFD for fluid flow analysis.
Textbooks: T1 P.N.Modi and S.M.Seth Hydraulics and Fluid Mechanics Including Hydraulics Machines, Standard Book House, 2002 T2 R.K.Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2018.
References: R1 K Sudramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw, New Delhi, 2020. R2 Yunus A, Cengel, John.M.Cimbala"Fluid Mechanics, - Fundamentals and Applications", McGraw Hill, 2019. **Web links:** W1: https://presiuniv.knimbus.com/user#/searchresult?searchId=fluid%20mechanics&_t=1738576815132 W2: https://nptel.ac.in/courses/105/101/105101082/
Topics relevant to "SKILL DEVELOPMENT": Analysis of Pipe flow network for **Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.**

Catalogue prepared by	Mr. Santhsoh M B
Recommended by the Board of Studies on	BOS Meeting No: 20, Dated: _____
Date of Approval by the Academic Council	Academic Council Meeting No: _____, dated on _____

Course Code: CIV2504	Course Title: Fluid Mechanics Lab Type of Course: 1] Program Core 2] Laboratory only	L-T-P- C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	Concepts of Flow through pipes, application of Bernoulli's Theorem and Monometers					
Anti-requisites	NIL					
Course Description	The primary objective of this Course is to make the students gain knowledge about the properties and behavior of fluids. It is a practical oriented Course dealing with how to measurement of discharge, major and minor losses through pipe. The Course is designed to impart knowledge on properties of fluids at rest and in motion. The students having basic knowledge on fluid mechanics theory Course can easily understand this Course. This Course helps students design culverts, bridges and closed conduits to carry particular discharge					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Fluid Mechanics Lab and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Compute the coefficient of discharge, major and minor losses for flow through pipes. 2) Interpret the values of flow measurement devices like VenturiMeter, orifice meter, v notch and its application in real projects					
Course Content:	Task 01: Discharge Measurement through Rotameter. Level 01- To measure the discharge through a liquid Rotameter. Level 02- To calibrate the Rotameter and find the error. Task 02: Verification of Bernoulli's theorem. Level 01- To verify Bernoulli's theorem. Level 02- To find the variation in the energy across various sections and plot the same on the graph. Task 03: To perform Reynold's Experiment. Level 01- To find the Reynold's number in pipe flow under various conditions. Level 02- To classify the nature of flow based on Reynold's number. Task 04: Discharge through Venturimeter Level 01- To measure the discharge through Venturimeter. Level 02- To study the variation of coefficient of discharge with the Reynold's number. Task 05: Discharge through Orifice meter. Level 01- To measure the discharge through orifice meter. Level 02- To study the variation of coefficient of discharge with the Reynold's number. Task 06: Determination of energy losses in pipe flow system. Level 01- To compute the major and minor losses in a pipe flow network. Level 02- To relate the friction coefficient with the Reynold's number Task 07: To determine the discharge through open channel flows. Level 01- To compute the discharge in open channel using rectangular and triangular notches.					

	Level 02- To calibrate the notch and compute the discharge in any open channel in the Campus Task 08: Determination of Impact of jet on vanes Level 01- To compute the Impact of jet on flat plate Level 02- To compute the Impact of jet on curved and inclined plate Task 09: Determination of metacentric height of a floating body Level 01- To compute the metacentric height of floating body with simple loading conditions Level 02- To compute the metacentric height of floating body with different combinations of load Task 10: Determination of energy losses in parallel pipe system Level 01- To compute the friction losses in a pipe parallel pipe network. Level 02- To compute the friction losses in a pipe parallel pipe network with varying diameter of pipes. Task 11: Determination of energy losses in series pipe system Level 01- To compute the friction losses in a series pipe network. Level 02- To compute the friction losses in a pipe series pipe network with varying diameter of pipes.
Targeted Application & Tools that can be used: Application Area is Hydraulic modelling, hydraulic design, Water supply and distribution network design. Professionally Used Software: PCSWMM, EPANET, WaterCAD, CFD for fluid flow analysis	
Text Book 1. "Fluid Mechanics Lab Manual", Presidency University. 2. P.N.Modi and S.M.Seth Hydraulics and Fluid Mechanics Including Hydraulics Machines, Standard Book House, 2002	
References 1. R1 K Sudramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw, New Delhi, 2020. 2. R2 Yunus A, Cengel, John.M.Cimbala"Fluid Mechanics, - Fundamentals and Applications", McGraw Hill, 2019. E-Resources 1. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2878905&site=ehost-live&ebv=EB&ppid=pp_C-1 2. https://sm-nitk.vlabs.ac.in/	
Topics relevant to "SKILL DEVELOPMENT": Measurement of Discharge, Major and minor losses through pipe for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Mr. Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code:
CIV2505</td><td colspan="5">Course Title: Hydrology and Irrigation Systems

Type of Course: Program Core
Theory Only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="10">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="10">1) Basic algebra, 2) Basic arithmetic 3) Basic statistics 4) Basic Science

Basic terminologies such as condensation, evaporation, melting, sublimation, humidity, stream flow and the necessity, importance and benefits of irrigation.</td></tr>
<tr><td>Anti-requisites</td><td colspan="10">NIL</td></tr>
<tr><td>Course Description</td><td colspan="10">The course introduces hydrology as both a science and as an engineering practice, particularly as relates to its application in water resources management and estimation. Topics that will be developed include understanding the Earth’s water and energy cycles, describing and monitoring components of the hydrological cycle, and modeling aspects of hydrological systems.

The course highlights various design techniques of effective irrigation methods which otherwise will boost food production and promote food security in the entire world at large.</td></tr>
<tr><td>Course objectives:</td><td colspan="10">The objective of the course is to familiarize the learners with the concepts of Hydrology and Irrigation Systems and attain Skill Development through Problem Solving methodologies</td></tr>
<tr><td>Course Out Comes</td><td colspan="10">On successful completion of the course the students shall be able to:

1] Discuss the concept of hydrology and components of hydrologic cycle such as precipitation, infiltration, evaporation and transpiration
2] Recognize the losses in precipitation
3] Estimate Runoff and Flood Hydrograph
4] Explain irrigation procedure.</td></tr>
<tr><td>Course Content:</td><td colspan="10"></td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to Hydrology and Precipitation</td><td>Assignment</td><td colspan="3">Data Collection/ Analysis</td><td colspan="2">9 Sessions</td></tr>
<tr><td colspan="11">Topics:
Hydrology: Introduction, Hydrologic Cycle, Water Budget Equation, Applications of Hydrology in Engineering.
Precipitation: Definition, Forms and types of precipitation, measurement of rain fall, optimum number of rain gauge stations, computation of mean rainfall, Estimation of missing data, Presentation of rainfall data.</td></tr>
<tr><td>Module 2</td><td colspan="3">Losses from Precipitation</td><td>Assignment</td><td colspan="3">Data Collection/ Analysis</td><td colspan="2">9 Sessions</td></tr>
<tr><td colspan="11">Topics:
Initial Losses, Evaporation, Evapo-transpiration, Infiltration: Introduction, Process, factors affecting, measurement.</td></tr>
<tr><td>Module 3</td><td colspan="3">Runoff and Hydrograph</td><td>Assignment</td><td colspan="3">Simulation/Data Collection</td><td colspan="2">12 Sessions</td></tr>
<tr><td colspan="11">Topics:
Runoff: Components of Runoff, Hydrograph, Influence of Catchment characteristics on Runoff
Hydrographs: Definition, components of hydrograph, base flow separation, unit hydrograph, Conversion of UH of different durations.
Flood: Concepts of Design Flood, Design Storm, Risk, Reliability and Safety, Introduction to Reservoir and Channel Routing Procedures, Concept of Flood Peak Attenuation</td></tr>
<tr><td>Module 4</td><td colspan="3">Irrigation</td><td>Case Study</td><td colspan="3">Data Collection/Analysis</td><td colspan="2">9 Sessions</td></tr>
<tr><td colspan="11">Topics:</td></tr>
</table>

Irrigation: Necessity of Irrigation, Types of Irrigation Systems, Methods of Irrigation, Water Requirements of Crops, Canal Irrigation, Water Logging and its Control	
Targeted Application & Tools that can be used: Application Area is Water Resource engineering, Irrigation Expert/Hydrological Modeling Specialist, Environmental Scientists. Professionally Used Software: QGIS/SWAT/MODFLOW	
Text Book T1. K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishers, New Delhi. T2. Garg S.K., Hydrology and Water Resources Engineering T3. Jayarami Reddy, "A Text Book of Hydrology", Lakshmi Publications, New Delhi.	
References R1. VenTe Chow, "Applied Hydrology", Tata McGraw Hill Publishers, New Delhi. R2. Garg S.K, "Irrigation Engineering and Hydraulic Structures" Khanna publications, New Delhi. R3. Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi. Web link: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=3103324&site=ehost-live	
Topics relevant to "SKILL DEVELOPMENT": Concepts of Design Flood, Design Storm, Risk, Reliability and Safety for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Mohammad Shahid G and Mr. Bhavan Kumar
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV2506	Course Title: Analysis of Determinate Structures Type of Course: Program Core & Theory only		L-T-P- C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	Strength of Materials - CIV 2500 Basic concepts of stresses, conditions of equilibrium and types of loads such as point load, UDL & UVL and supports. The basic properties of the materials, internal forces for various loads.					
Anti-requisites	NIL					
Course Description	The course illustrates the effect of external load in calculating the internal forces induced in the structures. The course deals with application of mathematical and engineering knowledge in calculating the slope and deflection which are required to analyze the determinate structures.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Analysis of Determinate Structures and attain Skill Development through Problem Solving methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Identify the static and kinematic indeterminacies of structures and analyze the plane trusses. 2. Analyze the arches and cables to determine the internal forces. 3. Apply the compatibility equation by knowing slope and deflection in analyzing the indeterminate structure by using the consistent deformation method. 4. Calculate the slope and deflection in beam elements by using moment area method and conjugate beam method.					
Course Content:						
Module 1	Introduction to Structural analysis and Analysis of Plane trusses	Assignment	Numerical problems and validating the results by using STAAD Pro	8 Sessions		
Topics: Structural forms, Conditional of equilibrium, Static degree of Indeterminacy, Static and Kinematic degree of indeterminacies of structural systems, linear and Nonlinear analysis, Types of trusses- Assumptions in analysis- Analysis of determinate trusses by method of joints and method of sections.						
Module 2	Arches and Cables	Assignment	Numerical problems	12 Sessions		
Topics: Arches: Three hinged parabolic arches with supports at same and different levels, Determination of normal thrust, radial shear and bending moment. Three hinged symmetrical circular arch and determination of bending moment Cable: Analysis of cables under point loads and UDL, Length of cables for supports at same and at different levels.						
Module 3	Consistent Deformation Method	Assignment	Numerical problems	06 Sessions		
Topics: Introduction to Slope and Deflection, Use of slopes and deflections in formulating the compatibility equations in analysing the Propped cantilever beam and fixed beam, Constructing the BMD and SFD when the structural elements are subjected to point load, UDL and UVL. Assignment: Construct the BMD and SFD for the given continuous beam						
Module 4	Deflection of beams	Assignment	Numerical problems and validating the	10 Sessions		

			results by using STAAD Pro	

Topics:
Introduction to slope and deflection, Moment area method, Mohr's Theorems, sign convention, slope and deflection by moment area method for simply supported and cantilever beams for standard load cases.
Introduction to Conjugate beam, slope and deflection by conjugate beam method for simply supported and cantilever beams for standard load cases.

Targeted Application & Tools that can be used:
The Couse enables the students to draw the Shear force and Bending moment diagram and determine the shear and bending stress distribution at a cross section in a beam. Identify the type of the structures and enhance their skill in determining the internal forces in the structural systems which are required in designing the structural element. The course also helps in understanding the behavior of the structural elements by knowing the slope and deflection of determinate beams.
Professionally Used Software: STAAD.Pro/ETABS.

Text Books:

1. Reddy C. S. "Basic Structural Analysis", Tata McGraw-Hill, Publishing Company Ltd.

References

1. Devadoss Menon, "*Structural Analysis*", Narosa Publishing House, New Dehli.
2. M.L. Gambhir, "*Fundamentals of Structural Mechanics and Analysis*", Eastern Economy Edition, PHI publishing Pvt. Ltd., 2nd printing, 2014.
3. Web link: https://nptel.ac.in/courses/105/105/105105166/

PU e-Library Resources

1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1227287&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=346589&site=ehost-live

Topics related to Skill development: Analysis of trusses by method of joints and method of sections, Analysis of arches and cables with supports at same and different levels, Analysis of determinate beams to find slope and deflection for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. S. B. Anadinni Mr. Ajay H A
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2507	Course Title: Analysis of Indeterminate Structures Type of Course: Program Core & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2500 Strength of Materials. CIV2506 Analysis of determinate structures. Basic concept in determinate structures and its structural behavior when they are subjected to various loads					
Anti-requisites	NIL					
Course Description	The course is conceptual in nature and demonstrates the behavior of the structural elements when they are subjected to various loads. This course helps to apply the mathematical and engineering knowledge in calculating the internal forces such as bending moment and shear force in the structural elements which may help in constructing the BMD and SFD. The internal forces can be validated by STAAD pro and ETABS software.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analysis of Indeterminate Structures and attain Skill Development through Problem Solving methodologies					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Apply the slope deflection equation to determine the slope and deflection in analyzing the indeterminate structure. 2. Calculate the internal forces such as bending moment and shear force by using slope deflection, moment distribution and kani's method. 3. Analyze the beam element by flexibility and stiffness matrix method.					
Course Content:						

Module 1	Slope and deflection method	Assignment	Numerical problems and validating the results by using STAAD Pro./ ETABS	08 Sessions
Introduction, Derivation of slope deflection equation, Analysis of continuous beams including settlement with different cross sectional area. Analysis of orthogonal rigid portal frame including sway with kinematic indeterminacy is ≤ 3. Construction of BMD & SFD for both the cases. Assignment: Determine the Final end moments for the given beam and frame using Slope deflection method				
Module 2	Moment Distribution method	Assignment	Numerical problems and validating the results by using STAAD Pro./ ETABS	08 Sessions
Introduction, Definition of basics terms (Absolute stiffness & relative Stiffness), Distribution factor. Analysis of continuous beams including settlement with different cross sectional area. Analysis of orthogonal rigid portal frame without sway with kinematic indeterminacy is ≤ 3. Construction of BMD & SFD for both the cases. Assignment: Determine the Final end moments for the given continuous beam and rigid portal frame using Moment Distribution method.				
Module 3	Kani's Method	Assignment	Numerical problems and validating the results by using STAAD Pro./ETABS	07 Sessions
Topics: Introduction, rotation factor. Analysis of continuous beams including settlement with different cross sectional area. Analysis of orthogonal rigid portal frame without sway with kinematic indeterminacy is ≤ 3. Construction of BMD & SFD for both the cases. Assignment: For a given continuous beam and rigid portal frame, determine the Final end moments using Kani's Method and draw SFD and BMD for the same.				
Module 4	Matrix Method	Assignment	Numerical problems	06 Sessions

Topics: Introduction Flexibility and Stiffness Matrix methods, Analysis of continuous beam by Flexibility and Stiffness matrix method with kinematic indeterminacy is ≤ 2. Construction of BMD & SFD for both the cases. Assignment: Using the Stiffness method or Flexibility method, analyze the continuous beam.	
Targeted Application & Tools that can be used: The Course enables the students to enhance their skill in understanding the structural behavior which helps in designing the RC structural elements. The course also helps in structural steel detailing by knowing the nature of bending moment. The concept of the course can be used in designing the Pre-stressed and Steel structural elements. Professionally Used Software: STAAD pro/ ETAB.	
Text Books: T1. Reddy C. S. "Basic Structural Analysis", Tata McGraw-Hill, Publishing Company Ltd.	
References: R1. V. N. Vazarani and M. M. Ratvani, "Analysis of Structures", Vil 2, Khanna Publishers. R2. Gupta S. P., G. S. Pandit and R Gupta, "Theory of Structures", Vol. II, Tata McGraw-Hill, Publishing Company Ltd. R3. Wang C. K., Indeterminate Structural Analysis", Tata McGraw-Hill, Publishing Company Ltd. Weblink: https://nptel.ac.in/courses/105/105/105105109/ https://nptel.ac.in/content/storage2/courses/105105109/pdf/m2l8.pdf E-BOOKS: Structural Analysis https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1227287&site=ehost-live	
Topics relevant to "SKILL DEVELOPMENT": Analysis of continuous beams including settlement with different cross sectional area using Slope Deflection method, Moment Distribution method and Kani's method for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Dr. S. B. Anadinni / Mrs. Divya. Nair
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3XXX	**Course Title:** **Design of RC Structural Elements** **Type of Course:** **Professional Core** **Theory Only Course**	**L-T-P-C**	3	1	0	4
Version No.	1.1					
Course Pre-requisites	CIV3002, CIV 2014					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to enable the students to appreciate the need for Analysis and Design of RCC Structural Elements and to develop the basic abilities of Structural Analysis and Design of RCC sections subjected to Flexure, Shear, Torsion and Bond. In addition, students will be introduced to the design principles of prestressed concrete elements. Students will learn to estimate stresses in concrete, losses in prestress, deflection and analysis of members subjected to flexure and shear. The course is both conceptual and analytical in nature and needs fair knowledge of Strength of Materials and Basic knowledge of Structural Analysis. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Design of RC Structural Elements** and attain **Skill Development** through **Problem Solving** methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply the principles, procedures and current code requirements to the analysis and design of reinforced concrete elements. 2. Solve engineering problems of reinforced concrete elements subjected to flexure and shear. 3. Demonstrate the procedural knowledge in designs of RC structural elements such as slabs and columns					
Course Content:						
Module 1	Introduction to Limit State Method and Design of RC Beams	Assignment	Programming Task, Data Analysis Task		**12 Sessions**	
Topics: Introduction to Reinforced Concrete Structures, Materials for Reinforced Concrete and Code requirements. Philosophy and principle of limit state design along with the assumptions, Introduction to stress block parameters, Concept of balanced, under and over reinforced sections. DESIGN OF BEAMS Analysis and design of singly reinforced beams, Analysis and Design of doubly reinforced beams, Design of Flanged Beams (T-Section).						
Module 2	Design of RC Sections for Shear, Torsion and Bond	Assignment	Programming Task		**6 Sessions**	

Topics:
Shear stresses in homogeneous rectangular beams, behavior of reinforced concrete under shear, Nominal shear stress, critical sections for shear design, Design shear strength with shear reinforcement with example. Primary and secondary torsion, general behavior in torsion. Concept of bond, Code requirements for bond, anchorage length and lap length.

Module 3	Design of Slabs	Assignment	Design Numerical from E-resources	**8 Sessions**

Topics: Introduction to one way and two –way slab, Design of simply supported one-way and two-way slab with simple support.

Module 4	Design of Column	Assignment	Design Numerical from E-resources	**12 Sessions**

Topics:
Estimation of effective length of a column, code requirements on slenderness limit, minimum eccentricities and reinforcement. Design of short axially loaded columns, Design of column subjected to combined axial load and uniaxial moment.
Types of footings, soil pressure under isolated footings, General design considerations and code requirements. Design of isolated footing for axial load and uniaxial moment.

Targeted Application & Tools that can be used:
Application Area is Infrastructure developing companies, Design and Construction Companies, Structural Consultancy Servicing Firms, Central and State Public Works Department.
Professionally Used Software: Excel, MATLAB, SAP 2000, STAAD Pro-RCDC, ETABS, ProConcrete, PRE-Stress, RAM Concept and Auto CAD Software.

Text Book

T1. Unnikrishnan Pillai and Devdas Menon, "*Design of Reinforced Concrete Structures",* Tata McGraw Hill Publications.

T2. Verghese P C, "*Limit State Design of Reinforced Concrete*", Prentice Hall of India, New Delhi

References

R1. BC Punmia, "*Limit State Design of Reinforced Concrete*", Prentice Hall of India, New Delhi

R2. Park and Paulay, "*Reinforced Concrete*", John Wiley and Sons.

R3. N. Krishnaraju*, "Reinforced Concrete Design: Principles and Practice",* New Age International.

Web Resources:

1. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=235546&site=ehost-live
2. https://nptel.ac.in/courses/105/105/105105105/
3. https://nptel.ac.in/courses/105/106/105106118/

Topics relevant to "Skill Development": Philosophy and principle of limit state design of RC sections, Analysis and Design of RCC rectangular and Flanged beams, Analysis and Design of RCC sections subjected Shear, Torsion and Bond for **Skill Development through Problem Solving methodologies**

Catalogue prepared by	Mr. Dayalan J Dr. Nakul Ramanna Mr. Ramachandra Gollar
Recommended by the Board of Studies on	BOS Meeting No: 20, Dated: _____
Date of Approval by the Academic Council	Academic Council Meeting No: _____, dated on _____

Course Code: CIV2509	Course Title: Analysis and Design of Pre-Stressed Concrete Elements Type of Course: Program Core Theory Only Course	L-T-P- C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	CIV2508 - Design of RCC Structural Elements					
Anti-requisites	NIL					
Course Description	The main objective of this course is to provide civil engineering students with the knowledge of pre-stressed concrete structures. This course is an introduction to design of pre-stressed concrete structures. It deals with the characteristics of high strength concrete and steel, basic principles of pre-stressing, pre-tensioning and post-tensioning system, analysis of section for flexure, stresses in concrete due to self-weight, normal force and bending, losses of pre-stress, deflection of pre-stressed structures, losses in pre-tensioning and post-tensioning members and design of pre-stressed concrete structures using limit state of collapse.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Pre-Stressed Concrete Design and attain Skill Development through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Summarize the pre-stressing systems and analytical procedure involved in determining stresses and cracking moments 2] Predict losses and deflections in prestressed concrete members 3] Illustrate design principles of prestressed concrete sections under flexure and shear					
Course Content:						
Module 1	Introduction, Pre-stressing systems, Analysis of PSC Beams	Assignment	Data Analysis Task	16 Sessions		
Topics: Basic concepts of pre stressing, historical development need for high strength of steel and concrete, terminology, advantages and applications. High strength concrete and high tensile steel Tensioning device, post tensioning systems, thermo electric pre stressing, chemical pre stressing. Basic assumptions, analysis of pre-stress, resultant stresses at a section, pressure line or thrust line. Concept of load balancing, stresses in tendons, cracking moments.						
Module 2	Losses of pre-stress and Deflection	Assignment	Numerical from E-resources	14 Sessions		
Topics: Nature of losses of pre stress, losses due to elastic deformation, loss due to shrinkage, creep, relaxation of stresses in steel, friction, anchorage slips, and total losses allowed for design, Factors influencing the deflections, Importance of control of deflection. Short-term and long-term deflections.						
Module 3	Flexural and shear strength of pre-stressed concrete members	Assignment	Numerical from E-resources	10 Sessions		
Topics: Types of flexural failure, strain compatibility, code procedures, Full and partial pre-stressed sections. Principal stresses, design of section for Flexure, ultimate shear resistances, design of shear reinforcements						

Targeted Application & Tools that can be used:

Application Area is Infrastructure developing companies, Design and Construction Companies, Structural Consultancy Servicing Firms, Central and State Public Works Department.

Professionally Used Software: Excel, MATLAB, SAP 2000, STAAD Pro-RCDC, ETABS, ProConcrete, PRE-Stress, RAM Concept and Auto CAD Software.

Text Book

T1. N.Krishna Raju, "Prestressed concrete", 6th Edition, Tata McGraw Publishers.

References

R1. T.Y.Lin and Ned H. Burns, "*Design of Pre-stressed concrete structures*", John Wiley and sons, New York.

R2. K.U. Muthu, Ibrahim Azmi, Janardhana Maganti and Vijayanand M, "*Prestressed Concrete*", 2016, Prentice Hall India Learning.

Web Resourcess:

4. https://nptel.ac.in/courses/105/106/105106118/

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=NAP_1_4412

Topics relevant to "SKILL DEVELOPMENT": Analysis of losses of pre-stressing force in Pre-stressed concrete beams, Determination Short term and Long term deflections in Pre stressed concrete beams, Analysis and Design of Pre stressed concrete subjected to Flexure and shear for Skill Development through Problem Solving methodologies.

Catalogue prepared by	Ms. Anju Mathew
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2510	Course Title: Design of Structural Steel Elements Type of Course: Program Core & Theory only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	CIV2007, CIV2013, CIV3002, CIV3003					
Anti-requisites	NIL					
Course Description	The objective of the course is to develop the knowledge in design of the various structural steel elements using limit state method conforming to codal provision. The design methodology is based on the latest Indian Standard Code of Practice for general construction (IS 800:2007). The course covers all the necessary components such as material specifications, connections and elementary design of structural members for designing steel structures. The behavior and design of tension members, compression members will be discussed. Design of compression members, built-up compression members along with the batten and lacing systems will also be explained. It comprises of design of various types of column bases, which transfers different kind of loads from super structures to underneath soil. The design of beam-to-beam, beam to column connections using bolted and welded connections shall be covered.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Design of Structural Steel Elements and attain Skill Development through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Recognize the design philosophy of steel structures and concept of limit state design 2. Identify the different failure modes of bolted and welded connections, and determine their design strengths. 3. Apply the design principles in design of tension and compression members according to specific design criteria.					
Course Content:						
Module 1	Introduction to Steel Structures and Design of Connections	Assignment	Numerical problems	12 Sessions		
Topics: Advantages and Disadvantages of Steel Structures, Limit state method Limit State of Strength, Structural Stability, Serviceability Limit states, Failure Criteria of steel, Design Consideration, Loading and load combinations, IS code provisions, Specification and Section classification. Design of bolted and welded joints – Eccentric connections - Efficiency of joints.						
Module 2	Design of Tension members	Assignment	Numerical problems and validate by software	10 Sessions		
Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Factors affecting the strength of tension members, Design of Tension members and design concept of Lug angles and Splices						
Module 3	Design of Compression Members	Assignment	Numerical problems and validate by software	10 Sessions		
Introduction, Failure modes, Behavior of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built-up Compression members, Introduction to design concept of Laced and Battened Systems. Types of column bases and column splice.						
Targeted Application & Tools that can be used: Application area is application of design of steel structures along with the connections in steel structures. Design of structural steel members subjected to tension, compression and flexure.						

Professionally Used Software: StaadPro/TEKLA	
Text Books: 1. S.K.Duggal, Limit state Design of steel Structures, 3rd Edition, McGraw Hill Education (India) Pvt. Ltd, 2019. 2. Subramanian .N, " *Steel Structures- Design and practice"*, Oxford University Press, New Delhi, 2011	
References 1 Dr.Ramachandra & Virendra Gehlot, "Limit State Design of Steel structures", – Scientific Publishers 2. S.S.Bhavikatti, Design of Steel Structures by Limit State Method, I.K. International publishing house. 3. Bureau of Indian Standards, IS 800-2007, IS 875-1987 SP- 6 (Part 1) or "Steel Tables" PU Web Resources: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=210034&site=ehost-live	
Topics relevant to "Skill Development" : Design of Tension and Compression Members for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Dayalan J/ Ms. Anju Mathew
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2511	Course Title: Construction Materials Testing Lab Type of Course: 1] Program Core 2] Laboratory only	L-T-P-C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	CIV2500 Strength of Materials, CIV2100 Building Materials and Concrete Technology					
Anti-requisites	NIL					
Course Description	The primary objective of this Course is to make the students gain knowledge about the mechanical properties of engineering materials. It is a practical oriented Course dealing with how to calculate the mechanical properties of materials such as tensile strength, compressive strength, flexural strength, shear strength, torsion, hardness, toughness and tests on fine and coarse aggregates as per relevant Indian Standard Codes.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Basic Material Testing Lab and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Compute the basic physical properties of aggregates required for mix design of concrete and design of pavements 2] Interpret the strength and quality of building materials subjected to various loading conditions					
Course Content:	Task 01: Test on Fine Aggregates: Sieve Analysis and Moisture Content Level No 01: To determine the fineness modulus and percentage moisture content of the given sample of fine aggregates Level No. 02: Plot the particle size distribution curve for a sample of soil and classify it. Task 02: Test on Fine Aggregate: Specific Gravity and Bulk Density Level No 01: To determine the specific gravity and bulk density of the given sample of fine aggregates Level No. 02: Collect fine aggregate samples from various sources (e.g. M Sand and River Sand) and compare the properties. Do a comparative study on the variation of bulk density based on change in the amount of compaction. Task 03: Test on Coarse Aggregate: Sieve Analysis and Water Absorption Level No 01: To determine the fineness modulus and percentage moisture content of the given sample of coarse aggregates Level No. 02: Plot the particle size distribution curve for a sample of soil and classify it. Task 04: Test on Coarse Aggregate: Specific Gravity and Bulk Density Level No 01: To determine the specific gravity and bulk density of the given sample of coarse aggregates Level No. 02: Collect coarse aggregate samples from various sources and compare the properties. Do a comparative study on the variation of bulk density based on change in the amount of compaction. Task 05: Aggregate Crushing and Impact Test Level No. 01: Calculate the crushing and impact value of a given sample of aggregates. Level No. 02: Discuss suitability of the aggregates accordingly for their use in pavement construction, concrete or otherwise. Try to explore a correlation					

	between crushing strength and impact strength of different samples of aggregates. Task 06: Shape test on Aggregates Level No. 01: Conduct shape test and estimate the percentage of flaky and elongated aggregates. Level No. 02: Discuss reasons for not using flaky and elongated aggregates in pavement construction. Further, compare workability of different concrete mixes with different flakiness and elongation indexed aggregates. Task 07: Tension Test Level No 01: To conduct tension test on given metal specimen and determine the following: Young's Modulus, Yield Stress, Ultimate Stress, Percentage elongation in length and Percentage reduction in cross-sectional area Level No. 02: Perform tension test on different materials and identifying the ductile or brittle nature of the material by interpreting the graph results. Task 08: Compression Test Level No 01: To calculate the ultimate compressive strength, percentage reduction in length and percentage increase in cross-sectional area of the given metal specimen. Level No. 02: Vary the dimensions and material of the test specimen and study the effect of buckling in slender members. Task 09: Flexure Test Level No 01: To determine the Modulus of elasticity in bending and Modulus of rupture of the given specimen. Level No. 02: Create different types of beams with different support conditions and loading, and study the variation in maximum bending moment. Task 10: Shear Test Level No 01: To conduct shear test on mild steel and calculate its ultimate single and double shear strength. Level No. 02: Varying the material and cross-sectional shape and dimension of the test specimen and study the variation in shear strength. Task 11: Torsion Test Level No 01: To calculate the modulus of rigidity of the given specimen. Level No. 02: Varying the material and cross-sectional shape and dimension of the test specimen and study the variation in modulus of rigidity. Task 12: Impact Test: Izod and Charpy Level No 01: To calculate the impact strength of the given specimen. Level No. 02: Study the effect of notch dimensions and shape on the impact strength of different materials Task 13: Hardness Test: Rockwell, Brinell and Vicker's Level No 01: To calculate the hardness numbers of the given specimen. Level No. 02: Establishing a co-relation between size of indentor, load applied and the Hardness Number obtained for different materials
Targeted Application & Tools that can be used: Strength of Material Testing Consultancy, Quality and Safety Inspection	
Text Book 1. "Basic Material Testing Lab Manual", Presidency University. 2. Relevant BIS Codes as mentioned in the Lab Manual	
References	

1. "Civil Engineering Materials: Introduction and Laboratory Testing" By Rashad Islam, 2020, CRC Press 2. "Concrete Technology" by MS Shetty E-Resources 1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2719552&site=ehost-live 2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2196240&site=ehost-live 3. https://sm-nitk.vlabs.ac.in/	
Topics relevant to "SKILL DEVELOPMENT": Tests on Fine and Coarse Aggregates, Tests on metals for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Anju Mathew/ Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2512	Course Title: Geotechnical Engineering Type of Course: Program Core Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CIV2500 Strength of Materials, CIV2503 Fluid Mechanics and Engineering Geology.					
Anti-requisites	Nil					
Course Description	Soil is considered by civil engineers as the complex engineering material. Geotechnical engineering is the study of the engineering properties, soil-water interactions and behavior of soils under various loads. This knowledge significantly influences the ability to design the foundations, pavement, underground and earth retaining structures, earth dams, embankments and landfills.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Geotechnical Engineering and attain Skill Development through Problem Solving methodologies					
Course Outcomes	On successful completion of this course the students shall be able to: • Describe soil formation, index properties of soil, clay mineralogy and soil classification. • Discuss the permeability, seepage and effective stress concepts. • Solve the problems on shear strength, compaction and consolidation parameters.					
Course Content:						
Module 1	Introduction to geotechnical engineering and basic properties of soil.	Assignment	Numerical	11 Sessions		
Topics: Definition, civil engineering problems related to soil, origin and formation of soil, regional soil deposits in India, phase diagram, volumetric relationships, water content, densities, unit weights, specific gravity and their inter-relationships, numerical. Index properties of soil and their determination - water content, in-situ density, specific gravity, particle size distribution, relative density, consistency limits; soil structure and clay minerals; soil classification, numerical.						
Module 2	Permeability, Effective Stresses and shear strength of soil	Assignment	Numerical	13 Sessions		
Topics: Flow through Soils: Darcy's law - assumption and validity, coefficient of permeability and its determination, factors affecting permeability, Seepage velocity, discharge velocity and coefficient of percolation, permeability of stratified soils, Effective Stress: Total stress, effective stress and Pore-water pressure, numerical, Shear strength- Concept of shear strength, Mohr circle of stresses, Mohr-Coulomb failure criterion, measurement of shear strength parameters.						
Module 3	Compaction and Consolidation of soil	Assignment	Data collection/ Excel	9 Sessions		
Topics: Compaction: Definition, Standard and Modified proctor's compaction tests, factors affecting compaction, numerical. Consolidation: Definition, mass-spring analogy, Terzaghi's one dimensional consolidation theory - assumption and limitations, normally consolidated, under consolidated and over consolidated soils, consolidation characteristics of soil (C_c, a_v, m_v and c_v) and numerical. Assignment: Determination of maximum dry density and optimum moisture content using excel						
Text Books						

T1. Gopal Ranjan and Rao, "*Basic and applied soil Mechanics"*, New Age International (P) Ltd., New Delhi. T2. "Soil Mechanics Lab Manual", Presidency University.
References R1. V. N. S. Murthy, "Geotechnical Engineering", CBS Publishers and Distributors. R2. K.R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers New Delhi. R3. Craig, R. F, "Soil Mechanics", English Language Book Society and V N Reinhold Co. Ltd., London. R4: Bureau of Indian Standards, "Indian Standard, Methods of test for soils, IS 2720: Part 1 to 41" Website: https://nptel.ac.in/courses/105103097 Notes/PPT: https://nptel.ac.in/courses/105103097 E Resources Presidency University: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1717698&site=ehost-live&ebv=EB&ppid=pp_1
Topics relevant to "SKILL DEVELOPMENT": Index properties of soil, Soil classification, Determination of shear strength, compaction characteristics, permeability of soil and consolidation parameters of soil for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2513	Course Title: Geotechnical Engineering Laboratory Type of Course: 1] Program Core 2] Laboratory only	L-T-P-C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	Students should have studied geotechnical engineering course to perform the laboratory experiments.					
Anti-requisites	NIL					
Course Description	This Course is aimed to perform common soil mechanics tests in order to better understand soils behaviour. The Course includes experiments on moisture content, Specific gravity, liquid and plastic limit, and analysis of grain size distribution including both sieve analysis and hydrometer, field density tests, hydraulic conductivity test including both constant and falling head tests, one dimensional consolidation test, direct shear test, unconfined compressive strength and UU triaxial test. The Course develops an ability to design and conduct experiments, as well as to analyze and interpret data.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Geotechnical Engineering Laboratory and attain Skill Development through Experiential Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Outline the physical and index properties of the soil. 2) Compute the coefficient of permeability and compaction parameters of soil 3) Compute shear strength parameters by direct shear test, unconfined compression test and triaxial shear test. 4) Compute the coefficient of consolidation.					

Course Content:	Task 01: Water content determination by oven drying method Task 02: Specific gravity test using pycnometer and density bottle method on the graph. Task 03: Grain size analysis. Level 01- Sieve analysis. Level 02- Hydrometer analysis (only demonstration). Task 04: In-situ density tests Level 01- Core-cutter method Level 02- Sand replacement method. Task 05: Consistency limits Level 01- Liquid limit test and Plastic limit test Level 02- Shrinkage limit test Task 06: Standard proctor compaction test Task 07: Co-efficient of permeability test Level 01- Constant head permeability test (only demonstration Level 02- Variable head permeability test Task 08: Shear strength tests Level 01-Unconfined compression test and Direct shear test Level 02- Triaxial shear test (unconsolidated undrained) Task 09: Consolidation test: Determination of compression index and coefficient of consolidation
Targeted Application & Tools that can be used: soil testing tasks and result interpretation could help students in future consulting work and even research. Professionally Used Software: Plaxis 2D and 3D, MATLAB/Python	
Text Book 1. "Soil Mechanics Laboratory Manual", Presidency University. 2. Lambe T.W., "Soil Testing for Engineers", Wiley Eastern Ltd., New Delhi.	
References 1. R1 Gopal Ranjan and Rao A.S.R. (2000), " Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi. E-Resources 1. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2878905&site=ehost-live&ebv=EB&ppid=pp_C-1 https://sm-nitk.vlabs.ac.in/	
Topics relevant to "SKILL DEVELOPMENT": Consolidation test: Determination of compression index and coefficient of consolidation, In-situ density tests for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Mr. Jagdish B Biradar
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022

Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: **CIV2514**	**Course Title: CIV2514 Foundation Engineering** **Type of Course: Professional Core Theory only**	**L-T-P-C**	3	0	0	3
Version No.	1.1					
Course Pre-requisites	**CIV2512 Geotechnical engineering**					
Anti-requisites	**NIL**					
Course Description	The course applies and extends the fundamental understanding of geotechnical engineering for analysis of stress distribution in soil, slope stability, earth pressures theories, stability analysis of retaining walls, design of shallow and pile foundations, bearing capacities of shallow and deep foundations.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Foundation Engineering** and attain **Skill Development** through **Problem Solving** methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Compute the factor of safety for slope stability and the stress distribution in soils. 2) Compute the lateral earth pressure of soil. 3) Choose the suitable retaining wall based on lateral earth pressure and stability. 4) Compute the load carrying capacity of shallow foundation and pile foundation. 5) Interpret the soil investigation report.					
Course Content:						
Module 1	**Stability Analysis of Slopes and Stress Distribution in soil**	Assignment	Plaxis software 2D/3D	8 Sessions		
Topics: Stability Analysis of Slopes: Infinite and Finite slopes, Types of failure of finite slopes, types of factor of safety, Taylor's stability number and numerical. Stress Distribution in soil: Stress due to self-weight, Boussinesq's Theory for Concentrated Load and Uniformly distributed Load, Wetergaard's Theory and numerical. Assignment: Stability analysis of slope with Plaxis software 2D/3D						
Module 2	**Lateral Earth pressure estimation for the construction of retaining wall**	Assignment	Collection of data	10 Sessions		
Topics: Lateral Earth pressure: Introduction, types of earth pressure (At rest, active, passive), Rankine's earth pressure theory: Active earth pressure; Passive Earth pressure for horizontal & inclined backfill for cohesive & Cohesion less soils, Coulomb's Wedge Theory: Active earth pressure; Passive Earth pressure conditions and numerical. Assignment: Collection of data of soil from a project site and lateral earth pressure determination.						
Module 3	**Shallow, pile foundations and Subsoil Investigation**	Assignment	Plaxis 2D Software	12 Sessions		
Topics: Shallow foundations: Safe bearing capacity and allowable bearing pressure, Terzaghi's bearing capacity, Types of shear failures. Effect of Water table on Bearing Capacity, Bearing capacity						

from field plate load tests, Standard Penetration Test and numerical. Pile Foundations: Classification, load carrying capacity of single pile – Dynamic Formula, Static formula, Load carrying capacity of pile groups, settlement of pile groups, Negative skin friction, numerical. Subsoil Investigation: Importance of exploration program, Methods of exploration: Boring, Types of samples -undisturbed, disturbed and representative samples, Samplers, sample disturbance, area ratio, Recovery ratio, clearance, Typical bore log. Number and soil exploration report.

Assignment: Foundation in over consolidated clay using Plaxis 2D software

Targeted Application & Tools that can be used:
The application of the principles are made in both the design and construction areas. Topics used to illustrate these aspects include site investigation techniques and new foundation design and construction. This field of engineering not only establishes the physical qualities and quantities needed for the construction of foundations but establishes the necessary design parameters needed for such construction. Such parameters are established by evaluating factors such as the bearing capacity of a particular soil, allowable soil pressure, and the influence of slopes and adjacent foundations.
Professionally Used Software: Plaxis 2D and 3D

Text Book:
V. N. S. Murthy, "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors.

References:
Das, B. M. "Principles of Foundation Engineering", Thomson India Edition, New Delhi.
J.E. Bowles, "Foundation Analysis and Design", McGrawHill Pub. Co. New York.
Craig, R. F. (1983), "Soil Mechanics", English Language Book Society and Van Nostrand Reinhold Co. Ltd., London.
IS Code: IS 1904 -1986: "General Requirements for Design and Construction of Founda
Website: https://nptel.ac.in/courses/105/105/105105176/
E-book: https://www.usb.ac.ir/FileStaff/5495_2020-1-25-11-9-53.pdf
Notes/PPT: https://nptel.ac.in/courses/105/105/105105176/
E Resources Presidency University:
https://web.s.ebscohost.com/ehost/resultsadvanced?vid=2&sid=5c2a6e67-f72e-4930-a9aa-2967a5662539%40redis&bquery=soil+mechanics+and+foundation+engineering&bdata=JmRiPWlpaCZ0eXBlPTEmc2VhcmNoTW9kZT1TdGFuZGFyZCZzaXRlPWVob3N0LWxpdmU%3d

Topics relevant to "Skill Development": Shallow and Deep Foundation design; Stability analysis of slopes for **Skill Development** through **Problem Solving methodologies**. **This is attained through assessment component mentioned in course handout.**

Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BOS Meeting No:
Date of Approval by the Academic Council	Academic Council Meeting No:

<table>
<tr><td>Course Code:
CIV2501</td><td colspan="4">Course Title: Transportation Engineering
Type of Course: Program Core & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">1] CIV2101 Surveying 2]Basic Mathematical abilities

3]Construction materials</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">The course helps in understanding the importance and characteristics of various modes of transportation such as road, rail and air.

The course spans from the history of highway development, classification of roads to the study about the geometric design of highways. Further, traffic characteristics and controls are also discussed. Pavement materials and their testing is introduced to the students. In addition, concepts of railway engineering cover components of railway tracks, elementary geometric design and signaling systems. Airport Engineering consists of aircraft characteristics, runways and terminal area planning.

The course is both conceptual and analytical in nature and needs fair knowledge of Surveying and mathematics.

The course detailing about Highway materials, Highway Geometric Design and it develops the critical thinking and analytical skills.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Transportation Engineering and attain Skill Development through Problem Solving methodologies.</td></tr>
<tr><td>Course Out Comes</td><td colspan="9">On successful completion of the course the students shall be able to:
• Recognize the importance of transportation, surveys involved in highway planning and the characterization of materials used in highway construction
• Compute highway geometric parameters
• Discuss the elements of airport planning and railway engineering.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to Transportation Engineering and Highway Materials</td><td>Assignment</td><td colspan="2">Numerical</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Importance of various modes of transportation, highway engineering, developments in Road Construction, characteristics of road transport, scope of highway and traffic engineering. Highway development and planning: Importance, classification of roads, road patterns, planning surveys; highway alignment and surveys. Maximum utility value.
Specification and tests on pavement materials, Marshall Mix Design</td></tr>
<tr><td>Module 2</td><td colspan="3">Highway Geometric Design</td><td>Case Study</td><td colspan="2">Data Collection</td><td colspan="2">15 Sessions</td></tr>
<tr><td colspan="10">Topics:
Cross section of rural, urban roads and highways. Cross section elements, sight distance, extra widening on horizontal curves, Setback distance on horizontal curves and design of horizontal and vertical alignment, summit curve and valley curve.</td></tr>
<tr><td>Module 3</td><td colspan="3">Railway Engineering and Airport Planning</td><td>Assignment</td><td colspan="2">Data Collection</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Location survey and alignment, permanent way, gauges, components, sleeper density, functions and requirements, signals, points and crossings
Aircraft characteristics, airport obstructions and zoning, runway, taxiways and aprons, terminal area planning.</td></tr>
</table>

Targeted Application & Tools that can be used:

Application areas include employment in Public Sector Undertakings such as the National Highways Authority of India (NHAI), Airports Authority of India (AAI) and Indian Railways. Rapid globalization with increase in mobility provides ample opportunities for employment in leading firms such as Tesla, Uber and Alstom.

Professionally used software: MATLAB/Python/Auto CAD

Text Books

1. Khanna, S.K and Justo, C.E.G., "*Highway Engineering*", Nem Chand and Bros. Roorkee (U.P), 1998.
2. Kadiyali L R, "*Traffic* Engineering *and Transport Planning*", Khanna Publishers, 2017.
3. M.M. Agarwal, "*Railway Engineering*", Prabha & Co. , 2007.
4. Khanna, S.K. and Arora, M.G. "*Airport Planning and Design"*, Nemchand and Bros. 1999.
5. Oza and Oza, "*Elements of Dock and Harbour Engineering"*, Charotar Publishing House, 1996.

References

1. Jothi Kristey and Lal, "*Introduction to Transportation Engineering"*, PHI, New Delhi, 2002.

Web Link:

W1: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2665206&site=ehost-live&ebv=EB&ppid=pp_Cover

W2: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1468148&site=ehost-live&ebv=EB&ppid=pp_Cover

Topics relevant to "Skill Development" : Tests on pavement materials, Sight Distance Calculations, Design of Horizontal and Vertical Alignment for Skill Development through Problem solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2515	Course Title: Water Infrastructure Systems Type of Course: Program Core & Theory only		L-T-P-C	3	0	0	3
Version No.	1.1						
Course Pre-requisites	CIV2503 Fluid Mechanics - Properties of fluids, Flow through pipes.						
Anti-requisites	NIL						
Course Description	The purpose of this course is to illustrate the need for water treatment and distribution systems and to develop the basic abilities of analyzing the quality of water. The course is both conceptual and analytical in nature and needs fair knowledge of chemistry and mathematics. The course develops the critical thinking and analytical skills.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Water Infrastructure Systems and attain Skill Development through Problem Solving methodologies.						
Course Outcomes	On successful completion of this course the students shall be able to: 1) Interpret the relevant treatment units/process for surface and subsurface water 2) Relate the process/principles in sizing and locating the treatment units 3) Analyze the comprehensive water distribution system for a locality						
Course Content:							
Module 1	Water demand and Water quality	Assignment	Data collection and analysis	09 Sessions			
Topics: Demand of Water: Types of water demands - Factors affecting per capita demand, Variations in demand of water, Peak factor, Design period and factors governing design period. Different methods of population forecasting. Surface and subsurface sources – Factors to be considered for selecting particular source of water. Water quality characteristics: Physical, chemical and biological characteristics of water, Drinking water standards –BIS & WHO							
Module 2	Water treatment	Assignment	Java program for water quality analysis	16 Sessions			
Topics: Water Treatment: Objectives of water Treatment, Treatment flow chart. Sedimentation, Sedimentation aided with Coagulation, optimum dosage of coagulant, design of clariflocculator. Filtration: mechanism -theory of filtration, types of filters, slow sand, rapid sand and pressure filters. Design of slow and rapid sand filter. Disinfection: types of disinfection, break point chlorination, chlorine demand, residual chlorine. Aeration and its types, Water Softening: methods for removal of hardness.							
Module 3	Collection, Conveyance and water distribution	Assignment	Case study	10 Sessions			
Topics: Advanced water treatment: Ion exchange, electro-dialysis, Reverse Osmosis, Ultra filtration. Fluoridation and de-fluoridation - Principles and design. Distribution system: Layout of distribution network, Methods of distribution and systems of supply.							
Targeted Application & Tools that can be used: Application Area is water sample collection and analysis, water treatment and distribution Professionally Used Software: Java, MS Excel and Auto cad							
Text Books 1. S.K. Garg, "Water Supply Engineering", Khanna Publishers. 2. B.C. Punmia, Ashok Jain & Arun Jain, "Water Supply Engineering, Vol. I", Laxmi Publications Pvt. Ltd, New Delhi.							
References 1. GS Birdie JS Birdie, "Water supply and Sanitary engineering", Dhanpat Rai Publishing Company (P) Ltd, New Delhi.							

2. "Manual on Water supply and Treatment", CPHEEO, 1999. Weblink: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1084472&site=ehost-live	
Topics relevant to "Skill Development": Design of water distribution system and Water quality analysis for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Bhavan Kumar, Mr. Santhosh M B, Dr. Jagdish Godihal
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code: CIV2516</td><td colspan="4">Course Title: Waste Water Treatment and Disposal Systems
Type of Course: Program core & Theory only</td><td>L-T-P-C</td><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Version No.</td><td colspan="9">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">CIV2503 Fluid Mechanics - Properties of fluids, Flow through pipes, CIV2515 Water infrastructure systems.</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">The purpose of this course is to illustrate the need for waste water treatment and disposal systems and to develop the basic abilities of analyzing the characteristics of waste water. The course is both conceptual and analytical in nature and needs fair knowledge of chemistry and mathematics. The course develops the critical thinking and analytical skills.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Waste Water Treatment and Disposal Systems and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of this course the students shall be able to:
4) Interpret the relevant treatment units/process for treatment of domestic sewage
5) Relate the process/principles in sizing and locating the sewage treatment plant
6) Analyze the appropriate disposal methods for sewage effluent/sludge</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td>Estimating the Sewage Discharge and Waste water characterization</td><td colspan="3">Waste water auditing and characterization</td><td colspan="2">Data collection and analysis</td><td colspan="2">13 Sessions</td></tr>
<tr><td colspan="10">Topics: Necessity for sanitation, estimating of dry weather flow and wet weather flow, factors affecting dry weather flow. Hydraulic design of sewers, sewer appurtenances. Waste water characteristics: sampling, physical, chemical and biological characteristics. Types of oxygen demand, Population equivalent and relative stability. Numericals on determination of quantity of wastwater for separate, combined and partially separate systems</td></tr>
<tr><td>Module 2</td><td>treatment of sewage</td><td colspan="3">Presentation</td><td colspan="2">Site visit and observation</td><td colspan="2">15 Sessions</td></tr>
<tr><td colspan="10">Topics: Flow diagram for municipal waste water treatment. Preliminary & Primary treatment: Theoretical principles and design: screens, grit chamber, skimming tank, Sedimentation tanks - Design criteria & Design examples. Secondary treatment: Trickling filter –operation and designs, Activated sludge process- operation and design.</td></tr>
<tr><td>Module 3</td><td>Disposing of Sewage Effluents</td><td colspan="3">Sewage effluents characterization</td><td colspan="2">Sample collection and analysis</td><td colspan="2">12 Sessions</td></tr>
<tr><td colspan="10">Topics: Digestion and disposal of primary and secondary sludge, Sludge digestion, Sludge digestion tanks. Disposal of sewage effluents, disposal standards, Disposal of Effluents by dilution – Disposal of waste water in rivers and self-purification of natural streams, oxygen sag curve, zones of purification. Disposal of Sewage from Isolated Buildings. Numericals on design of ViIP latrine, Pour flush latrine, Septic tank, Drain field and Soak pit.</td></tr>
<tr><td colspan="10">Targeted Application & Tools that can be used:
Application Area is Waste water sample collection and analysis , waste water characteristics, disposal of sewage effluents and waste water treatment
Professionally Used Software: Java, MS Excel and Auto cad</td></tr>
<tr><td colspan="10">Text Books</td></tr>
</table>

1 . S.K. Garg, "Sewage disposal and Air pollution engineering", Khanna Publishers	
References 1. Metcalf and Eddy, "Waste Water Engineering, Collection, Treatment and Disposal", Tata McGraw Hill, Inc., New York. 2. B.C.Punmia, Ashok Jain and Arun Jain, "Water Supply Engineering,", "Waste Water Engineering)," Laxmi Publications Pvt. Ltd, New Delhi. Web source: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1055556&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": Monitoring of waste water treatment process, Disposal standards for waste water for developing Employability Skills through Problem Solving methodologies.	
Catalogue prepared by	Mr. Bhavan Kumar, Mr Santhosh M B, Dr Jagdish Godihal
Recommended by the Board of Studies on	BOS Meeting No: 16, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

<table>
<tr><td>Course Code: CIV2517</td><td>Course Title: Environmental Engineering Lab

Type of Course: 1] Program Core
2] Laboratory only</td><td>L-T-P-C</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="6">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="6">CIV2515 Water infrastructure systems</td></tr>
<tr><td>Anti-requisites</td><td colspan="6">NIL</td></tr>
<tr><td>Course Description</td><td colspan="6">This course demonstrates analysis of water samples and experimental techniques, normally used in support of water and wastewater treatment facilities. This course emphasizes data acquisition and analysis, and engineering report writing. It is a practical oriented course provide an overview of physico-chemical properties of water and waste water. Based on the analytical results, source of contamination can be found and degree of treatment will be decided. This laboratory Course helps students to monitor the quality of surface, ground water and sewage water in terms of contaminants concentrations.</td></tr>
<tr><td>Course Objective</td><td colspan="6">The objective of the course is to familiarize the learners with the concepts of Environmental Engineering Lab and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="6">On successful completion of the course the students shall be able to:

1] Discuss the concepts of water quality parameters and their analytical tools.
2] Analyze the various quality characteristics of water and waste water.
3] Interpret the result in comparison with public health considerations.</td></tr>
<tr><td>Course Content:</td><td colspan="6">Mention the List of Laboratory tasks proposed to be conducted.

Task 01: Determination of pH of a given water sample

Task 02: Determination of Electrical conductivity of given water sample

Task 03: Determination of Total Dissolved solids of given water sample

Task 03: Determination of Turbidity of given water sample.

Task 04: Determination of acidity of given water sample.

Task 05: Determination of alkalinity of given water sample.

Task 06: Determination of total hardness of given water sample.

Task 07: Determination of Residual chlorine in given water sample.

Task 08: Determination of optimum dosage of coagulant using jar test

Task 09: Determination of total Solids in a given water sample.

Task 10: Determination of dissolved oxygen content in given water sample.

Task 11: Determination of BOD in a given water sample.

Task 12: Determination of COD in a given water sample.</td></tr>
<tr><td colspan="7">Targeted Application & Tools that can be used:
Application area is water sample collection and analysis, Water treatment and distribution.
SKILL DEVELOPMENT & EMPLOYABILITY: Analytical skill of water and waste water.</td></tr>
</table>

Professional Software: SPSS, Aquachem	
Text Books 1. Metcalf & Eddy, *Wastewater Engineering Treatment and Reuse (4th edition) (2004), mcgraw-hill publication, 1988.* Santhosh Kumar Garg, *Environmental Engineering (Vol. I) Water Supply Engineering, Khanna publishers. 1977.*	
References: 1. APHA Standard Methods for the Examination of Water and Wastewater, APHA, 2011 2. "Manual of water and wastewater analysis" NEERI Publication" Virtual lab Link: https://ee1-nitk.vlabs.ac.in/ https://ee2-nitk.vlabs.ac.in/ Web source: https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=12713786&site=ehost-live	
Topics relevant to "SKILL DEVELOPMENT Determination of Total Dissolved solids, dissolved oxygen content, BOD and COD of a given water sample for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Santhosh M.B., Dr. Venkatesha Raju K and Mr. Bhavankumar M
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: CIV2518	**Course Title:** Quantity Surveying, Cost Estimation and Asset Valuation **Type of Course:** Professional Core/ Theory Only		**L-T-P-C**	3	1	0	4
Version No.	1.1					
Course Pre-requisites	**Computer Aided Building Drawing Lab**					
Anti-requisites	**NIL**					
Course Description	This subject covers the various aspects of estimating quantities of items of works involved in buildings, water supply and sanitary works, road works and irrigation work. This also covers the rate analysis, valuation of properties and preparation of reports for estimation of various items.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Estimation, Costing and Valuation** and attain **Skill Development** through **Problem Solving** methodologies					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1) Describe the principles of estimation and units of measurement for various items of works 2) Compute the quantity of materials required for various civil engineering works with specification 3) Estimate the rate analysis for various building works 4) Estimate the valuation of various building works.					
Course Content:						
Module 1	**Introduction to estimation**	**Assignment**	**Collection of data/Excel**	**10 Sessions**		
Topics: General introduction to Quantity surveying/estimation – purpose/objectives of estimates, Different types of estimates, detailed estimate, approximate estimate, Units of measurement for various items of work, Principles of units of measurement for various items of works –earth work, cement/lime concrete in foundation, masonry work, Damp proof course, masonry work in superstructure walls, wood work, steel work, IS: 1200 – 1974- Parts 1 to 25, data sheets, contracts-types of contracts						
Module 2	**Method of building estimate**	**Assignment**	**Collection of data/Excel**	**25 Sessions**		
Topics: Methods of estimation -various items of work to be included in estimates-long wall short wall method and centreline method for various structures. Reinforcement bar bending and bar requirement schedules, Specifications – Types of specifications, General specification of various items of work, Detailed specification for various items of work. Reports, Report on estimates for the construction of various items						
Module 3	**Earthwork estimation and Rate Analysis**	**Assignment**	**Collection of data/Excel**	**12 Sessions**		
Topics: Road estimating, earthwork, mid sectional area method, Mean sectional area method, prismoidal formula method, Purpose of rate analysis, Analysis of rates for various building works, labour Estimation of Earthworks and Rate Analysis with Standard schedule of rates						

Module 4	**Valuation of buildings**	**Assignment**		**Collection of data/Excel**	**13 Sessions**

Topics:
Valuation introduction, Purpose of valuation, Gross Income, Net income, Outgoings, Municipal taxes, Scrap value, Salvage value, Market value, Book value, Obsolescence, Annuity, Capitalized value, Depreciation, Valuation of land and building.

Targeted Application & Tools that can be used:
Estimation of the material quantities, prepare a bill of quantities, make specifications and prepare tender documents. Student should also be able to prepare value estimates.
Professionally Used Software: Excel

Text Book:
1. B.N. Dutta, "*Estimating and Costing in Civil Engineering Theory and Practice*", UBS Publishers and Distributors Limited New Delhi.

References
1. M. Chakraborti, "*Estimating, Costing, Specification and Valuation on Civil Engineering*" National Halftone Co, Calcutta.
2. BIS: 1200 – 1974- Parts 1 to 25, "Methods of Measurement of Building and Civil Engineering Works", Bureau of Indian Standards, New DelhiWebsite:
https://nptel.ac.in/courses/105/108/105108075/
Notes/PPT: W1 https://nptel.ac.in/courses/105103093/14

E Resources Presidency University:

https://web.s.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMTEwODg0OF9fQU41?sid=48527c08-e2bb-4b6e-9e4f-2ce3f151760d@redis&vid=3&format=EK&ppid=Page-__-7

Topics relevant to "SKILL DEVELOPMENT": Preparing the bill of quantities for various items of buildings and valuation of buildings for **Skill Development** through **Problem Solving methodologies**. **This is attained through assessment component mentioned in course handout.**

Catalogue prepared by	**Dr. Madhavi T**
Recommended by the Board of Studies on	BOS Meeting No: 20, Dated: _____
Date of Approval by the Academic Council	Academic Council Meeting No: _____, dated on _____

<table>
<tr><td>Course Code:
CIV2519</td><td colspan="3">Course Title: Construction Project Management
Type of Course: Professional Core Theory</td><td>L-T-P- C</td><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Version No.</td><td colspan="8">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">[1] Construction Techniques and process [2] Probability and statistics

Basic Understanding of construction techniques and Process of different civil engineering projects, Basics of beta distribution and normal distribution of probability with their Mean, Standard deviation and variance.</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The purpose of this course is to deal with the need for management in civil engineering and to develop the basic understanding of project planning and scheduling along with quality and safety standards for any project. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics and skills of logical reasoning. The course develops critical thinking and basic skills required for a project manager. The course also enhances the analytical skills through assignments.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Construction Project Management and attain Skill Development through Problem Solving techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:
1) Describe the basic concepts of project development.
2) Prepare project plan, network and schedule for various projects.
3) Identify the risks in construction projects.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Basics of Construction Project</td><td>Assignment</td><td colspan="2">Data collection and Analysis</td><td colspan="3">8 Sessions</td></tr>
<tr><td colspan="9">Topics:
Introduction to Construction Project, Phases of a Construction Project, Stake holders of a Project, Structure of a Construction Organization, Traits of a Project Manager, Cost estimate: Client's and contractors perspective, Construction Contract: types of contracts, General Conditions of Contract, Special Conditions of Contract, Bill of Quantities, and Introduction to FIDIC Contracts.</td></tr>
<tr><td>Module 2</td><td colspan="2">Project Planning and Scheduling</td><td>Assignment</td><td colspan="2">Programming and Simulation</td><td colspan="3">16 Sessions</td></tr>
<tr><td colspan="9">Topics:
Work breakdown structure, Planning techniques – Event & Activity, Network diagram, Network logic, Duration of an activity, Forward & Backward pass, Float or Slack Time, Path and Critical Path, Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Bar Charts, Advantages of Network Techniques. Resource Management, Time-cost trade-off, Project control: S-curve, Earned value analysis.</td></tr>
<tr><td>Module 3</td><td>Risk Management</td><td>Assignment</td><td colspan="2">Data Collection and Analysis</td><td colspan="4">8 Sessions</td></tr>
<tr><td colspan="9">Topics:
Certainty, Risk and Uncertainty Reasons for the risks, Types of Risks, Risk Management Identification and Nature of Construction Risks, Minimizing risks and mitigating losses, Risk mitigation.</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used:</td></tr>
</table>

Application area is Construction Project management consultancies, Construction companies, Entrepreneurship. Professionally used software: MS Project, Oracle Primavera.	
Textbooks: 1. Kumar Neeraj Jha, "Construction Project Management – Theory and Practice", Pearson. 2. Jimmie W. Hinze "Construction Planning and Scheduling" Tata McGraw Hill	
References: 1. Sengupta B. and Guha H, "Construction Management and Planning", Tata McGraw Hill, New Delhi. 2. Moder J.J. and Phillips C.R., "Project Management with CPM and PERT" Website: Scheduling techniques in Projects: https://swayam.gov.in/nd1_noc19_ce24/preview Project Planning and Control: https://swayam.gov.in/nd1_noc19_ce30/preview Project Management: https://swayam.gov.in/nd1_noc19_mg30/preview.	
Topics relevant to "SKILL DEVELOPMENT ": Project planning and techniques, Project monitoring and control techniques, Application of project management techniques using software, Quality and safety standards in construction for **Skill Development** through **Problem solving techniques. This is attained through assessment component mentioned in Course Plan.**	
Catalogue prepared by	**Mrs. Divya Nair**
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2520	Course Title: Construction Project Management Type of Course: Professional Core Laboratory	L-T-P- C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	[1] Construction Techniques and process [2] Probability and statistics Basic Understanding of construction techniques and Process of different civil engineering projects, Basics of beta distribution and normal distribution of probability with their Mean, Standard deviation and variance.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to provide an opportunity to validate the planning and scheduling concepts that enhances the ability to visualize the real system performance. This laboratory course in Construction Project Management provides a hands-on experience with project planning, scheduling, budgeting, resource allocation, risk analysis, and execution using the industry-standard tools and techniques via using the MSP software. The course aims to bridge theoretical knowledge with practical applications to enhance students' ability to manage real-world construction projects effectively. The course is both conceptual and analytical in nature.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Construction Project Management** and attain **Skill Development** through **Experiential Learning** techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Prepare schedule of projects in MS Project/ Primavera software and perform various operations to optimize the schedule.					
Course Content:						

List of Laboratory Tasks:

Experiment No. 1: Creating project tasks in MS Project or Primavera.
Level 1: Define project tasks and its duration associated with construction of a Two storied residential Building with Conventional RCC construction.
Level 2: Define project tasks and its duration associated with construction of a Two storied residential Building with Conventional RCC construction including services such as electrical, plumbing and sanitary works.

Experiment No. 2: Defining Milestones and Dependencies among the project tasks in MS Project or Primavera.
Level 1: Define Milestones and assign logical relationships between project tasks for a Two storied residential Building with Conventional RCC construction.
Level 2: Define Milestones and assign logical relationships between project tasks for a Two storied residential Building with Conventional RCC construction including services such as electrical, plumbing and sanitary works.

Experiment No. 3: Creating and assigning resources in MS Project or Primavera
Level 1: Creating required resources for the project and assigning them to project tasks involved in construction of a Two storied residential Building with Conventional RCC construction.

Level 2: Creating required resources for the project and assigning them to project tasks involved in construction of a Two storied residential Building with Conventional RCC construction including services such as electrical, plumbing and sanitary works.

Experiment No. 4: Creating Project Baseline and Generating reports in MS Project or Primavera.
Level 1: Create project baseline and generate resource reports, cost reports and progress reports for a Two storied residential Building with Conventional RCC construction.
Level 2: Create project baseline and generate resource reports, cost reports and progress reports for a Two storied residential Building with Conventional RCC construction including services such as electrical, plumbing and sanitary works.

Experiment No. 5: Preparation of Project plan and schedule on MS Project or Primavera.
Level 1: Prepare a comprehensive project plan for one of the infrastructure project mentioned in the theory lecture using all the skills acquired in previous lab sessions.
Level 2: Prepare a comprehensive project plan for one of the infrastructure project mentioned in the theory lecture using all the skills acquired in previous lab sessions and perform resource optimization on the prepared plan.

Targeted Application & Tools that can be used:
Application area is Construction Project management consultancies, Construction companies, Entrepreneurship.
Professionally used software: MS Project, Oracle Primavera.

Textbooks:
1. Kumar Neeraj Jha, "Construction Project Management – Theory and Practice", Pearson.
2. Jimmie W. Hinze "Construction Planning and Scheduling" Tata McGraw Hill

References:
1. Sengupta B. and Guha H, "Construction Management and Planning", Tata McGraw Hill, New Delhi.
2. Moder J.J. and Phillips C.R., "Project Management with CPM and PERT"
Website:
Scheduling techniques in Projects: https://swayam.gov.in/nd1_noc19_ce24/preview
Project Planning and Control: https://swayam.gov.in/nd1_noc19_ce30/preview
Project Management: https://swayam.gov.in/nd1_noc19_mg30/preview.

Topics relevant to "SKILL DEVELOPMENT ": Project planning and techniques, Project monitoring and control techniques, Application of project management techniques using software, Quality and safety standards in construction for **Skill Development** through **Experiential Learning techniques. This is attained through assessment component mentioned in Course Plan.**

Catalogue prepared by	**Mrs. Divya Nair**
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2511	Course Title: Concrete and Highway Materials Testing La Type of Course: 1] Program Core 2] Laboratory Only	L-T-P-C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	CIV 1006, CIV2016, CIV2014, CIV2017					
Anti-requisites	NIL					
Course Description	The objective of concrete laboratory is to determine the physical properties of building construction materials like cement, fine and coarse aggregate. The tests include determination of specific gravity, fineness, normal consistency, setting times, workability and soundness of cement, fineness modulus of fine and coarse aggregate, strength of cement mortar, cement concrete. The course gives the knowledge on design the mix, make the specimens and test the same for their respective strengths. The objective of highway materials laboratory is to determine some of the properties of coarse aggregates and bitumen. Experiments include tests for impact, abrasion and crushing strength for coarse aggregates. For bitumen, tests include penetration, ductility, viscosity, softening point and flash and fire point, Marshall Stability and Binder content. The course enable to infer the suitability of these materials for construction of road. This laboratory course will help to understand the theoretical concepts learned in the course transportation engineering. On pursuing this Course, the first-hand knowledge on the properties and uses of concrete and highway materials will be developed.						
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Concrete and Highway Materials Testing Lab and attain Skill Development through Experiential Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Determine the quality of cement and aggregates as per the IS codes 2] Assess the properties of fresh and hardened concrete 3] Illustrate the stability & properties of bituminous materials 4] Interpret the experimental results of concrete and highway materials based on laboratory tests					
Course Content:	Task 01: Standard Consistency of cement and Setting time of cement Level No. 01: Calculate the standard consistency and setting time of a given sample of cement. Level No. 02: Determination of the percentage of weight of water to be added to cement to produce a cement paste of standard consistency, i.e. the paste of certain solidity, which is used to fix the quantity of water to be mixed in cement to conduct various tests on cement. Estimate the time when the cement loses its complete plasticity and attains sufficient firmness in order to resist definite loading. Task 02: Soundness Test of cement and Specific gravity of cement. Level No. 01: To determine the soundness test and specific gravity of cement sample. Level No. 02: Discuss the expansion of cement based on amount of lime present in cement and also discuss the expansion of cement influencing the properties of cement. Discuss the importance of the value of specific gravity of cement in concrete mix design. Task 03: Compressive strength of cement. Level No. 01: To determine the average compressive strength of cement. Level No. 02: Based on the test, discuss about the capacity of material to withstand or resist the compressive loads. Asses the grade of cement based on this test value. Task 04: Workability test of fresh concrete- Slump test, Compaction Factor test and Vee-bee Consistometer test.					

	Level No. 01: To determine the workability of concrete mix of given proportions using slump cone test, compaction factor test and Vee-Bee Consistometer test. Level No. 02: Based on the test, discuss about the requirement of water content needed for concrete to be used for different type of works and workable concrete which can be easily mixed, placed, compacted and finished. Compare the results of three different tests and suggest the suitability of concrete for specific types of construction. Task 05: Strength Tests of Hardened Concrete- Compressive strength, Split tensile strength and Flexural Strength of Concrete Level No. 01: To determine the average compressive strength, Split tensile strength and Flexural Strength of Concrete of a given grade of concrete. Level No. 02: Based on the test values, discuss the behavior of concrete under the compressive, tensile and bending stresses. Compare the results of all strength tests and discuss the performance of concrete under various types of loads. Task 06: Los Angeles Abrasion test Level No. 01: Calculate the abrasion value of a given sample of aggregates. Discuss the reasons for different number of drum rotations for different gradation of aggregates. Level No. 02: Compare the abrasion value of aggregates with different number of steel balls in the drum. Discuss suitability of the aggregates accordingly for their use in pavement construction, concrete or otherwise. Task 07: Specific Gravity and Penetration Test on Bitumen Level No. 01: To estimate the specific gravity and penetration value of a given sample of bitumen. Level No. 02: Investigate whether the penetration test can be used to evaluate the penetration value of tar. Comment on the results. Discuss the Penetration Grading System with its drawbacks. Task 08: Softening Point Test and Ductility Test Level No. 01: To estimate the softening point and ductility of a given sample of bitumen. Level No. 02: Compare different grades of bitumen with respect to their softening points and ductility values. Think about the temperature of laying and correlate with the softening point test. Also, try to establish a relationship between ductility and softening point (if any). Task 09: Viscosity and Flash, Fire Point Test Level No. 01: Estimate the viscosity of a given sample of bitumen. Also find out its flash and fire point test. Level No. 02: Compare viscosity values with penetration values. Analyze the relationship between the two. Discuss the viscosity grading system and compare it with the penetration grading system. Find out industrial values of flash and fire point. Interpret the results obtained in the laboratory and draw conclusions. Task 10: Marshall Stability Test Level No. 01: Estimate the Marshall stability value and the optimum binder content for a given mix. Level No. 02: Code the process of estimation of optimum binder content in MATLAB/Python and use it to estimate the optimum binder content for varying percentages of bitumen and different gradation of aggregates. Also use data visualization techniques to interpret various Marshall curves.
Targeted Application & Tools that can be used: The laboratory course would be useful in gaining exposure in material characterization which would help in future quality control related positions at construction firms. Also, material testing tasks and result interpretation could help students in future consulting work and even research.	

Text Book(s):

T1. "Concrete and Highway Materials Testing Lab Manual", Presidency University

T2. Khanna SK and Justo C E G, Veeraraghavan A "Highway Engineering", Nem Chand Bros, Roorkee.

T3. M.S. Shetty, "Concrete Technology", Chand S and Co.

References

1. Relevant IS Codes.

PU web resources:

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2721708&site=ehost-live&ebv=EB&ppid=pp_36

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2665206&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Workability test of fresh concrete- Slump test, Compaction Factor test and Vee-bee Consistometer test, Strength Tests of Hardened Concrete- Compressive strength, Split tensile strength and Flexural Strength of Concrete, Marshall Stability Test for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Dayalan J
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: CIV2511	Course Title: Concrete and Highway Materials Testing Lab Type of Course: 1] Program Core 2] Laboratory Only	L-T-P-C	0	0	2	1
Version No.	1.1					
Course Pre-requisites	CIV 1006, CIV2016, CIV2014, CIV2017					
Anti-requisites	NIL					
Course Description	The objective of concrete laboratory is to determine the physical properties of building construction materials like cement, fine and coarse aggregate. The tests include determination of specific gravity, fineness, normal consistency, setting times, workability and soundness of cement, fineness modulus of fine and coarse aggregate, strength of cement mortar, cement concrete. The course gives the knowledge on design the mix, make the specimens and test the same for their respective strengths. The objective of highway materials laboratory is to determine some of the properties of coarse aggregates and bitumen. Experiments include tests for impact, abrasion and crushing strength for coarse aggregates. For bitumen, tests include penetration, ductility, viscosity, softening point and flash and fire point, Marshall Stability and Binder content. The course enable to infer the suitability of these materials for construction of road. This laboratory course will help to understand the theoretical concepts learned in the course transportation engineering. On pursuing this Course, the first-hand knowledge on the properties and uses of concrete and highway materials will be developed.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Concrete and Highway Materials Testing Lab and attain Skill Development through Experiential Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Determine the quality of cement and aggregates as per the IS codes 2] Assess the properties of fresh and hardened concrete 3] Illustrate the stability & properties of bituminous materials 4] Interpret the experimental results of concrete and highway materials based on laboratory tests					
Course Content:	Task 01: Standard Consistency of cement and Setting time of cement Level No. 01: Calculate the standard consistency and setting time of a given sample of cement. Level No. 02: Determination of the percentage of weight of water to be added to cement to produce a cement paste of standard consistency, i.e. the paste of certain solidity, which is used to fix the quantity of water to be mixed in cement to conduct various tests on cement. Estimate the time when the cement loses its complete plasticity and attains sufficient firmness in order to resist definite loading. Task 02: Soundness Test of cement and Specific gravity of cement. Level No. 01: To determine the soundness test and specific gravity of cement sample. Level No. 02: Discuss the expansion of cement based on amount of lime present in cement and also discuss the expansion of cement influencing the properties of cement. Discuss the importance of the value of specific gravity of cement in concrete mix design. Task 03: Compressive strength of cement. Level No. 01: To determine the average compressive strength of cement. Level No. 02: Based on the test, discuss about the capacity of material to withstand or resist the compressive loads. Asses the grade of cement based on this test value.					

	Task 04: Workability test of fresh concrete- Slump test, Compaction Factor test and Vee-bee Consistometer test. Level No. 01: To determine the workability of concrete mix of given proportions using slump cone test, compaction factor test and Vee-Bee Consistometer test. Level No. 02: Based on the test, discuss about the requirement of water content needed for concrete to be used for different type of works and workable concrete which can be easily mixed, placed, compacted and finished. Compare the results of three different tests and suggest the suitability of concrete for specific types of construction. Task 05: Strength Tests of Hardened Concrete- Compressive strength, Split tensile strength and Flexural Strength of Concrete Level No. 01: To determine the average compressive strength, Split tensile strength and Flexural Strength of Concrete of a given grade of concrete. Level No. 02: Based on the test values, discuss the behavior of concrete under the compressive, tensile and bending stresses. Compare the results of all strength tests and discuss the performance of concrete under various types of loads. Task 06: Los Angeles Abrasion test Level No. 01: Calculate the abrasion value of a given sample of aggregates. Discuss the reasons for different number of drum rotations for different gradation of aggregates. Level No. 02: Compare the abrasion value of aggregates with different number of steel balls in the drum. Discuss suitability of the aggregates accordingly for their use in pavement construction, concrete or otherwise. Task 07: Specific Gravity and Penetration Test on Bitumen Level No. 01: To estimate the specific gravity and penetration value of a given sample of bitumen. Level No. 02: Investigate whether the penetration test can be used to evaluate the penetration value of tar. Comment on the results. Discuss the Penetration Grading System with its drawbacks. Task 08: Softening Point Test and Ductility Test Level No. 01: To estimate the softening point and ductility of a given sample of bitumen. Level No. 02: Compare different grades of bitumen with respect to their softening points and ductility values. Think about the temperature of laying and correlate with the softening point test. Also, try to establish a relationship between ductility and softening point (if any). Task 09: Viscosity and Flash, Fire Point Test Level No. 01: Estimate the viscosity of a given sample of bitumen. Also find out its flash and fire point test. Level No. 02: Compare viscosity values with penetration values. Analyze the relationship between the two. Discuss the viscosity grading system and compare it with the penetration grading system. Find out industrial values of flash and fire point. Interpret the results obtained in the laboratory and draw conclusions. Task 10: Marshall Stability Test Level No. 01: Estimate the Marshall stability value and the optimum binder content for a given mix. Level No. 02: Code the process of estimation of optimum binder content in MATLAB/Python and use it to estimate the optimum binder content for varying percentages of bitumen and different gradation of aggregates. Also use data visualization techniques to interpret various Marshall curves.
Targeted Application & Tools that can be used: The laboratory course would be useful in gaining exposure in material characterization which would help in future quality control related positions at construction firms. Also, material testing tasks and result interpretation could help students in future consulting work and even research.	

Text Book(s):

T1. "Concrete and Highway Materials Testing Lab Manual", Presidency University

T2. Khanna SK and Justo C E G, Veeraraghavan A "Highway Engineering", Nem Chand Bros, Roorkee.

T3. M.S. Shetty, "Concrete Technology", Chand S and Co.

References

1. Relevant IS Codes.

PU web resources:

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2721708&site=ehost-live&ebv=EB&ppid=pp_36

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2665206&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Workability test of fresh concrete- Slump test, Compaction Factor test and Vee-bee Consistometer test, Strength Tests of Hardened Concrete- Compressive strength, Split tensile strength and Flexural Strength of Concrete, Marshall Stability Test for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Dayalan J
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: **CIV2522**	**Course Title: Computer Aided Analysis & Detailing Lab** **Type of Course: 1] Professional Core** **2] Theory Integrated**	**L-T-P-C**	0	0	2	1
Version No.	2.1					
Course Pre-requisites	**CIV2508 – Design of RCC Structural Elements** **CIV2510 – Design of Structural Steel Elements**					
Anti-requisites	**NIL**					
Course Description	This Course illustrates the analysis of structural elements and building frames. It also exemplifies the reinforcement detailing of RC Structural Elements of a building. The course includes analysis, design and of Portal Frames, Isolated Footings, Combined footing, Retaining wall as well as detailing of steel connections, column and gusseted base. The modelling and analysis are done with software Packages such as STAAD. Pro and ETABS, whereas drafting and detailing is done with AutoCAD. This course develops the ability to understand the behaviour of structures through software simulation as well as to produce detailing drawing for execution at site.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Computer Aided Analysis & Detailing Lab** and attain **Employability Skills** through **Experiential Learning** techniques					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Apply concepts learnt in fundamental structural engineering courses for modelling and analysis of structures using commercial software packages. 2) Demonstrate competency in using commercial structural analysis and design software packages. 3) Sketch the reinforcement detailing for various structures in compliance with SP-34 IS code using commercial drafting packages. 4) Design the structural such as beams, columns and foundation for the given specifications using commercial software packages. 5) Prepare detailed drawing for structural steel elements with bolted and welded connections					
Course Content:	**Task 01: To design a given frame with different loading conditions** **Level No 01:** To design a 2D portal frame with different loading conditions and varying column heights using STAAD. Pro **Level No. 02:** To design a 3D portal frame with different loading conditions and same column heights using STAAD. Pro **Task 02: To design a given truss with different loading conditions** **Level No 01:** To design a 2D truss system using STAAD.Pro **Level No. 02:** To design a 2D truss system with different support conditions using STAAD.Pro **Task 03: Analysis and Design of Isolated Footing** **Level No 01:** To design an isolated footing with uniform thickness excluding self-weight with the help of STAAD Advanced Foundation. **Level No. 02:** To design an isolated footing with sloped thickness including self –weight with and without pedestal with the help of STAAD Advanced Foundation **Task 04: Detailing of Beams**					

	Level No 01: To draw the reinforcement detailing for a simply supported beam using AutoCAD as per SP34. **Level No. 02:** To draw the reinforcement detailing for a continuous/fixed beam using AutoCAD as per SP34. **Task 05: Detailing of Slabs** **Level No 01:** To draw the reinforcement detailing for a simply supported one-way/two-way slab using AutoCAD as per SP34. **Level No. 02:** To draw the reinforcement detailing for a two-way slab with continuous /discontinuous edges using AutoCAD as per SP34. **Task 06: Detailing of Columns** **Level No 01:** To draw the reinforcement detailing for a rectangular column using AutoCAD as per SP34. **Level No. 02:** To draw the reinforcement detailing for a circular column (spiral ties) using AutoCAD as per SP34. **Task 07: Detailing of isolated footing** **Level No 01:** To draw the reinforcement detailing for a square isolated using AutoCAD as per SP34. **Level No. 02:** To draw the reinforcement detailing for a rectangular isolated footing using AutoCAD as per SP34. **Task 08: Detailing of Staircase** **Level No 01:** To draw the reinforcement detailing for a dog legged staircase using AutoCAD as per SP34. **Level No. 02:** To draw the reinforcement detailing for a Open Newel staircase using AutoCAD as per SP34. **Task 09: Steel Connections – Beam to beam** **Level No 01:** To detail Beam to beam connection using cleat angle by bolted connections for given data. **Level No. 02:** To detail Beam to beam connection using cleat angle by welded connections for given data. **Task 10: Steel Connections – Beam to Column** **Level No 01:** To detail Beam to Column by unstiffened and stiffened bolted connections for given data. **Level No. 02:** To detail Beam to Column by unstiffened and stiffened welded connections for given data.

Targeted Application & Tools that can be used: Design Consultancy Firms as Structural Engineers involved in Analysis, Design and Detailing of Structural elements for building projects.
Tools used in profession: Software such as STAAD Pro., ETABS, STAAD Advanced Foundation software, TEKLA, AutoCAD

Text Book

1. T. S. Sarma "Design of RCC Buildings using STAAD Pro. V8i with Indian Examples – Static and Dynamic Methods", Educreation Publishing, 2017
2. Sham Tickoo, "Exploring Bentley STAAD Pro. V8i (SELECT Series 6)", BPB publications, 2017
3. SP 34: Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards
4. IS 800 (2007): General Construction in Steel - Code of Practice

References

1. P C Varghese, "*Limit State Design of Reinforced Concrete"*, Vol-II, Prentice Hall of India (P) Ltd.

<table>
<tr><td colspan="2">2. Vazirani V N and M M Ratwani, "Analysis of Structures", Vol-II, Khanna Publishers, New Delhi.
3. B C Punmia, "Reinforced Concrete Structures", Vol-II, Laxmi Publications (P) Ltd, New Delhi.
4. STAAD Pro. / ETABS / AutoCAD user manuals.
E-resources
1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1523718&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1538234&site=ehost-live</td></tr>
<tr><td colspan="2">Topics relevant to "EMPLOYABILITY SKILLS": Analysis, Design and Detailing of Frames, Columns, Isolated Footing, Combined Footing and Cantilever Retaining wall for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Catalogue prepared by</td><td>Mrs. Divya Nair/Mr. Ajay H A</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BoS No. 14 held on 30 July 2022</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 18 held on 03 August 2022</td></tr>
</table>

Course Code: CIV2521	**Course Title: Building Information Modelling Lab** **Type of Course:1] Professional Core** **2] Laboratory only**	**L-T-P-C**	0	0	2	1
Version No.	1.1					
Course Pre-requisites	**CIV2103 - Building Planning and Drawing**					
Anti-requisites	**NIL**					
Course Description	This course focuses on the skills and information needed to effectively use an existing Building Information Modelling (BIM) tool in planning and execution of a building construction project. This is a project-based course where one gains knowledge on the implementation of BIM concepts throughout the lifecycle of a building, from planning and design, to construction and operations. It includes Introduction to BIM fundamentals - Modeling Building Elements: modeling exterior and interior walls, creating floors and roofs, adding doors, windows, footings, columns, and beams, Building Envelope: modeling wall types and design features, working with doors, windows, and wall openings, creating roofs with different shapes and slopes. Curtain Systems: designing curtain grid patterns, adjusting grids and mullions, creating and using curtain panels types. Creating stairs and ramps, customizing stair shapes, modeling elevators. Sheets and construction documents, Families creation, Model sharing, Conceptual Massing, Visualization and Rendering.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Building Information Modeling** and attain **Employability Skills** through **Experiential Learning** techniques					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Implement projects using REVIT Architectural Template 2] Demonstrate competency in documenting small building projects using REVIT					
Course Content:						
Module 1:	Fundamentals of BIM	Lab Assessment		15 Sessions		
Topics: Definition, necessity and benefits of BIM, View, Retrieve Information and measure distance from BIM Models						
List of Laboratory Tasks: (15 sessions required):	**Task 01: Introduction to Autodesk Revit Architecture** **Task 02: Basic Drawing and Modify Tools** **Task 03: Setting Up Levels and Grids** **Task 04: Modeling Walls** **Task 05: Working with Doors and Windows** **Task 06: Working with Curtain Walls** **Task 07: Working with Views**					

	Task 08: Adding Components **Task 09: Modelling Floors** **Task 10: Modelling Ceilings** **Task 11: Modelling Roofs** **Task 12: Modelling Stairs, Railings, and Ramps** **Task 13: Annotating Construction Documents** **Task 14: Creating Rendering, Animations** **Task 15: Creating Construction Documents** **Task 16: Modelling Building** Level No. 02: Implementation of REVIT tools on different types of buildings
Targeted Application & Tools that can be used: **Construction Companies as BIM Engineer**	
Text Book **1. Eastman, "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors".** **2. "Mastering Autodesk Revit 2020" by Robert Yori, Markus Kim and Lance Kirby**	
References 1. "Basics of BIM: Introduction to Building Information Modeling" by VV Talapov 2. https://www.coursera.org/learn/bim-fundamentals 3. https://www.udemy.com/course/bim-training/ E book link R1: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1055429&site=ehost-live E book link R2: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2173861&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": BIM Modelling of Buildings using REVIT for developing **Employability Skills** through **Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**	
Catalogue prepared by	Ms. Anju Mathew
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3011CIV3111	Course Title: Remote Sensing and Geographical Information System Type of Course: Discipline Elective and Theory Only		L-T-P-C	2	2	0	3
Version No.	1.0					
Course Pre-requisites	[2] CIV2101 Surveying					
Anti-requisites	NIL					
Course Description	This course empowers the students to discover the various ways in which remote sensing techniques provide geospatial information which is appropriate, accurate, timely, accessible and available in a suitable format. New developments in Earth observation like imaging radar, LIDAR, hyper-spectral sensors and Unmanned Aerial Vehicle (UAV) / Drone based remote sensing are increasing the wealth of information that can be produced from remotely sensed data sources. The course also covers the Digital Image processing method and its applications. As a result, several new GIS applications that rely on advanced remotely sensed data sources have emerged at local, regional and global scales. The significant areas include the use of remote sensing data, platforms and sensors, image interpretation and processing techniques, fundamentals of GIS and spatial data analysis and applications of remote sensing and GIS in environment and urban applications are gaining importance.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Remote Sensing and Geographical Information System and attain Employability Skills through Problem Solving methodologies.						
Course Outcomes	On successful completion of this course the students shall be able to: 1)Understand the importance remote sensing and spectral signatures of rocks, soils, vegetation, water etc. 2) Explain image classifications using earth observation satellites. 3) Recognize Drone / UAV techniques and its application in solving Civil Engineering problems. 4) Prepare geospatial data and integrate it with a GIS to Create maps and images, to communicate spatial data and non-spatial information in a meaningful way to others.						
Course Content:						
Module 1	Introduction to Remote Sensing	Assignment	Data Analysis task	12 sessions		
Topics: Overview to remote sensing and its classification. Remote sensing sensors and its types; platforms, EMR interaction with earth surface material incident, reflected, absorbed and transmitted energy – reflectance – specular and diffused reflection surfaces – spectral signature – spectral signature curves. Elements of Image interpretation and processing techniques. Landsat, WorldView, Cartosat, Sentinel, GeoEye, ERS, RADARSAT Satellites and their sensors, geometry and radiometry, Orbital characteristics, Data products						
Module 2	Digital image Processing and interpretation techniques.	Case Studies on image classification and interpretation using QGIS.	Data analysis task	11 Sessions		
Topics: Introduction to digital image: Image classification - Supervised, Unsupervised and its various applications, Ground truth data and training set manipulation, Classification accuracy assessment. Interpretation of Multispectral Imagery and High-resolution data.						

Module 3	Introduction to UAV remote sensing and its applications	Assignment	Data Collection and Analysis	10 Sessions
Topics: Introduction to UAV remote sensing, techniques and prospects used in data collection. Applications in Civil Engineering projects				
Module 4	Geographical Information System	Assignment	Simulation/Data Analysis	10 Sessions
Raster and vector data. Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography				
Targeted Application & Tools that can be used: The students can work in the multi-national companies, Government Departments, Private industries as specialists to supports Scientists by designing and conducting remote sensing gathering efforts. They can also become entrepreneurs. Professionally used software: ARCMap / QGIS, MS Office.				
Text Books T1 Lillesand and Kiefer, *Remote Sensing and GIS , John Willey 2008.* T2 Kang-Tsung Chang, *Introduction to Geographic Information System, McGraw-Hill 2015*				
References R1 M. Anji Reddy, *Remote Sensing and Geographic Information System, Fourth Edition, BS Publications* R2 George Joseph and C Jeganathan, *Fundamentals of Remote Sensing, , Fourth Edition, The Orient Blackswan* R3 C. P. Lo, Albert K. W. Yeung, *Concept and Techniques of Geographic Information Systems, 2nd Edition, Pearson.* Websites: https://www.iirs.gov.in/ https://bhuvan.nrsc.gov.in/ http://edc.usgs.gov/ http://www.cr.usgs.gov/ http://www.earthsat.com/ https://www.gislounge.com/ https://www.esri.com/en-us/what-is-gis/overview https://www.usgs.gov/products/data-and-tools/gis-data https://www.qgis.org/ https://www.qgistutorials.com/ E-resources: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1790627&site=ehost-live https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=813105&site=ehost-live https://www.worldcat.org/title/remote-sensing-and-gis/oclc/768076807 https://onlinecourses.nptel.ac.in/noc21_ce61/preview https://onlinecourses.swayam2.ac.in/aic20_ge05/preview				
Topics related to development of "EMPLOYABILITY": Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Dr. Chandankeri G G			
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022			

Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3012CIV3112	Course Title: Construction Technology and Processes Type of Course: 1] Discipline Elective 2] Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course is an introductory course in Civil Engineering and covers various aspects of construction along with a brief overview to construction equipment, Construction 4.0 and sustainable construction. The course is conceptual in nature with an introduction to different aspects of construction technology and processes. An interest to understand the fundamental concepts of construction and a desire to be a successful Civil Engineer are key to enable students to complete the course successfully.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Construction Technology and Processes and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Explain the various components of a building. 2] Review different construction equipment. 3] Recognize the importance of adopting sustainability as well as the constant evolution in construction.					
Course Content:						
Module 1	Overview of Construction Technology	Assignment	Market Survey	16 Sessions		
Topics: Introduction to various types of Civil Engineering Structures, Framed and Load bearing structures. Components of building and their functions – Beams, Columns, Walls, Foundations. Overview of Masonry, Concrete and steel construction, Floors and roofs, Lintels and staircases, Types of Doors and windows. Overview of NBC code and its provisions. Formwork, scaffolding, Slip forming and Shoring.						
Module 2	Basics of Construction Equipment	Assignment	Report on Field Visit	12 Sessions		
Topics: Equipment for Earthwork Operation, Equipment for Compaction, Erection Equipment, Forklifts, Cranes and related equipment. Equipment for Production of aggregate and concreting; Materials handling Equipment – Portable Material Bins – Conveyors – Hauling Equipment.						
Module 3	Introduction to Sustainable Construction and Construction 4.0	Assignment	Article Review from E-resource	17 Sessions		
Topics: Relevance and importance of sustainability, Building life cycle, Introduction to Green building concepts, net-zero energy buildings. Precast Construction, Pre-fabricated Structures, Overview of Construction Automation - Robots in Construction, 3D Printing.						
Targeted Application & Tools that can be used:						

Concepts used in the course can be used for Site Engineer, Construction Project Manager, Planning Manager

Text Book

T1. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Building Construction", Laxmi Publications, 11th Edition, 2019.

T2. J. K. Yates, Daniel Castro-Lacouture, "Sustainability in Engineering Design and Construction", CRC Press, 2018.

T4. Anil Sawhney, Michael Riley, Javier Irizarry, "Construction 4.0: An Innovation Platform for the Built Environment", Routledge Publication, 2020.

References

R1. Roy Chudley, "Construction Technology - Volume 1 to 4", Pearson Education India, 2014.

R2. Edward Allen and Joseph Iano, "Fundamentals of Building Construction: Materials and Methods", 5th Edition, John Wiley & Sons Inc., Wiley Publishers, 2019.

R3. Edmundas Kazimieras Zavadskas, Jonas Šaparauskas, Jurgita Antuchevičienė, "Sustainability in Construction Engineering, MDPI AG, 2018.

R4. National Building Code, BIS, New Delhi

Web Based Resources and E-Resources:

W1. NPTEL Course on "Construction methods and equipment management", Prof. Indu Siva Ranjani Gandhi, https://nptel.ac.in/courses/105103206

W2. NPTEL Course on "Construction Planning and Management", Prof. Arbind Kumar Singh https://nptel.ac.in/courses/105103093

W3. Hanizzam Awang & Md. Azree Othuman Mydin, "Construction Methods and Technology", Penerbit USM (USM Press), 2016

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1487204&site=ehost-live

W4. Doyle, Sophie G., "Construction and Building: Design, Materials, and Techniques", Nova Science Publishers, 2011

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=780870&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Components of building and their functions, Various Construction Equipment used for excavation and concrete production for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course plan

Catalogue prepared by	Mr. Gopalakrishnan N
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV3014CIV3114	Course Title: Alternative building materials Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2100 Building Materials and Concrete Technology Knowledge of physical and mechanical properties of basic building materials are required. Knowledge of types of concretes and its suitable applications should be known.					
Anti-requisites	NIL					
Course Description	The objective of the course is to understand the environmental issues due to building materials and the energy consumption in manufacturing them. The course involves the study of various masonry blocks, masonry mortar and structural behavior of masonry under compression. It focuses on analyses of different alternate building materials, which will be suitable for specific climate in an environmentally sustainable manner and suggestion for suitable agro and industrial wastes as a building material. The students can able to understand the alternate building technologies, which are followed in present construction field.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Alternative building materials and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Select alternative building material with lower embodied energy. 2. Assess and Rate a building as per IGBC & LEED ratings manual. 3. Evaluate the strength properties of the masonry blocks in compression and bond strength of masonry mortar in flexure and shear. 4. Suggest suitable alternative construction technique for building and roofing systems.					
Course Content:						
Module 1	Alternative Building Materials	Assignments	Theory based questions	8 Sessions		
Topics: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers - metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Low carbon concrete, Modern composite concrete, Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications.						
Module 2	Green building techniques and ratings	Assignments	Calculation of embodied energy and energy savings calculations using EDGE	8 Sessions		
Topics: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle assessment, Sustainability framework, Global warming and construction industry, Green concepts in buildings, Green building ratings - IGBC and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmentally friendly and cost-effective building technologies, Requirements for buildings of different climatic regions. Case Study – Energy management in Building						
Module 3	Masonry blocks and mortars	Assignment	Theory based question	8 Sessions		

Topics:
Elements of Structural Masonry: Elements of Structural Masonry, Masonry materials, requirements of masonry units' characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud block. Manufacturing of stabilized blocks.
Structural Masonry Mortars: Mortars, cementitious materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar.
Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry.

Module 4	Alternative building technologies	Assignment	Theory based question	8 Sessions

Topics:
Alternative Building Technologies: Use of arches in foundation, alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications. Top down construction, Mivan Construction Technique.
Alternative Roofing Systems: Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes

Targeted Application & Tools that can be used:
The Course enables the students to suggest alternative material which has a lower embodied energy and aims at providing guidelines for green construction techniques and manuals for green ratings. This course also enables students to understand the bond strength of masonry mortar and suggest alternate technologies in construction of building and roofing systems.

Text Books:
1. KS Jagadish, B V Venkatarama Reddy and K S Nanjunda Rao, "Alternative Building Materials and Technologies", New Age International Publications, 2017
2. P C Varghese, "Buliding Materials", PHI Learning Pvt. Ltd

References
1. Arnold W Hendry, "Structural Masonry", Macmillan Publishers.
2. RJS Spence and DJ Cook, "Building Materials in Developing Countries", Wiley Publications

PU e-Library Resources
1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_17209

Web resources
1. https://nptel.ac.in/courses/124105013

Topics relevant to "EMPLOYABILITY SKILLS": Green building ratings using IGBC and LEED manuals.
Alternate construction techniques for designing an energy efficient building. Alternate roofing techniques for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3015CIV3115	Course Title: Design concepts of Building Services Type of Course: Program Core & Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	-					
Anti-requisites	NIL					
Course Description	This introductory course deals with the concepts of building services which include ventilation and lighting(HVAC), fire protection and safety measures, vertical transportation (Lifts / Elevators), water distribution services within the structure. Apart from this, the course covers in-depth fundamentals of electrical services to be provided in a building as per NBC.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Design concepts of Building Services and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Identify various types and purposes of ventilation that can be provided for a structure. 2) Choose the different types of services required for structure. 3) Analyze the types of building maintenance to be provided for a structure.					
Course Content:						
Module 1	Building services	Case studies	Data Analysis task AutoCAD			9 Hours
Topics: Basics of building services, Types of buildings, Classification and types of building services. Apply various types of services as per needs of building. Lighting - Natural and artificial lighting, Principles and factors, Lighting provisions as per NBC Ventilation – Natural and Mechanical. Principles and factors to be considered in the design of Ventilation						
Module 2	Water and Electrical services	Case Study	AutoCAD to study electrical Layouts			15 Hours
Topics: Cold and Hot water distribution system, Electrical services in the building per NBC, Prepare electrical services requirement and Layout of a given building (Eg. Residence, small work shop, show room, school building)						
Module 3	Lifts and Fire safety	Assignment	Data Collection and Analysis			15 Hours
Topics: Types of Elevators / Lifts, Design Considerations, Location, Sizes as per NBC 2005 , Types of Escalators, Types of Conveyors, Fire Safety – Materials and Systems / Services, Fire escape, Lightning protection						
Targeted Application & Tools that can be used: Sustainability engineer, Building Manager, Facilities Manager, Revit Architecture, AutoCAD, OpenBuildings Designer						
Textbooks: 1. R. Udaykumar "A text book on Building Services " Eswar Press, ISBN-13,9788178740638, Chennai						

2 . S. M. Patil "Building Services", Seema Publication, ISBN-13,1234567121246, Mumbai Revised edition
References: 1. Dr. B. C. Punmia "Building Construction ", Laxmi Publications (P) Ltd., 2. P. S. Gahlot "Building repair and Maintenance Management ", CBS Publishers & Distribution(P) Ltd, DEC-2010 3. "National Building Code of India - 20016", Bureau of Indian Standards, BIS, New Delhi E-Resources: **1.** Bernhard Lenz, Jürgen Schreiber, Thomas Stark, "Sustainable Building Services : Principles - Systems – Concepts", Edition Detail Green Books, 2011 https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=642066&site=ehost-live
Topics relevant to "EMPLOYABILITY SKILLS": Basics of Building Services, Lifts, Electrical Services for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Harshith Jagadish Gupta / Dr. Nakul R
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3016CIV3116	Course Title: Integration of SDGs in Civil Engineering Type of Course: Open Elective and Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course helps the students to learn to integrates 4 of the 17 SDGs proposed by the 2030 Agenda: 1. It ensures the availability and sustainable management of water and sanitation (SDG 6). 2. It develops resilient infrastructures (SDG 9). 3. It promotes inclusive, safe, resilient, and sustainable cities (SDG 11). 4. It combats climate change and its effects (SDG 13).					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Integration of SDGs in Civil Engineering and attain Employability Skills through Participative Learning techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Identify the latest technology-enabled systems for the management availability and sustainable management of water and sanitation (SDG6) 2. Interpret the dynamic behavior of the resilient infrastructures system in context to physical appearance and by focusing on representations, properties and impact factors (SDG9) 3. Demonstrate the infrastructure systems to benefit the citizens, based on SDGs 11 &13 concept as responsive cities.					
Course Content:						
Module 1	Sustainable management of water and sanitation	Assignment	Data Collection	12 Sessions		
Topics: Concepts of Sustainable Development Goals, Components of sustainable management of water and sanitation: Concepts, Challenges, Evolution of sustainable management of water and sanitation. Participatory Planning Process and Policies. Integrating SDG6						
Module 2	Development of resilient infrastructures	Case Study	Programming	12 Sessions		
Topics: Understanding resilient infrastructures: Definition and components; strategic planning, good governance, civic engagement and citizenship, security. planning framework for actions, process of drafting the plan, key considerations. Case studies integrating SDG 9						
Module 3	Inclusive, safe, resilient, and sustainable cities	Minor projects	Data Collection/ Analysis/ Smart solutions	16 Sessions		
Topics: Inclusive, safe, resilient, and sustainable cities: Concepts and challenges. Urban design and decision-making; city transport for all; water supply and sanitation, urban disaster management, management through decentralization. Case Studies integrating SDG11 and 13.						
Targeted Application & Tools that can be used: Application areas: Decision Support for Sustainable management of water and sanitation Professionally used software/Platform: MATLAB/GIS/Python/IoT						
Text Books 1. National Academy of Engineering, "14 Grand Challenges for Engineering in the 21st Century,"2020. [Online]. Available: http://www.engineeringchallenges.org/challenges.aspx. 2. Joseph N. Pelton; Indu B. Singh (2018) "Smart Cities of Today and Tomorrow: Better Technology, Infrastructure and Security" publication: Copernicus; 1st ed. 2019 edition.						

References United Nations. Sustainable Development Goals Report. United Nations. 2020. Available online: https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf	
Topics relevant to "EMPLOYABILITY SKILLS": Inclusive, safe, resilient, and sustainable cities for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Prof. Jagdish H Godihal
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3017CIV3117	Course Title: Optimization Methods for Civil Engineering Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic Mathematics					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students the fundamentals of classical optimization techniques and also exposing them to the theory of different non-classical optimization methods and algorithms developed for solving various types of civil engineering optimization problems. The course will also enable the students to apply the various classical and non-classical optimization techniques in solving real-world optimization problems by using MATLAB and MS Excel. The nature of the course is theory based and it discusses the concept of optimization and problem solving in Civil Engineering.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Optimization Methods for Civil Engineering and attain Employability Skills through Problem Solving methodologies					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Discuss methods of optimization. 2) Analyze basic civil engineering problems using classical method of optimization. 3) Perform non-linear optimization problems using MATLAB.					
Course Content:						
Module 1	Introduction to Optimization	Assignment	Case Study	8 sessions		
Introduction, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Optimization methods, solution techniques for linear and integer problems, Linear Programming Problem, Introduction to linear problem, General system of equations, Simplex method, Minimization versus maximization problems.						
Module 2	Introduction to classical optimization methods	Assignment	Data collection and analysis	12 sessions		
Classical optimization, Classification of optimization problems, Optimization techniques – classical and advanced techniques, Convexity and concavity of functions of one and two variables, Examples for transportation, assignment, water resources, structural and other optimization problems.						
Module 3	Introduction to Non-Linear Optimization	Assignment	Data collection and analysis	10 sessions		
Introduction to non-linear problems; Introduction to non-traditional optimization methods, Case studies from Civil Engineering, Engineering application using MATLAB and Excel solver for solving linear optimization problems using graphical and simplex methods						
Targeted Application & Tools that can be used: This Course helps student to apply the fundamentals of optimization techniques in civil engineering discipline and help to formulate objective functions under given set of constraints.						
Textbook T1. S. S. Rao, "Engineering Optimization: Theory and Practice", Wiley, 2008. T2. K. Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall, 2005						
References R1. S. R. F. Bennis, and R. K. Bhattacharjya, "Nature-Inspired Methods for Metaheuristics Optimization: Algorithms and Applications in Science and Engineering", Springer Inc. R2. Kumar, "Multicriterion Analysis in Engineering and Management", Prentice Hall, 2010. R3.https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=130325463&site=ehost-live						

Web Source: NPTEL course – Optimization methods for Civil Engineering: https://archive.nptel.ac.in/courses/105/103/105103210/	
Topics relevant to "EMPLOYABILITY SKILLS": Engineering application using MATLAB and Excel solver for solving linear optimization problems, Minimization versus maximization problems for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Ahamed Sharif
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3018	Course Title: Development and Applications of Special Concrete Type of Course: Discipline Elective and Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					

Course Pre-requisites	Design of RC Structural elements			
Anti-requisites	NIL			
Course Description	This course deals with the unified view of concrete materials, different types of special concretes and construction environment. The course is conceptual in nature and examines the parameters such as quality control methods for each type of concrete. The purpose of the course is to explain how some commonly used special concretes have been developed and how they are used in different conditions. The course compares different concrete types and encourages the students to apply the most suitable one for the construction scenario.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Development and Applications of Special Concrete and attain Employability Skills through Participative Learning techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: **1)** Recall the basic properties, methods and specifications of concrete. **2)** Explain the properties of self- compacting concrete, fibre-reinforced concrete and high strength concretes. **3)** Discuss the properties of shotcrete. **4)** Describe the use of different types of polymers in concrete			
Course Content:				
Module 1	Review of Normal concrete	Assignment	Case Study	10 Sessions
Topics: Basic properties of a concrete – Fresh concrete, Hardened concrete, Proportioning of Normal Concrete Mixes, Concrete Mix proportions, Admixtures in concrete, Curing of Concrete, Cold weather and Hot weather concreting, Importance of Right Methods and Specifications, Heat of hydration of cement and thermal stresses, Concreting Underwater, Roller Compacted Concrete.				
Module 2	Special Concrete	Assignment	Case study	12 Sessions
Topics: Self- Compacting concrete- Introduction, Basic ingredients, Characteristics, advantages, Super-plasticizers, Viscosity modifying admixtures, Powder Type SCC, Viscosity modifying Type SCC. Fibre- reinforced Concrete- Matrix concrete and Fibres, Classification of FRCs based on the Fibre Volume, Types of Fibres , Fibre- balling in Steel FRC, Mixing of Concrete- Batching , Types of Drum Mixers, Applications of FRC. Shotcrete- Definition, Typical Applications of Shotcrete/ Gunite, Characteristics of Shotcrete, Curing, Shotcrete for seismic retrofitting.				
Module 3	Polymer impregnated Concrete	Case Study	Case study	8 Sessions
Topics: Introduction, Using Polymers in Concrete, Advantages and Disadvantages, Latex modified concrete, Applications. Compaction of concrete- Process of compaction, Effect on fresh concrete, Effect on Hardened concrete, Effect of Over compaction, types of Compaction.				
Targeted Application & Tools that can be used: Application of Special concretes: in extreme weather conditions in larger structures such as power plants, off-shore buildings, docks, aerodromes etc Tools used: -				

- FRCcalc – Software for design of fiber reinforced concrete elements according to MC2010 recommendations
- MATLAB

Text Book:

T1. Mehta, P.K., and Monteiro P.J.M., Concrete – Microstructure, Properties and Materials, 3 rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, Prentice-Hall, Inc., 2006.

T2. Mohajerani A. etal, Amazing Types, Properties and Applications of Fibres in Construction Materials, Volume 12, 2019.

T3. JSCE subcommittee, Standard specifications for concrete structures – 2007 "Materials and construction", Report: JSCE guidelines for concrete (No. 16), Japan Society of Civil Engineers, Tokyo, Japan, 2010.

References:

R1. IS 1199(Part-6):2018, Fresh Concrete- Methods of Sampling, Testing and Analysis.

R2. Recommendation for Self Compacting Concrete, JSCE Newsletter.

R3. IS 9012:1978, 'Recommended Practice for Shotcreting'.

Weblinks:
https://onlinecourses.nptel.ac.in/noc22_ce09/preview

E-BOOKS:

1. Special Concrete and Composites 2017 (Sustainable concrete and Composites) https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1690704&site=ehost-live&ebv=EB&ppid=pp_169
2. High Performance Concrete – Innovation & Utilization https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=862193&site=ehost-live&ebv=EB&ppid=pp_389
3. Developments in Fiber-Reinforced Polymer (FRP) Composites for Civil Engineering https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=675924&site=ehost-live&ebv=EB&ppid=pp_178

Topics relevant to "EMPLOYABILITY SKILLS": Compaction of concrete- Process of compaction, Effect on fresh concrete, Effect on Hardened concrete, Effect of Over compaction, types of Compaction. Typical Applications of Shotcrete/ Gunite, Characteristics of Shotcrete, Importance of Right Methods and Specifications, Heat of hydration of cement and thermal stresses, Concreting Underwater, Roller Compacted Concrete for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Divya Nair
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3019CIV3119	Course Title: Safety in Construction Type of Course: Elective & Theory Only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course provides the concepts knowledge about the significance of Safety in Construction and to develop the basic abilities of safety management. The course is more of conceptual in nature and needs fair knowledge of causes for construction accidents. This course mainly focusses on management aspects of construction project safety. The course develops the construction site safety skills by attaining quality. This course aims to make the students well-versed with the latest safety and health regulations and the Indian Standards applicable to the construction industry. Students will be able to plan, assess, analyze and manage the hazardous construction project sites.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Safety in Construction and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **1)** Describe construction project management process. **2)** Discuss safety for construction projects. **3)** Apply construction safety rules, solutions for safety related issues in construction site.					
Course Content:						
Module 1	Project Organization Management	Assignment	Data Collection	10 Sessions		
Topics: Construction Projects: Concept, Project Categories, Characteristic of projects, project life cycle phase, Project Management- Project Management Function, Role of Project Manager, Organizing for Construction - Principles of organization, type of organization structure.						
Module 2	Safety Management	Case Study	Data Collection	12 Sessions		
Topics: Safety in Construction: Causes, classification, cost of an accident, safety programme for construction, protective equipment, accident report. Types of injuries, Personal & Structural safety. Recording injuries, Safety aspects. Construction Accident Statistics, Factors Affecting Effectiveness of Safety Programmes and Safety Performance on Construction Sites, Safety Auditing and Its Use in Proactive Prevention of Accidents. Introduction to OSHA regulations.						
Module 3	Construction Safety	Case Study	Data Collection	12 Sessions		
Topics: Safety consideration during construction, demolition, storage and handling of building materials and during use of equipment. Safety legislation and Standards, SoPs (Safe Operating Procedures) – Construction equipment, materials handling-disposal & hand tools.						
Targeted Application & Tools that can be used: Construction Sites, EHS dept.						
Text Books: T1. Hinze, J.W. (1997) Construction Safety, Prentice Hall T2. Mac Collum, D.V. (1995) Construction Safety Planning, John Wiley & Sons						

T3. Reese, C.D. & Eidson, J.V. (2006) Handbook of OSHA Construction Safety and Health, Taylor & Francis.
T4. Lingard, H. & Rowlinson, S. (2005) Occupational health and Safety in Construction Project Management, Spon Press.

References:

R1. David Gold Smith, Mc Graw Hill, *"Safety Management in construction and Industry" 1987.*

R2. K N Vaid, *"Construction Safety Management", NICMAR, Bombay*

R3. "Project Management Body of Knowledge" (PMBOK® GUIDE, Guide, A.), Project Management Institute, 2001.

Weblinks:

https://onlinecourses.nptel.ac.in/noc21_ce16/preview

https://onlinecourses.nptel.ac.in/noc22_mg55/preview

https://nptel.ac.in/courses/110/105/110105094/

https://web.p.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMjQ2NDA2OF9fQU41?sid=3281a842-6740-4e2b-a3d5-36b396d796c3@redis&vid=4&format=EB&rid=4

https://web.p.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMzIyMDcyX19BTg2?sid=3281a842-6740-4e2b-a3d5-36b396d796c3@redis&vid=5&format=EB&rid=1

Topics relevant to "EMPLOYABILITY SKILLS": Project Management- Project Management Function, Role of Project Manager, Safety management, Organizing for Construction, Principles of organization for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Sowmyashree T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3013CIV3113	Course Title: Advanced Concrete Technology Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2100 Building Materials and Concrete Technology, CIV2511 Concrete and Highway Materials Testing Lab					
Anti-requisites	NIL					
Course Description	This course enables the students to study the composition and microstructure of concrete along with their influence on strength and deformation characteristics of concrete. The course will also focus on serviceability of concrete as well as various tests to assess the durability of concrete. Students will learn about different methods of placing and curing concrete in different conditions. Students will also be exposed to the material requirements, mix proportioning and application of special concretes namely, HPC, SCC, GPC and HPFRC.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Advanced Concrete Technology and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Interpret the influence of the concrete components and admixtures on the properties of concrete 2] Predict the properties and durability of hardened concrete 3] Identify the correct concreting methods in the field depending upon the site condition 4] Choose the suitable concrete for different structures considering the on-site/client's requirements.					
Course Content:						
Module 1	Concrete Composition and their Influence on Concrete Properties	Market Survey	Survey and analysis of different cements as well chemical admixtures available in the market	9 Sessions		
Topics: Cement and its composition, types and grades of cement, Micro-structure of hydrated cement, Special cements, Aggregates for concrete, Chemical and Mineral Admixtures and their influence on properties of concrete.						
Module 2	Serviceability and Durability of concrete	Article Review	Article review on durability assessment of existing concrete structures.	10 Sessions		
Topics: Elasticity, Stress Strain MOE – relationship, Shrinkages – Types, Factors affecting Shrinkage, Mechanism of Shrinkage, Creep- Factors Influencing Creep, Relation Between Creep and Time, Mechanism of Creep, Effect of Creep, Durability of concrete, Permeability of Concrete, physical and chemical causes for distress in concrete - Chloride Diffusion, Carbonation, Acid attack on concrete, Sulfate attack on concrete, Efflorescence, Effects of sea water on concrete, Disruption by alkali–silica reaction, Abrasion of concrete, Erosion resistance, Cavitation resistance, Types of cracking, Thermal Properties (fire and temperature), Resistance to Wear and other Properties.						
Module 3	Placing and Curing of concrete	Project	Carry out and report the results of Non-destructive tests on structural elements in the buildings of Presidency University Campus	9 Sessions		
Topics:						

Fresh and hardened concrete properties, Special concreting techniques (Placing), Sprayed concrete, underwater concrete, grouting, slip form construction, pumped concrete, concrete for liquid retaining structures, vacuum process, concrete coatings and surface treatments, concreting in hot and cold weather, mass concreting, RMC, Compacting, Curing-methods, QC and QA of concrete, Repair and maintenance, Non-destructive testing methods.				
Module 4	Special Concretes	Programming Assignment	Write a program to carry out mix design of High performance concrete and Self compacting concrete as per IS 10262:2019 for a given set of input data.	9 Sessions
Topics: High strength concrete, high performance concrete, self-compacting concrete, light weight concrete, autoclaved aerated concrete, fibre reinforced concrete, foam concrete, geopolymer concrete, mix design for self-compacting and high-performance concrete, Factors influencing mix proportions.				
Targeted Application & Tools that can be used: Applications include all types of construction industries and infrastructure projects during as well as in RMC Plants. Tools: MS Excel/ C/ Python Programming				
Text Book 1. Neville A.M., "Properties of Concrete", Prentice Hall, 5th Edition 2012. 2. Shetty, M.S., "Concrete Technology: Theory and Practice", S. Chand and Co. Pvt. Ltd., Delhi, 2005. 3. Santhakumar A.R., "Concrete Technology", Oxford University Press India, 2006.				
References 1. Mehta, P.K. (1983), Concrete – Structure, Properties and Materials, Prentice Hall, New Jersey, USA. 2. Pierre-Claude Aitcin, "High Performance Concrete", Taylor & Francis, 2011. 3. Mary Krumboltz Hurd, "Formwork for Concrete", American Concrete Institute, 2005. 4. IS: 10262 (2019), Concrete Mix Proportioning – Guideline, BIS, New Delhi E-Resources 1. https://nptel.ac.in/courses/105/106/105106176 - Advanced Concrete Tcehnology NPTEL Course by Dr. Manu Santhanam 2. N V Nayak, A K Jain, "Handbook on Advanced Concrete Technology", Alpha Science International Ltd., Oford, UK, 2012. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1752766&site=ehost-live				
Topics relevant to development of "EMPLOYABILITY": Mix Design procedure for Special Concrete, Knowledge of Durability and Non-destructive Tests, Placing and curing Techniques for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Gopalakrishnan N			
Recommended by the Board of Studies on	BoS No. 11 held on 05 September 2020			
Date of Approval by the Academic Council	Academic Council Meeting No. 13 held on 06 November 2020			

<table>
<tr><td>Course Code: CIV3400</td><td colspan="3">Course Title: Structural Dynamics
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">[1] Engineering Mathematics [2] CIV2506 Analysis of Determinate structures [3] CIV2507 Analysis of Indeterminate structures

Basic Knowledge of differentiation and integration of mathematical equations are required along with the methods of analysis of determinate and indeterminate structures.</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The course will enable the students to gain knowledge of structural dynamics and principles for analysis of structures under dynamic loading. It deals with the concept of degree of freedom, modelling of structures as single degree and multi degree of freedom system, free and forced vibration in structures and the concept of damping in structures. The course also deals with the analysis of structural systems under various types of dynamic loading and introduces the concept of shear building.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Structural Dynamics and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of the course the students shall be able to:
1. Analyse the structures under dynamic loading.
2. Model any given structure as single and multi-degree of freedom systems.
3. Model a shear building as MDOF and analyze the response.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Structural dynamics and free vibration of SDOF systems</td><td>Assignment</td><td colspan="2">Numerical models of SDOF systems</td><td colspan="2">8 Sessions</td></tr>
<tr><td colspan="9">Topics:
Introduction to structural dynamics, brief history of vibration, Basic definitions, vibration of SDOF (Single Degree of Freedom) systems, undamped, Damped, Free vibrations, equivalent viscous damping, Logarithmic decrement.</td></tr>
<tr><td>Module 2</td><td colspan="2">Forced vibration of SDOF systems</td><td>Assignment</td><td colspan="2">Model a response spectrum for systems under various loadings</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Forced vibrations of SDOF system, Response of undamped and damped system subjected to harmonic loading, response to SDOF subject to harmonic base excitation, Duhamel’s integral, response to general system of loading, dynamic load factor, response spectrum.</td></tr>
<tr><td>Module 3</td><td colspan="2">Vibration of MDOF systems</td><td>Assignment</td><td colspan="2">Numerical models of MDOF systems</td><td colspan="2">6 Sessions</td></tr>
<tr><td colspan="9">Topics:
Free vibration of MDOF (Multi Degree Freedom System), Natural frequencies, Normal modes, Orthogonality of normal modes, Eigen Values. Free vibrations, Natural frequencies.</td></tr>
<tr><td>Module 4</td><td colspan="2">Shear modeling of buildings</td><td>Assignment</td><td colspan="2">Program the equations for obtaining shear building responses</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Forced vibrations, Shear buildings modelled as MDOF systems, Motion of shear buildings, Model Superposition Method, Response to shear buildings, Base motion, Harmonic fixed</td></tr>
</table>

excitation. Damped motion of shear buildings, Equations for damped shear buildings, uncoupled damped equations, conditions for damping uncoupled.
Targeted Application & Tools that can be used: The Course helps the students to understand the response of structures and analyse the structures under vibrations/dynamic loading. It enables them to model a structure as single degree of freedom systems and multi degree of freedom systems and analyse them. It also enables them to model a shear building and study their response.
Text Books: 3. Mario Paz,"Structural Dynamics", CBS publishers. 4. M. Mukhopadhaya,"Structural Dynamics: Vibrations & Systems", Anne Books Pvt. Ltd.
References 3. Clough & Penzien, "Structural Dynamics", Tata Mc Graw Hill. 4. Anil K. Chopra, "Dynamics of Structures – Theory and Application to Earthquake Engineering", 2nd Edition, Pearson Education. PU e-Library Resources 1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=249104&site=ehost-live
Topics related to Employability Skill: Analysis of single and multi-degree of freedom structural system subjected to free and forced vibrations. Analysis of shear buildings modeled as multi-degree of freedom systems for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3401	Course Title: Advanced RCC Structures Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	CIV2507 Analysis of Indeterminate Structures Design of RCC Structures					
Anti-requisites	NIL					
Course Description	This course enables understanding of the concepts for designing special RC structural elements for different loading conditions. The course is both conceptual and analytical in nature which enable applying mathematical and engineering knowledge to understand the behavior of the structure. The course focuses on computing the internal forces which are required to determine the required cross-sectional dimensions and reinforcement to carry the external load or to resist the induced internal forces.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Advanced RCC Structures and attain Employability Skills through Problem Solving.					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Illustrate the design concepts of building frames by limit state approach. 2. Sketch the reinforcement details for RC flat slabs with or without drops. 3. Compute the required cross-sectional area of steel for a combined foundation as per BIS codal provisions. 4. Compute the required cross-sectional area of steel for a water tank as per BIS codal provisions.					
Course Content:						
Module 1	Concepts of Limit State Design and Design concepts of Portal Frames	Assignment	Numerical problems with Software Programming	12 Sessions		
Topics: Basic concept of R.C. design and behavior of R.C members under different loading conditions. Transmission of Load path in rigid frames, Analysis of Portal frames with different end conditions and design concepts of portal frame as per BIS codal provisions.						
Module 2	Flat Slabs	Assignment	Numerical problems with Software Programming	12 Sessions		
Topics: Introduction of flat slab, components of flat slab, classification and behavior of flat slabs, BIS codal provisions, design methods- Direct design and equivalent frame method, design concept for flat slabs with and without drops.						
Module 3	Combined foundation	Assignment	Numerical problems with Software Programming	12 Sessions		
Topics: Combined Foundations - Introduction to combined foundations, Types of combined foundations, Design concept of rectangular and trapezoidal combined footings.						

Module 4	Water Tanks	Assignment	Numerical problems with Software Programming	12 Sessions

Topics:
Design of Water tanks – Design Requirements, Design of a Circular Tank resting on the ground, Design of a Rectangular tank resting on the ground

Targeted Application & Tools that can be used:
The knowledge acquired by the students help in designing the structural components which are provided in Warehouses, Hangars, Factories, Large retail units etc. Flat slab will be provided in commercial buildings for longer spans and also to enhance the aesthetic appearance of the structure. The Mat and combined foundation are adopted for multistoried buildings and where soil is soft.
Professionally Used Software: STAAD Pro, ETABS, MATLAB, SAP 2000 and Auto CAD Software.

Text Book:

T1. P. C. Varghese, *Advanced Reinforced Concrete Design, PHI Learning Private Ltd., New Delhi, 2011*

T2. P. C. Varghese, *Design of Reinforced Concrete Foundations, PHI Learning Private Ltd., New Delhi, 2010*

References:

R1. Varghese P C, *Limit State Design of Reinforced Concrete*, Prentice Hall of India, New Delhi

R2. Thomas Paulay, R. Park, *Reinforced Concrete Structures, John Wiley and sons New York*.

R3. Krishna Raju. N., *Advanced Reinforced Concrete Design, CBS Publishers & Distributors*

R4. SP-16: IS 456 Design hand book:

R5. IS 456 :2000 Code of Practice for Plain and Reinforced Concrete

Youtube link:

http://www.digimat.in/nptel/courses/video/105105105/L10.html

https://www.youtube.com/watch?v=undsd92MM8w

E BOOKS:

Advanced R.C.C. Design (RCC Volume- II)

https://web.p.ebscohost.com/ehost/detail/detail?vid=5&sid=985d933d-b358-4a32-870e-f536d9bd0e8c%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=2706885&db=nlebk

Reinforced Concrete: Design, Performance and Applications

https://web.p.ebscohost.com/ehost/detail/detail?vid=8&sid=985d933d-b358-4a32-870e-f536d9bd0e8c%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1488063&db=nlebk

Topics relevant to development of "EMPLOYABILITY SKILL":
Design concept for flat slabs with and without drops, Design concept of rectangular and trapezoidal combined footings, Design concept of water tanks for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Divya Nair/ Dr. S.B. Anadinni

Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/22

Course Code: CIV3402	Course Title: Design of Industrial Structures Type of Course: Discipline Elective & Theory only		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CIV 3002, CIV 3003, CIV 3004, CIV 3006					
Anti-requisites	NIL					
Course Description	This course deals with requirements, planning and design of industrial structures. It covers the different types of industrial structures and planning of Industrial Structures including the requirements regarding Lighting, Ventilation and Fire Safety – Protection against noise and vibration –as per Guidelines of Factories Act. It also include the design of auxiliary structures like Bunkers & Silos, Chimneys and Pipes. The course also focus on large span roof structures and structural aspects of foundation for industrial structures					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Design of Industrial Structures and attain Employability Skills through Problem Solving methodologies					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Understand the planning and functional requirements of various industries. 2] Demonstrate about the materials used and design of industry structural elements 3] Realize the basic concepts and design of power plant structures and design of power transmission structures. 4] Possess the ability to understand the design concepts of chimneys, bunkers and silos.					
Course Content:						
Module 1	Planning and functional requirements of Industrial Structures	Assignment	Numerical problems	06 classes		
Topics: Classification of Industries and industrial structures - Planning for Layout requirements regarding lighting, ventilation and fire safety - Protection against noise and vibration - Guidelines of Factories Act.						
Module 2	Industrial Buildings	Assignment	Numerical problems	10 classes		
Topics: Roofs for industrial buildings - Steel and RCC - Gantry girders - Design of corbels and nibs – Machine foundations						
Module 3	Power Plant & Power Transmission Structures	Assignment	Numerical problems	10 classes		
Topics: Types of power plants – Design of turbo generator foundation – Containment structures, Principles of analysis and design of lattice towers - Transmission towers - Tower foundations – Testing Towers						
Module 4	Auxiliary Structures	Assignment	Numerical problems and validate by software	06 classes		
Topics: Design of steel and RCC Chimneys – Bunkers and silos.						
Targeted Application & Tools that can be used:						

Application area is design of industrial structures along with the planning and functional requirements of Industries. Design of Industrial structures like power plant and power transmission towers, steel and RCC chimneys.
Professionally Used Software: StaadPro/Rivet

Text Books:

1. Advanced Reinforced Concrete Design, By N. Krishna Raju (CBS Publishers & Distributors).
2. Design of Steel Structures, By Ram Chandra.
3. Manohar S.N, "Tall Chimneys - Design and Construction", Tata McGraw Hill, 1985
4. Dunham, C.W., Planning of Industrial Structures, John Wiley and Sons(2001).
5. Santhakumar A.R. and Murthy S.S., "Transmission Line Structures", Tata McGrawHill, 1992.

References

1. Srinivasulu P and Vaidyanathan.C, "Handbook of Machine Foundations", Tata McGraw Hill, 1976.
2. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", Birkhauser Publishers, 2004. 5.
3. Procs. of Advanced course on "Industrial Structures", Structural Engineering Research Centre, Chennai, 1982
4. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=143717050&site=ehost-live
5. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=143771675&site=ehost-live

Topics relevant to "Employability" :
Design of turbo generator foundation, design of lattice towers, transmission towers, testing Towers for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr.Dayalan J
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

<table>
<tr><td>Course Code: CIV3403</td><td colspan="4">Course Title: Repair and Rehabilitation of Structures
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">Building Materials & Concrete Technology, Design of RCC Structures</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Objectives</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Advanced RCC Structures and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Description</td><td colspan="9">This course helps learn how to identify various deterioration mechanisms or damage mechanisms in concrete structures. Use of various non-destructive, partially-destructive tools to assess the condition of the structure will be discussed. Tips on selecting measurable parameters that are useful in deciding the further repair and maintenance practices will be provided. Typical practices for near-surface repair, corrosion protection, structural strengthening, structural stabilization, etc. will be discussed in detail. The course helps to suggest evaluation and repair/retrofitting methods for extending the service life of concrete structures. Importance for preventive maintenance practices (instead of corrective maintenance practices) will be discussed throughout the coursework.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of the course the students shall be able to:
1. Explain the cause(s) for deterioration of structures.
2. Describe the Non-Destructive Test (NDT) methods available for conditional field assessment of a structure
3. Discuss repair material(s) to retrofit a deficient member.
4. Demonstrate appropriate method for strengthening a distressed structure.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="3">Deterioration causes</td><td>Assignments</td><td colspan="3">Article review</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Introduction - Permeability of concrete, aggressive chemical agents, concrete defects, durability aspects, distress identification and repair management - Causes of distress in concrete structures - Holistic Models for deterioration of concrete.</td></tr>
<tr><td>Module 2</td><td colspan="3">Inspection and NDT</td><td>Assignments</td><td colspan="3">Case study on application of NDT and Data analysis</td><td colspan="2">12 Sessions</td></tr>
<tr><td colspan="10">Topics
Condition Survey- Definition, objectives, different stages - Preliminary inspection, planning stage, visual inspection, field and laboratory testing. Non-Destructive evaluation tests - Concrete strength assessment- Rebound hammer test - Ultrasonic pulse velocity tests, penetration resistance, pull out tests, core sampling and testing - Chemical Tests - Carbonation and chloride content, Corrosion potential assessment- cover meter survey, half-cell potentiometer test, resistivity measurement, Evaluation of reserve strength of existing structures.</td></tr>
<tr><td>Module 3</td><td colspan="3">Repair Materials</td><td>Assignment</td><td colspan="3">Market Survey</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Selection of repair materials for concrete - performance requirements of repair systems, Strength and durability aspects, cost and suitability aspects, Materials for repair - Premixed cement concrete and mortars, polymer modified mortars and concrete, epoxy systems including epoxy mortars and concrete, polyester resins, coatings.</td></tr>
</table>

Module 4	Repair Methods and Case studies	Assignment	Case study on RCC jacketing techniques	12 Sessions

Topics

Repair methods - Chemical and electrochemical method of repair, Guniting, shotcreting, Resin/polymer modified slurry injection, polymer concrete system, reinforcement replacement, plate bonding technique, polymer and epoxy overlays, fiber-wrap technique, ferrocement jacketing, RCC jacketing, propping and supporting, foundation rehabilitation methods, NSM method.

Discussion of case studies of RCC buildings, water tanks, industrial structures subjected to distress, Contracts and Specification.

Targeted Application & Tools that can be used:

The Course enables the students to identify the cause of deterioration and distress in the structures. Use of appropriate NDT equipment for obtaining the data such as reserve strength and corrosion penetration and estimation of extent of chemical attack. The course also enables the students to choose an appropriate material for repair of structures and suitable methods of strengthening the structures.

Project work/Assignment:

1] Conducting a case study of a Block in the University to obtain the data such as surface hardness of different components using Rebound Hammer.

2] Model a structural component with any jacketing technique using ANSYS and assess the improvement in strength.

Text Books:

1. "CPWD Handbook on Repair and Rehabilitation of RCC buildings", Govt of India Press, New Delhi, 2002.
2. R.N. Raika, "Learning from failures - Deficiencies in Design, Construction and Service" Rand Centre (SDCPL), Raikar Bhavan, Bombay, 1987
3. Dr. B. Vidivelli, "Rehabilitation of Concrete Structures", Standard Publishers, 2009.

References

1. Santhakumar A.R., "Concrete Technology" Oxford University Press, New Delhi, 2007
2. J.G. Teng, J.F. Chen, S.T. Smith, L. Lam, "FRP: Strengthened RC Structures", Wiley Publications.
3. 440.2R-10/17: Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.

E-Resources

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=NAP_1_3580

Topics relevant to development of "EMPLOYABILITY SKILL": NDT tests, Selection of suitable materials for repairs, Methods of repair, Retrofitting/Jacketing techniques for developing Employability Skills through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Nakul R/ Mr. Gopalakrishnan N
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/22

<table>
<tr><td>Course Code: CIV3404</td><td colspan="4">Course Title: Matrix methods of Structural analysis
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">Basic knowledge of Arithmetic, Fundamentals of Matrices and Determinants and Basics of Structural analysis.</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">This course will help students formulate otherwise a complex structural beam, frame or a truss problem into simple matrices and obtain the solutions in terms of Axial force, Shear force, Bending moment, Slope and Deflection by simplifying them. The course will help in analyzing both determinate and indeterminate beams, plane frames and trusses by Flexibility (force) as well as Stiffness (displacement) approach to draw the Shear force diagram and Bending moment diagrams.</td></tr>
<tr><td>Course Objectives</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Matrix methods of Structural analysis and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of the course the students shall be able to:
1. Estimate the structural systems to application of concepts of flexibility and stiffness matrices for simple problems.
2. Identify, formulate and solve engineering problems with respect to flexibility and stiffness matrices as applied to continuous beams, rigid frames and trusses.
3. Identify, formulate and solve engineering problems by application of concepts of direct stiffness method as applied to continuous beams and trusses.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Matrix Method of Structural analysis</td><td>Assignments</td><td colspan="3">Theory based questions</td><td colspan="3">6 Sessions</td></tr>
<tr><td colspan="10">Topics: Structural systems, geometric and material non-linearity, principle of superposition, equilibrium and compatibility conditions, static and kinematic indeterminacy, principle of minimum potential energy and minimum complementary energy, concepts of stiffness and flexibility, flexibility and stiffness matrices of beam and truss elements.</td></tr>
<tr><td>Module 2</td><td colspan="2">Element Flexibility Method</td><td>Assignments</td><td colspan="3">Analysis by flexibility method and use of STAAD Pro/ ETABS</td><td colspan="3">10 Sessions</td></tr>
<tr><td colspan="10">Topics: Force transformation matrix, global flexibility matrix, analysis of continuous beams, rigid frames and trusses.</td></tr>
<tr><td>Module 3</td><td colspan="2">Element Stiffness Method</td><td>Assignment</td><td colspan="3">Analysis by stiffness method and use of STAAD Pro/ ETABS</td><td colspan="3">10 Sessions</td></tr>
<tr><td colspan="10">Topics: Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, rigid frames and trusses.</td></tr>
<tr><td>Module 4</td><td colspan="2">Direct Stiffness Method</td><td>Assignment</td><td colspan="3">Analysis by direct stiffness method and use of STAAD Pro/ ETABS</td><td colspan="3">8 Sessions</td></tr>
<tr><td colspan="10">Topics: Local and global coordinates systems, principle of contra gradience, global stiffness matrices of beam and truss elements, analysis of continuous beams and trusses.</td></tr>
<tr><td colspan="10">Targeted Application & Tools that can be used:
The Course enables the students to analyse continuous beams, plane trusses and frames using flexibility method, stiffness method and direct stiffness method. This course will also enable them to draw the force diagram for trusses and shear force and bending moment diagrams</td></tr>
</table>

for continuous beams and plane frames after the analysis. The data obtained after analysis can be verified by using professionally used softwares such as STAAD Pro and ETABS.

Text Books:

1. Weaver W and Gere J H, "Matrix Analysis of Framed Structures", CBS publications, New Delhi.
2. Rajasekaran S, "Computational Structural Mechanics", PHI, New Delhi.
3. Madhujit Mukhopadhay and Abdul Hamid Sheikh, "Matrix and Finite Element Analysis of Structures", Ane Books Pvt. Ltd.

References

1. Godbole P N et.al, "Matrix Method of Structural Analysis", PHI ltd, New Delhi.
2. Pundit and Gupta, "Theory of Structures Vol II", TMH publications, New Delhi
3. A K Jain, "Advanced Structural Analysis", Nemchand Publications, Roorkee

Web Links

https://nptel.ac.in/courses/105105180

PU e-Library Resources

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1227287&site=ehost-live

Topics relevant to Employability Skills: Structural systems, concepts of stiffness and flexibility, analysis by flexibility and stiffness matrices for beam, frame and truss elements for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mr. Ajay H A
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV3405	Course Title: Masonry Structures Type of Course: Discipline Elective and Theory	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Basic Knowledge of Concrete technology and design of RC structures					
Anti-requisites	NIL					
Course Description	The objective of this course is to understand properties of masonry units, design criteria of various types of wall subjected to different load system and to provide knowledge in analysis and design of masonry elements. This course is a basic course on design of masonry structures. It deals with the properties of masonry units, strength properties, behavior of masonry walls under different loading conditions. The course also deals with the design of masonry walls subjected to axial, eccentric and transverse load. The students having basic knowledge of structural analysis and strength of materials can easily understand this course. This Course helps students to understand the concept of analysis and design of masonry elements.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Masonry Structures and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Summarize the properties of masonry units, strength and factors affecting strength 2) Infer codal provisions applicable to design of masonry structures 3) Illustrate the design principles for design of a masonry wall subjected to axial and eccentric load					
Course Content:						
Module 1	Introduction to Masonry	Assignment	Data Collection	10 Sessions		
Topics: Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units- strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks. Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.						
Module 2	Codal Provisions and Design Considerations	Assignment	Data Collection	11 Sessions		
Topics: Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses. Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls and cavity walls.						
Module 3	Design of Masonry Walls	Assignment	Data collection	14 Sessions		
Topics: Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL. Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, design of wall with openings. Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls.						

Targeted Application & Tools that can be used: Inspection and Design of Masonry Structures, Rehabilitation of historical structures Staad Pro, Excel, Matlab	
Textbooks: T1. Henry, A.W., "Structural Masonry", Macmillan Education Ltd., 1990. T2. Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH, 1987. T3. M. L. Gambhir, "Building and Construction Materials", Mc Graw Hill education Pvt. Ltd.	
References: R1. IS 1905–1987 "Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi. R2. SP 20 (S&T) – 1991, "Hand book on masonry design and construction (1st revision) BIS, New Delhi. Additional web-based resources W1. NPTEL Course – Design of Masonry Structures, Arun Menon https://nptel.ac.in/courses/105106197/	
Topics related to "Employability Skills": Design of Masonry Walls for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Nakul R
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/22

<table>
<tr><td>Course Code: CIV3406</td><td colspan="4">Course Title: Advanced Design of Steel Structures
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">CIV2507 - Analysis of Indeterminate structures
CIV3004 - Design of Steel Structures</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">The objective of this course is to understand the plastic behavior of structures and the principles of plastic analysis of Structures as well as to expose students to design of steel trusses and gantry girder. The main objective of this course is to provide civil engineering students with the knowledge of plastic analysis and behavior as well as design of steel structures. This course is a second level course on steel structures. It deals with the plastic behavior of structures, plastic analysis, and development of plastic hinges. It also deals with the design of steel trusses and gantry girders as per limit state of design following the Indian codal provisions. The basic knowledge of structural analysis and design of steel structures is essential to easily understand this course. This Course helps to design steel trusses for supporting the roof of industrial structures, railway stations and to design gantry girders used in factories and manufacturing industries to lift and move heavy machinery/equipment.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Advanced Design of Steel Structures and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of this course the students shall be able to:
1] Demonstrate the design procedure for Laterally Unrestrained Beams
2] Explain the concept of plastic analysis and fire resistance for structural steel elements.
3] Demonstrate the design concept of Cold formed Steel sections.
4] Choose appropriate steel sections for different components of a steel roof truss.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="2">Laterally Unrestrained Beams</td><td>Assignment</td><td colspan="2">Numerical problems from E-resources</td><td colspan="3">10 sessions</td></tr>
<tr><td colspan="10">Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, Mono- symmetric and non- uniform beams – Design Examples. Concepts of Shear Center, Warping, Uniform and Non-Uniform torsion</td></tr>
<tr><td>Module 2</td><td colspan="2">Plastic Analysis and Fire Resistance of Structural Steel</td><td>Assignment</td><td colspan="2">Case study on fire protection measures in various steel structures</td><td colspan="3">10 Sessions</td></tr>
<tr><td colspan="10">Introduction to plastic behaviour of Structural steel, Plastic theory, Plastic hinge concept, Plastic collapse load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis, conditions of plastic analysis, Plastic analysis of Beams.
Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance Ratings. Numerical Examples.</td></tr>
<tr><td>Module 3</td><td colspan="2">Design of Cold formed steel sections</td><td>Assignment</td><td colspan="2">Numerical problems from E-Resources</td><td colspan="3">08 Sessions</td></tr>
<tr><td colspan="10">Techniques of manufacture and properties of Cold formed steel sections, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801 & 811 code provisions for Design of Cold Form sections. Numerical examples on beam design and column design.</td></tr>
</table>

Module 4	Design of Steel Roof Truss	Assignment	Numerical problems from E-Resources	08 Sessions
Introduction and Types of Roof Trusses, Selection of type of trusses, Types of member sections and selection of sections, Loads on roof trusses and load combinations, Deflection of Trusses, Design procedure for a Roof Truss, Design of Rafter, purlins and ties, Connections in trusses.				
Targeted Application & Tools that can be used: Application area is application of design of steel trusses and gantry girders as per limit state of design following the Indian codal provisions and design of steel trusses for supporting the roof of industrial structures, railway stations and to design gantry girders used in factories.				
Text Books: 1 . Duggal S.K, *"Limit State Design of Steel Structures"*, Tata Mac Graw Hill, New Delhi, 2010. 2. N. Subramanian "Design of Steel Structures"- Oxford, 2008.				
References 1 . Ramachandra, "Limit State of Design of Steel Structures" Standard Book House - 2012. 2. Web Based Resource: NPTEL Course on "Design of Steel Structures II", Prof. S.R.Satish Kumar and Prof. A.R.Santha Kumar. https://nptel.ac.in/courses/105/106/105106113/ E-Resources https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=210034&site=ehost-live				
Topics relevant to "Employment Skill": Selection of members for roof truss, cold formed steel design using software for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Gopalakrishnan N			
Recommended by the Board of Studies on	14th BOS held on 30/07/2022			
Date of Approval by the Academic Council	Academic Council Meeting No. 18 dated 01/08/22			

Course Code: CIV3407	Course Title: Design of Retaining Structures Type of Course: Discipline Elective Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	[1] CIV2514 Foundation Engineering [2] CIV2508 Design of RCC structural Elements Concepts of lateral earth pressure under different soil conditions and Limit states and Working stress method of design of RCC structural elements.					
Anti-requisites	NIL					
Course Description	The course will enable the students to understand effect of the lateral earth pressure on the cantilever retaining walls for different soil conditions and suggesting a suitable type of retaining wall. The course also helps the students to calculate the hydrostatic pressure distribution on the walls of rectangular and circular water tanks resting on the ground. The students can apply the analytical skill and design concepts to draw the structural details.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Design of Retaining Structures and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Calculate the lateral earth pressure on a cantilever retaining walls. 2. Sketch the reinforcement details for components of retaining structures as per IS456:2000. 3. Compute the hydrostatic pressure on the walls of rectangular and circular tanks resting on ground. 4. Show the structural details for circular water tank with flexible and rigid bases resting on the ground as per IS3370:2009.					
Course Content:						
Module 1	Cantilever retaining wall	Assignments	Numerical problems and validating the results by using STAAD pro	12 Classes		
Topics: Introduction to retaining wall, Lateral earth pressure, earth retaining structures, retaining walls, types. Cantilever retaining wall - Stability of retaining wall, structural action, factor of safety, shear key, design concept of components of cantilever retaining wall as per IS456:2000.						
Module 2	Circular water tank resting on ground	Assignment	Numerical problems and validating the results by using STAAD pro	12 Classes		
Topics: Circular water Tank: Types of tanks, hydrostatic pressure distribution on walls, Design concepts of circular tanks resting on ground with flexible base and rigid base as per IS:3370:2009.						
Module 3	Rectangular water tank resting on ground	Assignment	Numerical problems and validating the results by using STAAD pro	10 Classes		
Topics: Rectangular water tank: Types of tanks, hydrostatic pressure distribution on walls, Design concepts of rectangular tanks resting on ground as per IS:3370:2009.						
Targeted Application & Tools that can be used: The Couse enable the students to decide a suitable type of retaining structure to retain the earth in construction of roads in hilly regions and to provide the wing walls in bridges and culverts. The						

course also helps the students in adopting a suitable water tank in water supply scheme for rural and urban areas.
Professionally Used Software: STAAD pro/SAP.

Text Books:

1. Unnikrishnan Pillai and Devdas Menon., "Reinforced concrete Design", Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006
2. P. C. Varghese, "Advanced Reinforced Concrete Design", PHI Learning Private Ltd., New Delhi, 2011

References

1. Thomas Paulay, R. Park, "Reinforced Concrete Structures", John Wiley and sons New York.
2. B.C. Punmia, "Reinforced Concrete Structures", Laxmi Publishing Co.
3. Krishna Raju. N., "Advanced Reinforced Concrete Design", CBS Publishers & Distributors

PU e-Library Resources

1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=21603100&site=ehost-live
2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=6786140&site=ehost-live
3. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=148750142&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Suitability and structural action of cantilever retaining wall. Suitability and structural action of circular and rectangular water tanks, Topics related to Employability, Design concepts of cantilever retaining wall, Design concepts of circular and rectangular water tanks for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. S. B. Anadinni Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3408	Course Title: Elements of Earthquake Engineering Type of Course: Discipline Elective Theory Only Course		L-T-P-C	3	0	0	3
Version No.	1.1						
Course Pre-requisites	CIV2008 - Engineering Geology, CIV2512 - Geotechnical Engineering, CIV2508 - Design of RCC Structural Elements, CIV3004 - Design of Steel Structures						
Anti-requisites	NIL						
Course Description	This Course is designed to give an idea of basic seismology and its effects on structures. The objective of this course is to teach how to design a structure resistant to the natural force of an earthquake. The course includes basics of structural dynamics, engineering seismology, conceptual design, linear earthquake analysis and response spectra, load combinations. The course finds its application in effective design of Reinforced Concert Structures resistant to natural earthquake forces resulting from tectonic plate movements.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Elements of Earthquake Engineering and attain Employability Skills through Problem Solving methodologies.						
Course Out Comes	On successful completion of the course the students shall be able to: 1] Apply the basic principles of structural dynamics to calculate mode shapes 2] Describe the basic concepts of engineering seismology. 3] Recognize the detrimental effects of structural irregularity on seismic performance of a structure. 4] Apply the Indian Standard codal provisions for the seismic analysis of reinforced concrete structures.						
Course Content:							
Module 1	Dynamics for Earthquake Analysis	Assignment	Computation of Mode Shapes for a 4-storey RC Building	15 Sessions			
Topics: Equations of Motion – Newton's Law, D'Alembert's Principle, Degrees of Freedom, Simplified Single Degree of Freedom System, Equation of motion for free and forced vibration for un-damped and damped SDOF system. Mode shapes and frequency.							
Module 2	Engineering Seismology	Case Study	Case Study of any relevant past earthquake with presentation.	12 Sessions			
Topics: Causes of Earthquake – Elastic Rebound Theory, Theory of Plate Tectonics; Types of Seismic waves; Basic terms, Magnitude and intensity of Earthquake; Characteristics of Ground Motion; Classification of Earthquakes; Seismic zoning; Vertical irregularity and plan configuration problems, Conceptual Design - Building configuration – building characteristics – Quality of construction and materials.							
Module 3	Code Based Seismic Analysis Methods	Programming Assignment	Write a program to calculate base shear distribution for regular buildings using static and dynamic method.	10 Sessions			
Topics:							

Seismic design philosophy, Design Earthquake Loads and Load Combinations; Basic Assumptions, Methods of Elastic Analysis – Equivalent lateral force method, response spectrum method. Step-by-step Procedure for Seismic Analysis of a Multi-storeyed RC Building.	
Targeted Application & Tools that can be used: Applied in structural engineering consultancies to provide earthquake resistant design of structures. Tools: ETABS, Staad Pro.	
Text Book 1. Pankaj Agarwal and Manish Shrikande, "Earthquake Resistant Design of Structures", Prentice Hall of India Private Ltd, New Delhi 2. Duggal S K, "Earthquake Resistant Design of Structures". Oxford University Press, New Delhi	
References 1. Anil K Chopra, "Dynamics of Structures", Pearson Education, Asia, New Delhi 2. Dr. Vinod Hosur, "Earthquake-Resistant Design of Building Structures", Wiley Precise Textbook, New Delhi 3. https://nptel.ac.in/courses/105/101/105101004/ 4.https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2013888&site=ehost-live	
Topics relevant to development of "Employability": Mode shapes and frequency. Seismic design philosophy, Methods of Elastic Analysis – Equivalent lateral force method, response spectrum method. Step-by-step Procedure for Seismic Analysis of a Multi-storeyed RC Building for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Anju Mathew
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3409	Course Title: Bridge Design Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1] Structural Analysis, 2] CIV2508 Design of RCC Structural Elements Basic concepts of drawing SFD and BMD in flexural members, Influence line diagram, Basic concepts of rolling loads for maximum response of shear force and bending moment, Theory of Limit state Method of Design of Reinforced concrete structures, Design of RC Structural elements subjected to Flexural bending and shear.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to appreciate the need for Structural Analysis and Design of Road Bridges as per Indian Road Congress Code. The course will enable the students to learn the knowledge of various types of bridge systems and the Basic Concepts in Design of Road Bridges. The knowledge of bridge design is useful for designing bridges across highway or waterway. After successful completion of the Course, the students would acquire knowledge on the various types of bridge systems, Specification of Design of Road bridges, Various types of rolling loads as per IRC code, Design of RCC slab culvert, Design of RCC T-beam bridge System and PSC Bridge girders. The course is both conceptual and analytical in nature and needs fair knowledge of Strength of Materials, Structural Analysis and Design of RCC Structural Elements. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Bridge Design and attain Employability Skills through Problem Solving methodologies					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Summarize basic concepts in the selection of type of bridge for a given topography and functions of different components of bridges. 2] Identify the standard loadings on Road bridges as per IRC 6 Code. 3] Illustrate the design procedure for RCC Slab culvert, Box Culvert and RCC T beam as per IRC Codal provisions. 4] Analyze the abutment and piers for stability under different forces as per IRC.					
Course Content:						
Module 1	Introduction and Standard Load Specifications	Assignment	Case Studies on different types of bridges		9 Classes	
Topics: Introduction: Components of Bridges, classification of bridges, masonry, arches, RCC, PSC, Steel and composite, brief description of different types and proportionate sketching. Importance of bearings and Types of bearings Choice of bridge type - Importance of proper investigation. Standard Specifications of Road bridges: Indian Road Congress Bridge Code, Width of carriageway, Clearances, loads to be considered- Dead load, IRC Standard live loads, Impact effect, Review of IRC loadings.						
Module 2	Design of RCC Slab Culvert and Box Culvert	Assignment	Programming assignment on calculation of BM and		9 Classes	

			depth requirement for RC slab	
Application of live loads on deck slabs. Design of RCC Slab Culvert: Design of RCC slab culvert for IRC Class AA tracked vehicle and IRC Class 70 R loadings. Design of Box culvert (Single vent only) - Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF				
Module 3	Design of RCC T- beam Bridge	Assignment	Preparation of Spreadsheet for computing moments and shear force in deck slab for various loading condition	9 Classes
Design of T- beam Bridge system- Design of Deck slab, Design of Cross Girders and Longitudinal Girders, Reinforcement detailing in Deck, cross and Main Girders.				
Module 4	Substructures and Foundation	Assignment	Problems on Stability Analysis from E-resources	9 Classes
Types of Abutments and Pier. General features of Abutments, forces acting on abutments and Stability analysis of abutments. Forces acting on piers and Stability analysis of piers. Wing walls and types, Types of Bridge foundation.				
Targeted Application & Tools that can be used: Application Area is Infrastructure developing companies, Design and Construction Companies, Structural Consultancy Servicing Firms, Central and State Public Works Department. Professionally Used Software: Excel, MATLAB, SAP 2000, STAAD Pro, MIDAS.				
Text Book T1. Johnson D Victor, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co New Delhi. T2. Krishna Raju N, "Design of Bridges", Oxford and IBH Publishing Co New Delhi.				
References R1. S P Bindra, "Principles and Practice of Bridge Engineering", Dhanpat Rai and Sons New Delhi. R2. "IRC 6 – 2014 Standard Specifications and Code of Practice for Road Bridges Section II Loads and Stresses", the Indian Road Congress, New Delhi. R3. "IRC 112 – 2011 Standard Specifications and Code of Practice for Road Bridges Section III, Cement Concrete (Plain and Reinforced), the Indian Road Congress, New Delhi. E-Resources W1. Lin Weiwei, Teruhiko Yoda, "Bridge Engineering : Classifications, Design Loading, and Analysis Methods", Oxford : Butterworth-Heinemann. 2017 https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1144690&site=ehost-live				
Topics relevant to development of "Employability": Determination of design discharge-Linear water way, Economical span, Design of RCC slab culvert for IRC Class AA tracked vehicle and IRC Class 70 R loadings, Design of RCC T- beam and deck slab Bridge system, for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Ramachandra Gollar/ Mr. Gopalakrishnan N			
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022			

Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3410	Course Title: Stability of Structures Type of Course: Discipline Elective & Theory only		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	[1] Differential Equations [2] CIV2507 Analysis of Indeterminate structures [3] CIV3413 Theory of Elasticity [4] Fine Element Analysis Basic Knowledge of differential equations, theory of elasticity and finite element analysis is a must to understand and complete the course successfully					
Anti-requisites	NIL					
Course Description	The course deals with the basic concepts and principles of stability of structures. The course deals with the types of buckling and computing the buckling loads of columns; elastic buckling of frames and Plates. The course also includes analysis of the structural elements for stability.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Stability of Structures and attain Employability Skills through Problem Solving methodologies					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Compute the critical loads for discrete and continuous systems. 2. Demonstrate the use of shape functions in structures. 3. Compute the critical load of simply supported rectangular plates.					
Course Content:						
Module 1	Beam-Column	Assignment	Program the Euler's equation for different end conditions	8 Sessions		
Topics: Beam – column – Differential equation. Beam column subjected to lateral concentrated load, several concentrated loads and continuous lateral load. Application of trigonometric series, Euler's formulation using fourth order differential equation for pined – pined, fixed – fixed, fixed – free and fixed –pinned column.						
Module 2	Buckling of frames and continuous beams. Elastic Energy method	Assignment	Numerical problems on determination of critical loads	8 Sessions		
Topics: Approximate calculation of critical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Column subjected to non – conservative follower and pulsating forces.						
Module 3	Stability analysis by finite element approach	Assignment	Develop stiffness matrix for plate elements using MATLAB	10 Sessions		
Topics: Derivation of shape functions for a two noded Bernoulli-Euler beam element (lateral and translational dof) –element stiffness and Element geometric stiffness matrices – Assembled stiffness and geometric stiffness matrices for a discretised column with different boundary conditions – Evaluation of critical loads for a discretised (two elements) column (both ends built-in). Algorithm to generate geometric stiffness matrix for four noded and eight noded isoparametric plate elements. Buckling of pin jointed frames (maximum of two active dof)-symmetrical single bay Portal frame.						

Module 4	Buckling of simply supported rectangular plate	Assignment	Numerical problems on determination of critical loads	10 Sessions
Topics: Buckling of simply supported rectangular plate: Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides- Buckling of a Rectangular Plate Simply Supported along two opposite sides and uniformly compressed in the Direction Parallel to those sides.				
Targeted Application & Tools that can be used: The Course helps the students to understand the response of structures and analyse the structures under vibrations/dynamic loading. It enables them to model a structure as single degree of freedom systems and multi degree of freedom systems and analyse them. It also enables them to model a shear building and study their response.				
Text Books: 1. Stephen P.Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, McGraw – Hill, New Delhi. 2. H.Zeiglar, "Principles of Structural Stability"-Blaisdall Publications. Ltd.				
References 1. Alexandar Chajes, Principles of Structural Stability Theory, Prentice Hall, New Jersey. 2. N.G.R. Iyengar, Structural Stability of columns and plates, Affiliated East west press Pvt Ltd. PU e-Library Resources 1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=249104&site=ehost-live				
Topics related to Employability: Buckling of a Rectangular Plate Simply Supported along two opposite sides and uniformly compressed in the Direction Parallel to those sides for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout				
Catalogue prepared by	Dr. Nakul Ramanna			
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021			
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021			

Course Code: CIV3411	Course Title: Pre-fabricated Structures Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1] Building Construction, 2] CIV2500 Strength of Materials, 3] CIV2508 Design of RCC Structural Elements Structural Components of an Engineering structure, Basic concepts of drawing SFD and BMD in flexural members, Simple Bending Theory, Theory of Limit state Method of Design of Reinforced concrete structures, Design of RC Structural elements subjected to Flexural bending and shear.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to appreciate the knowledge of design of Pre-fabricated structures and execute the same for a given structure, different types of stresses acting on the structures while lifting the prefabricated structures and type of equipment required to support such stresses. The course will enable the students to learn the knowledge of various types of Prefabricates structures, Analysis and Design Principles and Erection methods of Pre-fabricated Structures. The course is both conceptual and analytical in nature and needs fair knowledge of Building construction, Strength of Materials and Design of RCC Structural Elements. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Pre-fabricated Structures and attain Employability Skills through Problem Solving methodologies					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe principles and components of prefabricated structures. 2] Choose the application of different prefabricated elements based on the project requirement. 3] Apply the knowledge of design, production and hoisting technology of prefabricated member.					
Course Content:						
Module 1	General Principles of Prefabrication	Assignment	Programming Task		9 classes	
Topics: Introduction, Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication - Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures – Disuniting of structures – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns – Symmetrical frames.						
Module 2	Prefabricated Elements	Assignment	Programming Task/Use of Structural Analysis and Design Softwares		9 classes	
Topics: Roof and floor panels, ribbed floor panels – wall panels – footings – Joints for different structural Connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings –Expansion joints in pre-cast construction. Designing and detailing of precast unit for factory structures –Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storeyed frames –Single storeyed buildings – slabs, beams and columns.						
Module 3	Production and Hoisting Technology	Term Paper			9 classes	
Topics:						

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. Equipment's for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads.				
Module 4	Design of Industrial Buildings	Term Paper		9 classes
Topics: Components of single-storey industrial sheds with crane gantry systems, Design of R.C. Roof Trusses, Roof Panels, Design of R.C. crane-gantry girders, corbels and columns, wind bracing design. Design Of Shell Roofs For Industrial Sheds: Cylindrical, Folded plate and hyper-prefabricated shells, Erection and jointing, joint design, hand book based design.				
Targeted Application & Tools that can be used:				
Application Area is Infrastructure developing companies, Design and Construction Companies, Structural Consultancy Servicing Firms, Central and State Public Works Department. Professionally Used Software: Excel, MATLAB, SAP 2000, STAAD Pro and Auto CAD Software.				
Text Book T1. L. Mokk, (2007), "Prefabricated Concrete for Industrial and Public Structures", Publishing House of the Hungarian Academy of Sciences, Budapest. T2. Marta Serrats(2012), "PreFab Houses Design"				
References R1. T. Koncz, (1971), "Manual of Precast Concrete Construction", Vol. I, II, III & IV, Berlin. R2. B. Lewicki, (1998), "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam, London, New York. R3. "Structural Design Manual, Precast Concrete Connection Details", (2009), Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag. R4. Hass, A.M, (1983), "Precast concrete design and Applications", Applied Science Publishers. Web Resources: https://nptel.ac.in/courses/124/105/124105013/ PU E-Resource: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=603814&site=ehost-live				
Topics relevant to development of "Employability": Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns – Symmetrical frames for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout				
Catalogue prepared by	Mr. Ramachandra Gollar			
Recommended by the Board of Studies on	BOS No: 12th BoS held on 07 August 2021			
Date of Approval by the Academic Council	16th Academic Council held on 23 October 2021			

Course Code: CIV3412	Course Title: Finite Element Method Type of Course: Discipline Elective & Theory Only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1] CIV2500 Strength of Materials, 2] CIV2507 Analysis of Indeterminate Structures Basic concepts of drawing SFD and BMD in flexural members, Simple Stresses and Strains, Shear Stresses in Beams, Theory of Simple bending and Torsion. Structural Analysis of Statically Indeterminate structures- Force and Displacement methods, Formulation of Stiffness and Flexible matrix.					
Anti-requisites	NIL					
Course Description	Finite element method was developed as a numerical method of stress analysis but now it has been extended as a general method of solution to many complex engineering problems. The main aim of this course is to enable to gain theoretical knowledge of the finite element method and its application with the ability to identify and rectify the errors while solving engineering problems and interpret the results from the analysis. The course is both conceptual and analytical in nature and needs fair knowledge of Strength of Materials and Basic knowledge of Structural Analysis. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Finite Element Method and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Understand the concepts behind formulation methods in Finite Element Method. 2] Develop element characteristic equation and generation of global equation. 3] Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, and solve them for displacements, stress and strains induced. 4] Identify the application and characteristics of FEA for elements such as bars, beams, plane and Isoperimetric elements.					
Course Content:						
Module 1	Theory of finite Element Method	Term paper	Data Analysis	12 Sessions		
Topics: Equilibrium, Boundary conditions, Strain Displacement relations, Stress – strain relations, One Dimensional Problems Finite element modeling coordinates, Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, shape functions. Direct stiffness method, Galerkin's method, Virtual work method, Variational method, Principles of Minimum potential energy, Rayleigh-ritz method						
Module 2	One-Dimensional Problems	Term paper	Data Analysis	10 Sessions		
Topics: One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.						
Module 3	Two Dimensional Scalar Variable Problems	Assignment	Programming Task, Data Analysis Task	8 Sessions		

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.				
Module 4	Two Dimensional Vector Variable Problems	Assignment	Programming Task, Data Analysis Task	7 Sessions
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.				
Module 5	Isoparametric Formulation	Term paper	Simulation/Data Analysis	6 Sessions
Topics: Basic theorems of isoparametric concept, Uniqueness of mapping, Iso-parametric, Super-parametric, Sub-parametric elements.				
Targeted Application & Tools that can be used: Application Area is Infrastructure developing companies, Design and Construction Companies, Structural Consultancy Servicing Firms, Research and Development Laboratories. Professionally Used Software: MS- Excel, MATLAB, SAP 2000, STAAD Pro Software, Ansys				
Text Book 1. Krishnamoorthy C.S., "Finite Element analysis" - Tata McGraw Hill 2. Desai C &Abel J F.," Introduction to Finite element Method" , East West Press Pvt. Ltd., 3. Cook R D et.al., "Concepts and applications of Finite Element analysis ", John Wiley				
References 1. Daryl L Logan, "A first course on Finite element Method", Cengage Learning 2. Bathe K J - " Finite Element Procedures in Engineering analysis "- Prentice Hall 2. Rajasekharan S, Finite Element analysis in engineering design- Wheeler Publishers 3. Bathe K J, Finite element Procedures- PHI Pvt. Ltd. New Delhi. 4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=645685&site=ehost-live				
Topics relevant to "EMPLOYABILITY SKILLS": Analysis of two-dimensional bar element, analysis of two-dimensional trusses, Plane stress and plane strain problems, beam and frame analysis using two node elements for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				

Catalogue prepared by	Mr. Ramachandra Gollar, Mr. Deepak Arora , Ms. Anju Mathew
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3413	Course Title: Theory of Elasticity Type of Course: Program Core & Theory Only	L-T-P- C	2	1	0	3
Version No.	1.1					
Course Pre-requisites	CIV2007 - Strength of Materials Moment and Couple, Concept of Free-body diagram, Stress distribution at a cross-section due to Bending Moment and Shear force, Stress distribution at a cross-section due to Bending Moment and Shear force. Torsion of circular and hollow circular shafts and shear stresses due to torsion					
Anti-requisites	NIL					
Course Description	Theory of elasticity, also known as advanced mechanics of solids, is the branch of continuum mechanics which deals with the behaviour of deformable bodies. Theory of elasticity is an advanced subject in civil engineering and has specific application in fatigue and fracture mechanics which deals with the initiation and propagation of cracks in solid materials. This course is conceptual and analytical. Thus, by attending this course one will gain theoretical knowledge of solid mechanics, solving methods in solid mechanics, and interpret the results from the analysis using programming and simulation.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Theory of Elasticity and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply principles of elastic theory to structural engineering problems. 2. Compute the stress and strain in-plane structural engineering problems. 3. Solve the 2D rectangular coordinate system engineering problems. 4. Solve the 2D polar coordinate system engineering problems. 5. Solve the non-circular structural sections subjected to torsion.					
Course Content:						
Module 1	Basic concepts of deformation of bodies	Term paper/Assignment	Data analysis/ Simulation	11 Sessions		
Topics- Introduction to the mathematical theory of elasticity: Elasticity, stress, strain, Hooke's law, two-dimensional idealisations, plane stress and plane strain problems, equations of equilibrium, strain-displacement relations, constitutive relations, compatibility conditions, displacement and traction boundary conditions.						
Module 2	Introduction to Cartesian Tensors	Term paper/Assignment	Data Analysis	10 Sessions		
Topics- Transformation laws of cartesian tensors, special tensors and tensor operations, the Kronecker's delta, the permutation tensor, the e-d identity, symmetry and skew-symmetry, contraction, derivatives and the comma notation, Gauss' theorem, the base vectors and some special vector operations, eigenvalue problem of a symmetric second order tensor, equations of elasticity using index notation.						
Module 3	Problems in 2D rectangular coordinate	Term paper	Data Analysis	8 Sessions		
Topics- Solution by polynomials, Saint Venant principle, bending of a cantilever loaded at the end, bending of a beam by uniformly load, another case of the continuously loaded beam, Programming assignment.						

Module 4	Problems in 2D Polar coordinate	Term paper/ Assignment	Simulation/Data Analysis	7 Sessions
Topics- General equation in polar coordinates, stress distribution symmetrical about an axis, pure bending of a curved bar, strain component in polar coordinates, displacement for symmetrical stress distributions, rotating disks, Programming assignment				
Module 5	Torsion of non-circular sections	Term paper	Data Analysis	6 Sessions
Topics- St. Venant's theory, Torsion of elliptical sections, Torsion of triangular sections - Prandtl's membrane analogy, Torsion of rolled profiles - Stress concentration around re-entrant corners.				
Targeted Application & Tools that can be used: The students can apply knowledge of the course to finite element analysis and fracture mechanics of solids. Professionally used software- MS-Excel, MATLAB.				
Text Book 1. Timoshenko and Goodier, Theory of Elasticity and Plasticity, McGraw-Hill, 2006. 2. L. S. Srinath, Advanced Mechanics of Solids, McGraw-Hill, 1992.				
References 1. C. T Wang, Applied Elasticity, McGraw-Hill, 1953. 2. Sadhu Singh, Theory of Elasticity, Khanna Publishers, 1997. 3.https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=272276&site=ehost-live				
Topics relevant to the development of Employability SKILLS: Transformation of stress and strain in a 3D field, stress function, Solution by polynomials, General equation in polar coordinates for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr. Deepak Arora, Ms. Anju Mathew			
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023			
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023			

Course Code: CIV3414	Course Title: Advanced Prestressed Concrete Design Type of Course: Discipline Elective & Theory only	L-T-P- C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	CIV2508 Design of RCC Structural Elements					
Anti-requisites	NIL					
Course Description	The main objective of this course is to provide civil engineering students with the advanced knowledge of pre-stressed concrete structures. This course deals with mainly design of composite beams and tension members, compression members, slab and grid floors, precast elements. It also focus on anchorage zone stresses in post tensioned members and shear and torsional resistance of the PSC sections. It covers the analysis of indeterminate beams.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Advanced Prestressed Concrete Design and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Illustrate design principles of prestressed concrete sections under shear and torsion. 2. Understand the variation of anchorage zone stress and design of anchorage reinforcement. 3. Realize the basic concepts and design of tension, compression members and PSC slabs. 4. Possess the ability to understand the design concepts of composite beams.					
Course Content:						
Module 1	Shear and Torsional reinforcement	Assignment	Numerical problems	08 classes		
Topics: Shear and Torsional Resistance: Shear and principal stresses, ultimate shear resistance, design of shear reinforcement, Torsion, Design of reinforcement for torsion. Anchorage Zone Stresses in Post-Tensioned Members: Introduction, stress distribution in end block, investigations on Anchorage zone stresses, Magnel and Guyon's Methods, Comparative Analysis, Anchorage zone reinforcement.						
Module 2	Design of Tension and compression members	Assignment	Numerical problems	08 classes		
Topics: Tension Members: Introduction, Ties, Pressure pipes – fabrication process, analysis, design and specifications. Design of prestressed concrete cylindrical water tanks - Design of prestressed concrete pipes. Compression Members: Introduction, Columns, short columns, long columns, biaxially loaded columns, Design specifications, Design of prestressed concrete piles.						
Module 3	Statically indeterminate Structures and PSC slabs	Assignment	Numerical problems	08 classes		
Topics: Statically indeterminate Structures: Introduction, Advantages of continuous members, effect of prestressing in indeterminate structures, methods of analysis for secondary moments, concordant cable profile, Guyon's theorem, Ultimate load analysis, Design of continuous beams and portal frames. PSC Slabs: Types of prestressed concrete slab - design of one-way slab - design of two-way slab - design of simple flat slab.						
Module 4	Composite Beams and Precast Elements	Assignment	Numerical problems and validate by software	10 classes		

Topics: Composite Beams: Composite construction with precast PSC beams and cast-in-situ R.C. Slab - Analysis and Design - Ultimate Strength - their applications - Special Structures like folded plates, prestressed cylindrical shells, spherical shells, partial prestressing - Principles, analysis and design concepts.	
Targeted Application & Tools that can be used: Prestressed concrete is used in a wide range of building and civil structures where its improved performance can allow for longer spans, reduced structural thicknesses, and material savings compared with simple reinforced concrete.	
Text Books: 1. Krishna Raju N "Prestressed Concrete", N. Krishna Raju, TataMcgrawhill, 3rd edition, 1995. 2. Lin T.Y. and H. Burns "Design of Prestressed concrete structures", John Wiley & Sons, 1982.	
References 1. Pandit.G.S and Gupta.S.P "Prestressed Concrete", CBS Publishers, 1993. 2. Dayaratnam.P "Prestressed Concrete Structures", Oxford & IBH, 5th Edition, 1991 Web Resource: https://nptel.ac.in/courses/105/106/105106117/ https://nptel.ac.in/courses/105/106/105106118/ PU Resources: 1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=NAP_1_4412	
Topics relevant to "Employment": Stress distribution in end block and anchorage zone stresses. Design of tension and compression members. Design of slabs and grid floors for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr.Dayalan J
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV3415	Course Title: Earthquake Resistant Design of Structures Type of Course: 1] Discipline Elective 2] Theory Only		L-T-P-C	2	1	0	3
Version No.	1.1					
Course Pre-requisites	CIV3408 - Elements of Earthquake Engineering					
Anti-requisites	NIL					
Course Description	The objective of this course is to teach how to design a structure resistant to the natural force of an earthquake. This course includes the ductile detailing using Indian standard codes, concepts, types and design of shear wall Masonry and Steel structures under seismic loading. Also, a glimpse earthquake resistant design of special structures like water tank, chimney and bridges will be studied.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Earthquake Resistant Design of Structures and attain Employability Skills through Problem Solving Methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Apply the ductile design considerations for RC buildings as per IS Codes 2] Discuss the seismic response of masonry and steel buildings. 3] Apply codal provisions to the seismic design of special structures.					
Course Content:						
Module 1	Design and detailing of RC Building Structures	Programming Assignment	Write a program to calculate core confining concrete	10 Sessions		
Topics: Ductility Considerations in Earthquake Resistant Design of RC Buildings, Ductile detailing as per IS 13920: 2016, Step-by-step Procedure for Seismic Design of a Multi-storeyed RC Building. Reinforced Concrete Shear Walls: Structural behaviour, failure pattern, design and detailing.						
Module 2	Seismic Behaviour of Masonry and Steel Buildings	Case Study	Timber Structures	10 Sessions		
Topics: Categories of masonry buildings and their behaviour, Confined masonry construction, Improving seismic behaviour of masonry buildings, restoration and strengthening of masonry walls. Seismic behaviour of structural steel, Behaviour of steel frames, flexural members; connection design and joint behaviour, bracing members, Ductile design of frame members.						
Module 3	Seismic Design of Special Structures	Excel Program	Design of Water Tank	15 Sessions		
Topics: Special structures: Design of water tanks – Elevated tower supported tanks- Hydrodynamic pressure in tanks – examples Design of towers – Stack like structures – Chimneys – Design principles of retaining walls – Concept of design of bridges – Design of bearings						
Targeted Application & Tools that can be used: Applied in structural engineering consultancies to provide earthquake resistant design of structures. Tools: ETABS, Staad Pro. , LS-Dyna						
Text Book 1. Pankaj Agarwal and Manish Shrikande, "Earthquake Resistant Design of Structures", Prentice Hall of India Private Ltd, New Delhi 2. Duggal S K, "Earthquake Resistant Design of Structures". Oxford University Press, New Delhi 3. https://nptel.ac.in/courses/105/101/105101004/						

References 1. Anil K Chopra, "Dynamics of Structures", Pearson Education, Asia, New Delhi 2. Dr. Vinod Hosur, "Earthquake-Resistant Design of Building Structures", Wiley Precise Textbook, New Delhi E-Resources https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2013888&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": Special structures: Design of water tanks – Elevated tower supported tanks- Hydrodynamic pressure in tanks – examples Design of towers – Stack like structures – Chimneys – Design principles of retaining walls – Concept of design of bridges – Design of bearings for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Ms. Anju Mathew
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

<table>
<tr><td>Course Code:
CIV3416</td><td colspan="5">Course Title: Offshore structures
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="10">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="10">CIV 2013, CIV 3002, CIV 3003</td></tr>
<tr><td>Anti-requisites</td><td colspan="10">NIL</td></tr>
<tr><td>Course Description</td><td colspan="10">The objective of the course is to develop the knowledge in analysis and design of the various offshore structures conforming to codal provisions. The course also includes the topics to get exposed to special features of offshore structures like geometry, forces encountered, structural modeling for design purpose together with their design. The course covers wave theories, wind forces and other forces acting on offshore structures. Students also get familiarize with design of platforms, helipads, jacket tower and mooring cables and pipelines including the Corrosion and Fatigue Failure behavior. Students are expected to obtain basic knowledge about the design and failure mode of offshore structures after finished this course.</td></tr>
<tr><td>Course Objectives</td><td colspan="10">The objective of the course is to familiarize the learners with the concepts of Offshore structures and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="10">On successful completion of this course the students shall be able to:
1] To develop the knowledge of wave generalized process and wave theories
2] Evaluate forces on offshore structures
3] Design of offshore structures with failure probability</td></tr>
<tr><td>Course Content:</td><td colspan="10"></td></tr>
<tr><td>Module 1</td><td colspan="3">Wave Theories</td><td>Assignment</td><td colspan="3">Case study</td><td colspan="2">10 classes</td></tr>
<tr><td colspan="11">Topics:
Conservation mass and momentum, Euler equation, Bernoullis Equation, Potential flow, Classification of waves, small amplitude or Linear Airy’s theory, dispersion relationship, water particle kinematics, wave energy.</td></tr>
<tr><td>Module 2</td><td colspan="3">Forces on Offshore Structures</td><td>Assignment</td><td colspan="3">Numerical problems and validate by software</td><td colspan="2">12 classes</td></tr>
<tr><td colspan="11">Wind forces, wind forces on vertical, inclined cylinders, structures – current forces and use of Morrison equation, Different type of offshore structures, fixed jacket platform.</td></tr>
<tr><td>Module 3</td><td colspan="3">Design of Offshore Structures</td><td>Assignment</td><td colspan="3">Numerical problems and validate by software</td><td colspan="2">12 classes</td></tr>
<tr><td colspan="11">Static method of analysis - foundation analysis and dynamics of offshore structures, Design of platforms, helipads, jacket tower and mooring cables and pipelines – Corrosion and Fatigue Failure.</td></tr>
<tr><td colspan="11">Targeted Application & Tools that can be used:
Application area is understanding of wave theories, analysis and design of offshore structures.
Professionally Used Software: StaadPro/Revit</td></tr>
<tr><td colspan="11">Text Books:
1.Chakrabarti, S.K., “Hydrodynamics of Offshore Structures”, Computational mechanics, Publications, 1987
2.Reddy DV and Arockiasamy M., “Offshore Structures”, Vol.1, Krieger Publication Company, Malabar, Florida, 1991</td></tr>
<tr><td colspan="11">References
1 . Thamas H Dawson, “Offshore Structural Engineering”, Prentice Hall Inc. Englewood, Cliffs, N.J. 1983.</td></tr>
</table>

<table>
<tr><td colspan="2">2. Wiegel.R..L, “Oceanographical Engineering”, Prentice Hall Inc. Englewood, Cliffs, N.J. 1964.
3. API RP 2A., Planning, Designing and Constructing Fixed Offshore Platforms, API
4. https://nptel.ac.in/courses/114106011

PU Web Resources
1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=248830&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2401171&site=ehost-live</td></tr>
<tr><td colspan="2">Topics relevant to “EMPLOYABILITY SKILLS”: Wind forces, wind forces on vertical, inclined cylinders, structures – current forces and use of Morrison equation. Static method of analysis - foundation analysis and dynamics of offshore structures, Design of platforms, helipads, jacket tower and mooring cables and pipelines for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Catalogue prepared by</td><td>Mr. Dayalan J</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BoS No. 14 held on 30 July 2022</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 18 held on 03 August 2022</td></tr>
</table>

<table>
<tr><td>Course Code:
CIV3417</td><td colspan="3">Course Title: Structural Health Monitoring
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Basics of Concrete Technology and Design of Reinforced Concrete Structures</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The objective of the course is to develop the knowledge about structural health monitoring of concrete structures. The course also includes the topics to understand the various causes, factors responsible for various defects in structures. It also includes the assessment of health of structures using static field and dynamics field testing methods. The introduction to repair and rehabilitation of strictures is also included for better understanding of structural health monitoring concepts.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Structural Health Monitoring and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:
1] Diagnose the distress in the structure by understanding the causes and factors
2] Assess the health of structure using static and dynamic field methods
3] Carryout repairs and rehabilitation measures of the structure</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Structural Health Monitoring</td><td>Assignment</td><td colspan="2">Case study</td><td colspan="2">10 classes</td></tr>
<tr><td colspan="9">Topics:
Structural Health–Factors affecting Health of Structures–Repair and Rehabilitation – Facets of Maintenance – importance of Maintenance – Various aspects of Inspection – Assessment procedure
for evaluating a damaged structure – causes of deterioration.
Structural Health Monitoring–Concepts, Various Measures, Structural Safety in Alteration
Structural Audit–Assessment of Health of Structure- Assessment by NDT equipment‘s, SHM Procedures</td></tr>
<tr><td>Module 2</td><td colspan="2">Static and Dynamic Field Testing</td><td>Assignment</td><td colspan="2">Numerical problems and validate by software</td><td colspan="2">10 classes</td></tr>
<tr><td colspan="9">Topics:
Static Field Testing– Types of Static Tests, Static Testing- Static field testing- types of static tests loading methods- Behavioral/ Diagnostic tests - Proof tests -Static response measurement – strain gauges, LVDTs, dial gauges - case study .
Dynamic Field Testing–Types of dynamic tests - Stress history data -Dynamic load allowance tests - Ambient vibration tests – Forced Vibration Method - Dynamic response methods - Impact hammer testing- Shaker testing - Periodic and continuous monitoring</td></tr>
<tr><td>Module 3</td><td colspan="2">Introduction to Repairs and Rehabilitations of Structures</td><td>Assignment</td><td colspan="2">Numerical problems and validate by software</td><td colspan="2">10 classes</td></tr>
<tr><td colspan="9">Introduction to Repairs and Rehabilitations of Structures– Case Studies(Site Visits), piezo–electric materials and others materials, electro mechanical impedance (EMI) technique, adaptations of EMI technique</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used:
Application area is understanding of static and dynamic field testing of structures.</td></tr>
<tr><td colspan="9">Text Books:</td></tr>
</table>

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006. 2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
References 1. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006. 2. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007 PU Web Resources https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2325554&site=ehost-live
Topics relevant to "EMPLOYABILITY SKILLS": Dynamic Field Testing–Types of dynamic tests - Stress history data -Dynamic load allowance tests - Ambient vibration tests – Forced Vibration Method - Dynamic response methods for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr.Dayalan J
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3418	Course Title: Glass in Buildings: Design and Applications Type of Course: Discipline Elective and Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Design of RC Structural elements					
Anti-requisites	NIL					
Course Description	This course deals with one of the most energy efficient building materials i.e "Glass" that lends an aesthetic and functional value to a building. The course is conceptual in nature that covers the critical aspects of Glass façade engineering. The purpose of the course is to highlight more about glass manufacturing, types of coating used on the glass, glass processing techniques as well as the standards related to glass as per NBC 2016. The fundamentals of day-lighting as well as the interior glazing and applications are also learnt in the course.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Glass in Buildings: Design and Applications and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: **1)** Identify various processes in Glass manufacturing and warehouse management. **2)** Illustrate different Glass processing techniques such as cutting, grinding, fabrication, tempering, lamination etc **3)** Explain the operations and applications of Facade systems. **4)** Discuss the strategies and techniques in Day-lighting in buildings.					
Course Content:						
Module 1	Glass manufacturing process	Assignment	Case Study	11 Sessions		
Topics: Glass as a building material, Float Glass manufacturing Process, Glass coating technology- Needs and Types, Glass selection and applications, Industrial and Glass handling safety, Eco packaging of Glass, Warehouse Management, Production planning and control. Glass design: Sustainability and Aesthetics, Structural Control and Design for Energy efficiency, Design Tools for Glass selection, Building Envelope modeling and design, Structural analysis and design software for Glass structures.						
Module 2	Glass Processing Technology	Assignment	Case study	12 Sessions		
Topics: Glass Processing: Cutting and snapping, Pre-processing –drilling, Grinding, Fabrication, Pre-processing- washing, Tempering, Insulating Glass unit, Lamination, Sealant. Sustainable building and facades: Facade Fundamentals, Glass applications on Facades, Facade factory operations, Energy efficiency in Façade systems, Structural design of facades. Root cause and analysis for troubles, Standards related to Glass- NBC 2016, Applications, Innovations and Futuristic trends.						
Module 3	Useful Daylighting in Buildings	Assignment	Case study	07 Sessions		
Topics: Introduction to Useful Daylighting in Buildings – Fundamentals of daylighting , Daylighting Strategies and Techniques, ECEBC and Green building requirements, Daylight simulation , daylighting Controls, Achieving Acoustics through Glass. Interior Glazing and Applications, Passive fire protection, Choices for Project segment.						
Targeted Application & Tools that can be used:						

Application of Glass in buildings: as an insulation material, structural component, external glazing material, cladding material in Multi-storeyed Buildings and Facades
Tools used: -
RFEM/RSTAB –3D modular software system used for Structural analysis and Design software for Glass structures.

Text Book:

T1. Mic Patterson, *Structural Glass Facades and Enclosures, Wiley Publishers, New Jersey,2011.*

T2. Dr. N.K Garg, *Guidelines For Use Of Glass In Buildings, New Age International (P) Ltd., 2018*

References:

R1. Joseph S. Amstock, Handbook of Glass in Construction,McGrawHill 1997.

R2. Bernhard Weller, Stefan Unnewehr, Kristina Härth, Silke Tasche, Glass in Building: Principles, Applications, Examples, Walter de Gruyter GmbH, 2009.

Weblinks:
https://nptel.ac.in/courses/105106177
https://www.youtube.com/watch?v=S6hNFuaV7ro (Glass making process)

E-BOOKS:

1. Conference on Architectural and Structural Applications of Glass
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=489954&site=ehost-live&ebv=EB&ppid=pp_915

2. Facade Construction Manual
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2030444&site=ehost-live

3. Cultures of **Glass** Architecture
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=269795&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Glass coating technology- Needs and Types, Glass selection and applications. Industrial and Glass handling safety, Eco packaging of Glass, Warehouse Management, Production planning and control
Glass Processing: Cutting and snapping, Pre-processing –drilling, Grinding, Fabrication, Pre-processing- washing, Tempering, Insulating Glass unit, Lamination for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Divya Nair
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3419	Course Title: Design of Tall Buildings Type of Course: Discipline Elective Theory Only Course		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites						
Anti-requisites	NIL					
Course Description	This Course is designed to give an initial idea about the analysis and design of tall buildings, which are different from a regular building. It focuses on the design philosophies applied for a tall building along with special materials and loading. It gives an introduction to the various structural forms or systems used for the construction of a tall building along with the various analysis procedures adopted for the design of tall buildings.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Design of Tall Buildings and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Explain the design principle along with the loads acting on tall buildings 2] Summarize the different types of structural systems used for tall buildings. 3] Discuss the analysis procedure adopted for design of tall buildings.					
Course Content:						
Module 1	Design Criteria and Loading	Assignment	Mix Design			10 Sessions
Topics: Design philosophy, materials - high performance Concrete - Fiber reinforced Concrete – Light-weight Concrete - Design mixes, Gravity Loading: Dead and live load, methods of live load reduction, Impact, gravity loading, construction loads. Wind loading: Static and dynamic approach, Analytical and wind tunnel experimental method. Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading working stress design, Limit state design, plastic design.						
Module 2	Behaviour Of Various Structural Systems	Case Study	Case Study on the top 5 tallest buildings and their structural systems			10 Sessions
Topics: Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger - braced and hybrid mega system.						
Module 3	Analysis and Design	Software Analysis	ETABS modelling of Tall Building			15 Sessions
Topics: Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of building as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerised general three dimensional analysis. Structural elements: Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow. Design for differential movement, creep and shrinkage, effects, temperature effects and fire resistance.						
Targeted Application & Tools that can be used: Applied in structural engineering consultancies to provide design of tall structures. Tools: ETABS, Staad Pro., Tekla Structures						
Text Book 1. Taranath B.S., "Structural Analysis and Design of Tall Building", McGraw Hill						

References 1. Wilf gang Schuller, "High Rise Building Structures", John Wiley and Sons 2. Bryan S Smith, Alexcoull, "Tall Building Structures, Analysis and Design", John Wiley and Sons Inc. 3. https://nptel.ac.in/courses/105/101/105101004/ 4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=516055&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of building as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerised general three dimensional analysis for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Anju Mathew
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3420	Course Title: Theory of Plates and Shells Type of Course: Discipline Elective Theory Only Course		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites						
Anti-requisites	NIL					
Course Description	This Course is designed to achieve fundamental understanding of the classical theory of elastic plates and shells, address limitations and differences, introduce nomenclature, and present analytical and numerical solution techniques. It also aims to enable students to apply the theory of plates and shells to problems, involving various geometries and boundary conditions, to diverse problems in civil, mechanical, aerospace engineering, and other related fields.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Theory of Plates and Shells and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Explain the theory of plate bending. 2] Summarize the effect of lateral loading on plates. 3] Explain the deformation of shells.					
Course Content:						
Module 1	Introduction to Plates	Assignment	Analysis of Plates in SAP	10 Sessions		
Topics: Assumptions in the theory of thin plates – Pure bending of Plates –Relations between bending moments and curvature - Particular cases of pure bending of rectangular plates, Cylindrical bending - immovable simply supported edges – Synclastic bending and Anticlastic bending – Strain energy in pure bending of plates in Cartesian and polar coordinates – Limitations.						
Module 2	Lateral Loading on Plates	Assignment	Numerical Analysis	10 Sessions		
Topics: Laterally Loaded Circular Plates:- Differential equation of equilibrium – Uniformly loaded circular plates with simply supported and fixed boundary conditions – Annular plate with uniform moment and shear force along the boundaries. Laterally Loaded Rectangular Plates: - Differential equation of plates – Boundary conditions – Navier solution for simply supported plates subjected to uniformly distributed load and point load – Levy's method of solution for plates having two opposite edges simply supported with various symmetrical boundary conditions along the other two edges loaded with u. d. l. – Simply supported plates with moments distributed along the edges - Approximate Methods.						
Module 3	Introduction to Shells	Case Study	Case Study of Lotus Temple and Sydney Opera House	15 Sessions		
Topics: Deformation of Shells without Bending:- Definitions and notation, shells in the form of a surface of revolution, displacements, unsymmetrical loading, spherical shell supported at isolated points, membrane theory of cylindrical shells, the use of stress function in calculating membrane forces of shells. General Theory of Cylindrical Shells:- A circular cylindrical shell loaded symmetrically with respect to its axis, symmetrical deformation						
Targeted Application & Tools that can be used: Applied in structural engineering consultancies to provide design of various structures. Tools: SAP, ANSYS, ABAQUS						
Text Book						

1. S.P Timoshenko and S.W Krieger , " Theory of Plates and Shells ", McGraw Hill
References 1. R. Szilard , "Theory and Analysis of Plates - Classical Numerical Methods ", Prentice Hall 2. N.K Bairagi , " Plate Analysis ", Khanna Publishers, New Delhi . 3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=753436&site=ehost-live
Topics relevant to "EMPLOYABILITY SKILLS": Differential equation of plates – Boundary conditions – Navier solution for simply supported plates subjected to uniformly distributed load and point load for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Anju Mathew
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3421	Course Title: Design of Steel Concrete Composite Structures Type of Course: Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basics of Design of RCC and Steel Structures					
Anti-requisites	NIL					
Course Description	The objective of the course is to develop an exposure to composite structural members and carry out the design of connections and girder. This course include the introduction to composite construction and composite behaviour of steel concrete composite structures. The course is designed to acquire the knowledge to conceptualize and design the composite beams, columns, floors, slabs and concrete filled steel tubes and also to get introduced to various connections and connection design of composite structures. This course focus on gaining knowledge in the behaviour of composite box girder bridges and to possess practical knowledge on the skills of composite construction and seismic behaviour of composite structures through case studies.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Design of Steel Concrete Composite Structures and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Illustrate the behaviour of composite structures. 2] Design various composite structural elements such as beams, columns, floors, slabs and concrete filled steel tubes. 3] Analyse the connection behaviour and design					
Course Content:						
Module 1	Introduction to Composite Structures	Assignment	Case study	10 classes		
Topics: Introduction to Steel –Concrete Composite Construction – Theory of Composite Structures – Introduction to Steel – Concrete – Steel – Sandwich Construction.						
Module 2	Design of Composite Member	Assignment	Numerical problems and validate by software	10 classes		
Topics: Behaviour of composite beams – columns – Design of Composite beam – Concrete Composite Columns – Design of Composite Trusses. Case Studies on steel – concrete composite construction structures in buildings – Seismic behaviour of composite						
Module 3	Design of Connections	Assignment	Numerical problems and validate by software	08 classes		
Types of Connections – Design of Connections in Composite structures – Shear Connections – Design of Connections in composite trusses. Behaviour of girder bridges – Design concepts						
Targeted Application & Tools that can be used: Application area is understanding the behavior of composite beams – columns – Design of Composite beam .						
Text Books: 1. Johnson R.P., "Composite Structures of Steel and Concrete", Blackwell Scientific Publications, UK 2008. 2. Oehers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental Behaviour", Permagon Press, Oxford, 1999						
References						

1. Owens .G.W. & Knowels.P. "Steel Designs Manual", (Fifth Edition) Steel Concrete Institute (UK) Oxford Black well Scientific Publications, 1992 PU Web Resources https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=230876&site=ehost-live https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=120662&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": Design of Composite beam – Concrete Composite Columns – Design of Composite Trusses. Case Studies on steel – concrete composite construction structures in buildings – Seismic behaviour of composite for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr.Dayalan J
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2022	Course Title: Railway Engineering & Tunnelling Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2101 Surveying and CIV2501 Transportation Engineering					
Anti-requisites	NIL					
Course Description	The course will be an introduction to the railway engineering and rail infrastructures. The course includes the railway track components and its geometric design. Concepts of railway traction, points and crossings, stations, as well as signalling and control system are also touched upon. The latter half deals with tunnel engineering and its various aspects and components. Tunnel lining, drainage and ventilation systems along with tunnel construction safety is also discussed in detail.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Railway Engineering & Tunnelling and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Explain about the railway track and its component functions. 2] Compute the various parameters for geometric design of railway track. 3] Illustrate the various components of rail transportation. 4] Discuss the basic features of tunnel engineering and its safety features.					
Course Content:						
Module 1	Introduction to Railway Engineering	Assignment	Data collection	12 Sessions		
Topics: Components of railway track, different gauges in India, conning of wheels, function and types of rails, Classification of rails and rail gauges, defects in rails, creep of rails, rail joints and welding of rails, sleepers – types, spacing and density, rail fixtures and fastenings, ballast, subgrade and embankment						
Module 2	Geometric Design of Railway	Assignment	Software Application	10 Sessions		
Topics: Geometric design of railway track: gradients, grade compensation, speed of trains on curves, super elevation, cant deficiency, negative super elevation, Curve design and Extra widening on horizontal curves.						
Module 3	Components of Rail Transport	Assignment	Software Application	11 Sessions		
Topics: Railway traction and track resistance, stresses in railway track – rails, sleepers, ballast. Points and crossings – turnouts, switches, crossings. Track junctions – types, splits, diamond, gauntlet, scissor crossovers. Railway stations - requirements, facilities, classifications, platforms, loops, sidings. Signaling and control system – objectives, classification, Interlocking of signals and points						
Module 4	Introduction to Tunnel Engineering	Case Study	Data Collection	12 Sessions		
Topics: Tunnels: Necessity/advantage of a tunnel, Classification of Tunnels, Size and shape of a tunnel, Alignment of a Tunnel, Portals and Shafts, Methods of Tunneling in Hard Rock and Soft ground,						

Mucking, Lighting and Ventilation in tunnel, Dust control, Drainage of tunnels, Safety in tunnel construction.

Targeted Application & Tools that can be used:
Professionally Used Software: Open Rail Designer

Text Books:

1. Saxena Subhash C and Satyapal Arora, *"A Course in Railway Engineering"*, Dhanpat Rai and Sons, Delhi, 1998.
2. Satish Chandra and Agarwal M.M, *"Railway Engineering"*, Oxford University Press, New Delhi,2008.
3. B L Gupta, *"Road, Railway, Bridge & Tunnel Engineering"*, Standard Publishers, Delhi,2015.Ahuja and Birdi, *"Road, Railway, Bridge & Tunnel Engineering",* Standard book house, Delhi.

References:

1. Mundrey J.S., *"A course in Railway Track Engineering"*, Tata McGraw Hill,2009.
2. R. Shrinivasan , *"Harbour , Dock and Tunnel Engineering"*, Charotar Publishers, 2016.

Web link:

NPTEL course – Transportation Engineering II - Prof. Rajat Rastogi
https://nptel.ac.in/courses/105107123

NPTEL course – Rock Mechanics and Tunneling - Prof. Debarghya Chakraborty
https://nptel.ac.in/courses/105105212

3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_563

Topics relevant to "Employability": Signaling and control system in railways and Safety in Tunnel construction, Methods of Tunneling in Hard Rock and Soft ground for developing Employability Skills through Participative Learning techniques. This is attained through the Presentation as mentioned in the assessment component.

Catalogue prepared by	Mr. Navneet Singh/ Mr. Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2023	Course Title: Airport Engineering and Harbour Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course deals with the designing of various components of airport, docks and harbour. This course also gives an idea of planning the transportation system in modern cities. This course consists of airport engineering, aircraft characteristics, airport obstructions and zoning, runway, taxiways and aprons, terminal area planning and urban transportation systems etc. The Harbour component discusses about essential components of harbour engineering mainly planning and layout of harbors, ports along with ships and their sizes. These concepts can be applied in designing railway, airport and harbour components.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Airport Engineering and Harbour and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Explain the various Airport characteristics and components. 2. Design runway length. 3. Discuss the layout and components of Harbours and Ports.					
Course Content:						
Module 1	Airport Planning	Assignment	Data Collection	8 Sessions		
Topics: Airport Terminology, classification, Aircraft Characteristics, Airport survey, Site selection, Airport Size and obstructions.						
Module 2	Airport Design	Case Study	Data Collection	12 Sessions		
Topics: Runway Orientation, Basic Runway Length, Geometric Design of Runway, Layout of Taxiway, Geometric Standards, Exit Taxiway, Terminal Building, Apron, Typical Airport Layout, Visual Aids, Grading and Drainage, Air Traffic Control.						
Module 3	Introduction to Harbour Engineering	Case Study	Data Collection	10 Sessions		
Topics: Classification of Harbour, Accessibility and size of Harbours, Classification of Ports, Port Facilities, Breakwater – function and types, Planning and Layout of Ports, Docking, Repairing, Approach, Loading Unloading, Storing, Dredging and Guiding Facilities						
Targeted Application & Tools that can be used: Runway design, orientation, wind rose diagram						
Text Book Rangwala, "Airport Engineering", Charotar R. Srinivasan, "Harbour, Dock and Tunnel Engineering", Charotar						

<table>
<tr><td colspan="2">References
Khanna S.K., and Arora M.G. “Airport Planning and Design”, Nem chand and Bros. 2012
Saxena and Subhash C, “Airport Engineering: Planning and Design” CBS Publishers, 2008
Oza and Oza, “Dock and Harbour Engineering”, Charotar Publishing House, 2016
Web links:
PU E-Resourse(s)
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1468148&site=ehost-live
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=446056&site=ehost-live</td></tr>
<tr><td colspan="2">Topics relevant to “EMPLOYABILITY SKILLS”: Runway Orientation, Basic Runway Length, Geometric Design of Runway, Layout of Taxiway, Geometric Standards for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Catalogue prepared by</td><td>Mrs. Sowmyashree T</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BoS No. 12 held on 07 August 2021</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 16 held on 23 October 2021</td></tr>
</table>

Course Code: CIV2024	Course Title: Pavement Materials and Construction Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	1] CIV2501 Transportation Engineering 2] Concrete and Highway Materials Testing Laboratory Basic insights into various types of pavement materials and their characterization.					
Anti-requisites	NIL					
Course Description	This course consists of studies of various Pavement construction materials and the associated tests for them, and also deals with different methods of pavement constructions. This course will include topics related to Pavement materials like Soil, Aggregates (Natural, Artificial), Bitumen, Emulsion, Cutbacks, Modified Bituminous Binder (Polymer, Rubber),Bituminous Mixes, Cement and Cement Concrete (Plain, RCC, PSC), stabilized materials (Cement, Lime, others), Recycled Materials and Geosynthetics. The course mainly focuses on the significance of these materials in construction, their desirable properties and various laboratory and field tests associated with them.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Pavement Materials and Construction and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Describe soil and aggregates along with various tests performed on them 2] Discuss salient features of bitumen, tar and their behaviour 3] Illustrate the tests and engineering properties of pavement materials in context to its field application 4] Explain the Current practices and future trends in the area of pavement materials					
Course Content:						
Module 1	Soil cement and Aggregates	Assignment	Programming	10 classes		
Topics: Soil: Introduction to soil as a highway material; Classification of soils; Consistency Limits; Soil compaction and role of moisture; Mechanical properties of soil (Shear strength, Unconfined compressive strength, Resilient modulus, California bearing ratio, Modulus of subgrade reaction etc.); Introduction to expansive soils, relevant tests, and soil stabilization techniques. Cement: Production of cement; Theory of hydration and importance of different hydration products; Physical and chemical properties of cement; Types of cement; Pozzolanic and geopolymer materials as alternate cement Aggregates: Aggregate origin, types, production, and quarrying operation; Classification of aggregates; Aggregate gradation and gradation parameters; Theories of aggregate blending; Mineralogy of aggregates						
Module 2	Bitumen Bituminous Mixtures and Tar	Case Study	Data Collection	10 classes		
Topics: Origin, Preparation, Properties and Chemical Constitution of bituminous road binders, Requirements. Bituminous emulsion and Cutbacks- Preparation, Characteristics, uses and tests, Stone Matrix Asphalt. Bitumen Grading Systems, Viscoelastic behavior of bitumen- Complex Modulus, Master Curve Bituminous Mixtures: Production of bituminous mixtures: Laboratory and Plant; Role of bituminous mixture and desirable properties; Volumetric of bituminous mixture; Mix design of bituminous mixture. Tar-properties and uses						
Module 3	Sustainable Materials and Geosynthetics	Assignment	Data Collection	7 classes		

Topics:
Recycled materials used in Road Construction- recycled aggregates, plastic wastes, recycled asphalt shingles, crumb rubber, foundry sands, supplementary cementitious materials and likewise.
Geosynthetics in Road Construction- Subgrade Separation and Stabilization, Base Reinforcement, Overlay Stress Absorption and Reinforcement, Pavement Rehabilitation

Module 4	Highway Construction	Case Study	Data Collection	8 classes

Topics:
Various types of equipment for excavation, grading and compaction- their working principles, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction. Sub grade: Earthwork grading and Construction of embankments and cuts for roads, Preparation of subgrade, quality control tests. Pavement Maintenance and Evaluation
Common field practices and construction issues

Targeted Application & Tools that can be used
Application areas: This course would help generate the employability of graduates in Pavement construction industry as Supervising Engineers to ensure that roads are constructed in accordance with the technical specifications, optimizing use of available materials thus minimizing project cost.

They can also be employed in Quality control (QC) sector having knowledge of various tests and desirable properties of the construction materials.

Professionally used software: MATLAB/Python/MX roads/ Open-door

Text Books

1. Khanna, S.K and Justo, C.E.G., "*Highway Engineering*", Nem Chand and Bros. Roorkee (U.P), 1998.
2. Dar-Hao Chen and Cindy Estakhri, *"Material, Design, Construction, Maintenance, and Testing of Pavement"*, Geotechnical Special Publications, American Society of Civil Engineers, 2009.

References

1. Freddy L. Roberts and Kandhal, P.S., *"Hot Mix Asphalt Materials, Mixture Design and Construction*", University of Texas Austin, Texas, NAPA Education Foundation Lanham, Maryland, 1991.
2. A T Papagiannakis and E A Masad, *"Pavement Design and Materials"*, John Wiley & Sons, 2008.
3. Fumio Tatsuoka, Antonio Gomes Correia and Yoshitsugu Momoya*, "Design and Construction of Pavements and Rail Tracks"*, Taylor & Francis Books, UK, 2009.

Weblink:

1. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=710371&site=ehost-live
2. *https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=121367&site=ehost-live*

Topics relevant to "EMPLOYABILITY SKILLS": Earthwork grading and Construction of embankments and cuts for roads, Quality control tests, Pavement Maintenance and Evaluation for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mr. Aayush Kumar/ Ms. Sangeetha H M/Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2025	Course Title: Urban Transport Planning Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2501 Transportation Engineering					
Anti-requisites	NIL					
Course Description	This Course deals with the planning of transportation systems in modern cities. This course consists of urban transport planning, modeling techniques in planning, data collection and inventories, trip generation and distribution, modal split and traffic assignment, urban mass transportation process, basic elements of transport networks, and land use planning models. It also covers essentials of transportation economics and current topics of relevance such as sustainable urban transportation, integrated public transport planning, intermediate public transport, nature of traffic problems in cities, application of technology in transportation and urban freight distribution.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Urban Transport Planning and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the importance of transport planning and transportation surveys. 2] Explain trip generation and trip distribution in the transportation planning process. 3] Apply trip distribution process. 4] Apply basics of transportation economics for sustainable transportation.					
Course Content:						
Module 1	Introduction to Urban Transport	Assignment	Data Collection	5 Sessions		
Topics: Introduction –General , transportation in cities , future development Urban Activity System, classification of roads, types of urban or road system, urban goods movement-classification of urban goods movements ,methodology of approach to analysis of goods movement ,modelling demand for goods transport ,urban transportation system planning conceptual aspects						
Module 2	Introduction to Urban Transport Planning	Assignment	Data Collection	5 Sessions		
Topics: Transport Planning: Definition, Relevance, Scope, Systems approach to transport planning, Stages in transport planning; Urban and Intelligent Transportation, Urban Mass Transit Systems Transportation Survey: Zoning; Types of survey- Home interview Surveys, Commercial Vehicle Surveys, Taxi Surveys, etc. ; Inventory of Transport Facilities, Inventory of Land Use and Economic Activities						
Module 3	Trip Generation and Distribution	Assignment	Software Application	8 Sessions		
Topics: Trip Generation: Trips, Trip purpose, Factors Governing Trip Generation and Attraction Rates, Multiple Linear Regression Analysis, Trip Rate Analysis, Cross Classification Trip Distribution: Origin-Destination Matrix, Methods of Trip Distribution: Growth Factor method and Synthetic methods, Problems						
Module 4	Mode Choice, Traffic Assignment and economics	Assignment	Software Application	13 sessions		
Topics: Modal Split: Factors affecting modal split, Modal Split analysis, Logit Model, Problems, Definition and scope of transportation economics, transportation demand and supply, Concept of elasticity,						

marginal cost, opportunity cost, congestion pricing Concept of sustainable transportation, main approaches towards sustainable transport/freight, Solutions

Traffic Assignment: Description of transport network, Purpose, Principles, Assignment Techniques, Problems

Targeted Application & Tools that can be used

Application areas: The course caters to employability of graduates as transport planners and consultants in future. The rapid growth of existing cities and development of new cities has created huge demand for transportation and its effective planning. In addition to passenger transport, the area of freight transport is promising where graduates can be employed to provide innovative solutions. It also helps nurture skills of students to apply concepts of transport planning learnt during the course in real time projects through software applications. The course also caters to environment and sustainability by helping plan and design efficient traffic management systems which can reduce congestion on roads, encourage public transport, reduce emissions and create a positive impact on the environment.

Professionally used software: CUBE/TransCAD/open doors

Text Books

1. Kadiyali L R, "*Traffic* Engineering *and Transport Planning*", Khanna Publishers, 2017.
2. Papacostas, "*Fundamentals of Transportation Planning*", Tata McGraw Hill, 2002.
3. Subash C Saxena, "*A Course in Traffic Planning and Designing"*, Dhanapat Rai and Sons, Delhi, 1989.

References

2. Jothi Kristey and Lal, "*Introduction to Transportation Engineering"*, PHI, New Delhi, 2002.
3. Wilson AG, "*Urban and Regional Models in Geography and Planning*", John Wiley and Sons, London, 1974.
4. Hutchinson B.G, "*Introduction to Urban System Planning*", Tata McGraw Hill.

E Resources:

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=103100&site=ehost-live&ebv=EB&ppid=pp_16

Topics relevant to "EMPLOYABILITY SKILLS": Transport Planning, Urban and Intelligent Transportation, Urban Mass Transit Systems, transportation demand and supply, sustainable transportation/freight for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Madhavi T /Ms. Sangeetha H M
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2026	Course Title: Traffic Engineering Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1] CIV2501 Transportation Engineering 2] Highway Engineering Basic insights into traffic stream characteristics					
Anti-requisites	NIL					
Course Description	The course deals with various elements of road traffic such as the road user and the vehicles. In addition, detailed discussions on various traffic studies such as volume and speed studies, accident studies will be held. Emphasis would be given on the methods of traffic data collection, fundamentals of traffic flow and highway capacity. Traffic regulation and control related topics would include design of rotaries and traffic signal design. Latest concepts of intelligent transport systems, road safety, street furniture and lighting would form an integral part of the course.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Traffic Engineering and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the importance of traffic engineering and its components. 2] Discuss traffic stream characteristics. 3] Explain various traffic studies and their onsite applications. 4] Compute rotary and traffic signal design parameters.					
Course Content:						
Module 1	Introduction to Traffic Engineering	Assignment	Numerical Problems	6 classes		
Topics: Introduction, Objectives and scope of traffic engineering, Mobility and Accessibility, Traffic Engineering Elements and Components of road Traffic, Road Users- the vehicle, driver and road, Traffic characteristics Problems						
Module 2	Traffic Stream	Assignment	Programming	7 classes		
Topics: Traffic Stream parameter and their relationships- Traffic Density and Relationships among Macroscopic Parameters, Single Regime Traffic Stream Models, Multi-Regime Models and Characteristics of Interrupted Flow headway, density, flow, Models in traffic engineering Shockwave and queuing						
Module 3	Traffic Studies	Case Study	Data Collection	10 classes		
Topics: Sampling in traffic studies, objectives, methods of traffic study – equipment, data collection, analysis and interpretation of Spot speeds, Speed and delay, Volume, Origin – destination, Parking and Accident studies						
Module 4	Traffic Operations	Assignment	Simulation	8 classes		
Topics: Traffic Regulations, Traffic Control Devices, Signage, Intersections, Conflict Points, Rotary Design Traffic signals: Types of Signals- Fixed time and Vehicle Actuated Signals Traffic Signal Design: Determination of Optimum Cycle Length, Green time, Red time, Webster's method: Problems; Intelligent Transportation Systems Road Safety: Road crashes, Road Safety Audit, Accident Prevention, Traffic Calming Street Furniture, Lighting						
Targeted Application & Tools that can be used						

Application areas: The course caters to employability of graduates as traffic engineers in future. The rapid growth of cities with their traffic challenges provide ample opportunities for employment in future.
It also helps nurture skills of students by providing real time situations to apply concepts of traffic engineering in future such as in creating a green corridor: a signal-less organ transport corridor in a city.
The course also caters to environment and sustainability by helping plan and design efficient traffic interchanges and signals which can reduce congestion on roads and contribute to lesser carbon emissions.

Professionally used software: VISSIM, MATLAB/Python

Text Books

4. Kadiyali L R, "*Traffic* Engineering *and Transport Planning*", Khanna Publishers, 2017.
5. Khanna, S.K and Justo, C.E.G., "*Highway Engineering*", Nem Chand and Bros. Roorkee (U.P), 1998.
6. Mc. Shane, William R., Roess, Roger P. and Prassas Elena S., "*Traffic Engineering*", Pearson, 2019.

References

5. Jothi Kristey and Lal, "*Introduction to Transportation Engineering"*, PHI, New Delhi, 2002.
6. AASHTO, *"A Policy on Geometric Design of Highway and Streets"*, 2004.
7. R. J. Salter and N. B. Hounsel, *"Highway Traffic Analysis and Design"*, Macmillan Press Ltd, 1996.
8. Chandra, Satish, S. Gangopadhyay, S. Velmurugan, and Kayitha Ravinder. "Indian highway capacity manual (Indo-HCM)." (2017).
9. Gartner, Nathan H., Carrol Jl Messer, and Ajay Rathi. "Traffic flow theory-A state-of-the-art report: revised monograph on traffic flow theory." (2002).

Weblink:

1. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=710371&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=121367&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Models in traffic engineering, Model traffic stream characteristics in MATLAB/Python using real time traffic data, methods of traffic study – equipment, data collection, analysis and interpretation, Perform simulation of rotary and traffic signals in VISSIM for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Aayush Kumar/ Ms. Sangeetha H M
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3019	Course Title: Advanced Surveying Type of Course: Discipline Elective & Theory Only Course	L- T-P- C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	CIV2101 Surveying					
Anti-requisites	Nil					
Course Description	This course will demonstrate the application geometric principles to arrive at solutions to surveying problems. Analyze spatial data using appropriate computational and analytical techniques. Use the concepts of advanced data capturing methods necessary for engineering practice. The Course consists of advanced surveying concepts including geodetic surveying, introduction to field astronomy, aerial photogrammetry and modern surveying instruments.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Advanced Surveying and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply the knowledge of geodetic surveying and theory of errors to accurately determine distances and angles. 2. Illustrate the principle and applications of field astronomy 3. Demonstrate the use of modern surveying instruments, aerial photogrammetry and remote sensing for capturing the geodetic data accurately.					
Course Content:						
Module 1	Geodetic Surveying	Case Study	Data Collection	08 Sessions		
Topics: Geodetic Surveying: Principle and Classification of triangulation system, Selection of base line and stations, Orders of triangulation, Triangulation figures, Reduction to Centre.						
Module 2	Introduction to Field Astronomy	Assignment	Programming task and Data collection.	10 Sessions		
Topics: Earth, celestial sphere, earth and celestial coordinate systems, spherical triangle, astronomical triangle, Napier's rule and related Numerical.						
Module 3	Aerial Photogrammetry and Total station.	Assignment	Data Collection	17 Sessions		
Topics: Aerial Photogrammetry: Introduction, Uses, Aerial photographs, Definitions, Scale of vertical and tilted photograph, Ground Co-ordinates, Relief Displacements, Ground control, Procedure of aerial survey, overlaps and mosaics, Stereoscopes, Parallax. Total station - Different parts and the concepts of total station working mechanism followed by in depth practical exercise, which helps to gain practical understanding and essential skill sets required for present Surveying industry and Drone survey.						
Targeted Application & Tools that can be used: Application area of surveying is for data collection for construction of various structures. Construction companies, Public works department, Irrigation department, Railway department and Survey of India etc. Professionally used software: AutoCAD and E-survey.						
Text Book 1) B.C. Punmia, "Surveying Vol.2", Laxmi Publications pvt. Ltd., New Delhi-2009						

2) Chandra. A.M, "Plane Surveying and Higher Surveying", New Age International (P) Limited Publishers, Chennai-2006	
References 1) Kanetkar T P and S V Kulkarni, "Surveying and Levelling Part 2", Pune Vidyarthi Griha Prakashan-2009 E-Resource https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1227289&site=ehost-live	
Topics related to development of "Employability Skills": Concepts of geodetic Surveying, aerial Photogrammetry and Total station for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Bhavan Kumar
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3020	Course Title: Highway Geometric Design Type of Course: Discipline Elective & Theory only	L-T-P-C	2	1	0	3
Version No.	1.1					
Course Pre-requisites	Basic knowledge of Mathematical calculations and some concepts of Physics.					
Anti-requisites	NIL					
Course Description	This course deals with the study of geometric design provisions for various transportation facilities as per IRC and other guidelines. Discussion of controls governing geometric design, route layout and selection. Elements of design include sight distances, horizontal alignment, transition curves, super elevation and side friction. Vertical alignment consists of grades, crest and sag curves. Highway cross-sectional elements and design of rural roads and urban streets. The course also deals with at grade inter-sections - sight distance considerations and principles of design, channelization.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Highway Geometric Design and attain Employability Skills through Problem Solving methodologies					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Discuss components of Geometric design in the context of transportation planning & design 2) Identify the criteria for design of various elements of highway. 3) Relate the design/principles of highway geometric design and utilize the tools required for highway geometric design					
Course Content:						
Module 1	Introduction to Highway design	Assignment	Data Collection	5 Sessions		
Topics: Introduction to highway geometric design: Definition and scope of geometric design, Introduction to various elements of Highway geometric design. Factors affecting Geometric design of Highways. Human and vehicle factors: Concepts and application of human factors in design and typical vehicle factors used in geometric design.						
Module 2	Factors affecting geometric design	Case Study	Data Collection	10 Sessions		
Topics: Sight Distances: Overview, types of sight distances, Factors affecting sight distances on highway, stopping sight distance, overtaking sight distance, overtaking zones, sight distance at intersection. Scaling and recording sight distance from a plan.						
Module 3	Horizontal and Vertical Alignment	Assignment	Data Collection and Analysis	17 Sessions		
Topics: Horizontal Alignment: Overview, Design speed, horizontal curve, Centrifugal ratio or impact factor, Analysis of Super-elevation, Design of Super-elevation, Attainment of Super-elevation, Radius of horizontal curve, Extra Widening, Mechanical widening, Transition curves, Setback distance, Curve resistance. Vertical Alignment: Overview, Gradient, types of gradient, grade compensation, Summit curve, types of summit curve, length of summit curve, Valley curve, design consideration, length of valley curve, safety criteria.						
Targeted Application & Tools that can be used: Application Areas: This course would help graduates pursue career as a full time Highway Design Engineer being able to apply basic principles for the design of roads within the context of a design problem. They would also develop skills of preparing detailed plans for such infrastructure elements. Also can assess the environmental impacts consideration pertaining to the location and design of roads.						

Professionally Used Software: Mx Road, VISSIM, MS Excel

Textbooks:

1. S.K Khanna, C. E. G. Justo, A Veeraragavan., „Highway Engineering“, 10th Edition
2. L. R. kadiyali & Dr. N.B. Lal, “Principles and Practices of Highway Engineering” Khanna Publishers
3. Khanna, S.K and Justo, C.E.G., “*Highway Engineering*”, Nem Chand and Bros. Roorkee (U.P), 2011.

Reference books:

1. Xundon Jia, Wen Cheng, Ming Guan, “Highway Geometric design”, Kendall Hunt Publishing Company, 2012.

Web link:

2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2665206&site=ehost-live

Topics related to development of “Employability Skills”: Scaling and recording sight distance from a Plan for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Santhosh M B / Mr. Navneet Singh
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV3021	Course Title: Pavement Design Type of Course: Discipline Elective & Theory only	L-T-P-C	2	1	0	3
Version No.	1.1					
Course Pre-requisites	1] CIV2501 Transportation Engineering 2] Highway Engineering 3] Concrete and Highway Materials Testing Laboratory Basic insights into types of pavements and material characterization.					
Anti-requisites	NIL					
Course Description	This Course gives detailed knowledge about designing different types of pavements based on various load and climatic conditions. It consists of analysis and design of pavements, types and components, comparison between Highway and Airport pavements. Further, sub grade properties, stresses and deflections, wheel load stresses, procedures, advantages and applications of different Pavement Design Methods will be discussed.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Pavement Design and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the structural and functional aspects of various types of pavements. 2] Estimate the critical design traffic for pavement design. 3] Apply concepts of flexible pavement design in practical scenario. 4] Compute stresses in concrete pavements for various load combinations.					
Course Content:						
Module 1	Introduction to Pavement Design	Assignment	Data Collection	06 sessions		
Topics: Requirement of pavements, Types of pavement structures, Functions of various pavement components, Introduction to factors affecting pavement design, Failure criteria in Rigid and Flexible pavement, Pavement distresses, Comparison between rigid and flexible pavement. Pavement Material Characterization– Soil, Aggregates and Bitumen.						
Module 2	Design considerations for Flexible Pavement	Assignment	Software Application, Data Collection	07 sessions		
Topics: Wheel load considerations – Maximum Wheel load, Axle Configurations, Concept of tyre pressure and contact pressure, Estimation of Design Traffic. Desired material characteristics, Climatic Considerations. Introduction to analysis of stresses in Flexible pavement by layer theory concept. Maintenance of Bituminous surfaces of highways as per IRC 82.						
Module 3	Design methods of Flexible Pavements	Assignment	Software Application	08 Sessions		
Topics: Discussion on various methods of Flexible Pavement Design – CBR/IRC Method, Group Index Method, etc. Discussion on IRC 37 guidelines for Flexible Pavement Design, Marshall Mix Design. Methods for the design of flexible airport pavement.						
Module 4	Design Considerations and Design Methods of Rigid Pavements	Assignment	Data Collection	09 sessions		
Topics: Basic Concepts of analysis of stresses in Rigid pavement, Modified Westergaard's equations, Analysis of wheel load stresses, Warping stress due to temperature differential, Frictional Stress, Critical Stress combinations, Joints in cement concrete pavement and their functions. General Design approach, Design of dowel bars and Tie bars, Introduction to IRC 58 Guidelines Maintenance of Rigid Pavements as per IRC SP 83.						
Targeted Application & Tools that can be used						

Application areas: The course is useful for graduates while seeking employment in the field of design of highway pavements or airport runways. Design engineers with higher skill set are always in demand by the industry.
Professionally used software: IIT-PAVE/MATLAB/Python/ MX- LOAD

Text Books

1. Yoder and Witezak, "*Principles of pavement design*", John Wiley and Sons, 2011.
2. *Khanna, S.K and Justo, C.E.G.,* "Highway Engineering"*, Nem Chand and Bros. Roorkee (U.P), 1998.*

References

1. Yang, "*Design of functional pavements*", McGraw –Hill, 1972.
2. Huang, Y.H. "*Pavement Analysis and Design*", Pearson Education, 2008.

Weblink:

1. *https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=121367&site=ehost-live*
2. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=710371&site=ehost-live

Topics relevant to "Employment :
Pavement Material Characterization, Maintenance of Bituminous surfaces of highways as per IRC 82, Maintenance of Rigid Pavements as per IRC SP 83, White topping overlay in roads for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Aayush Kumar / Santhosh M B
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV3022	Course Title: Highway Construction and Maintenance Type of Course: Discipline Elective & Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	[1] Highway Engineering [2] Concrete and Highway materials testing laboratory Basics of pavement materials and their characterization.					
Anti-requisites	NIL					
Course Description	This course presents practices and techniques used in the construction of Hot-Mix Asphalt (HMA) and Portland Cement Concrete (PCC) pavements. The course is designed to provide engineering students exposure to many elements of the construction activities in order to aid in the analysis of solving construction-related problems. The course also discusses various issues affecting pavement performance and corresponding maintenance procedures being adopted for the same.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Highway Construction and Maintenance and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Discuss the working aspects of HMA and PCC pavement construction. 2] Identify the construction steps and technique used for HMA and PCC pavement construction 3] Explain various pavement distresses on-site observation. 4] Interpret the maintenance procedures for different pavement types.					
Course Content:						
Module 1	HMA Pavements	Assignment	Programming Task	7 Sessions		
Topics: Hot Mix Asphalt (HMA): Difference between construction of HMA and PCC pavements. Introduction, plant operations, Surface preparation, HMA mix delivery, placement & compaction, HMA construction problems and troubleshooting.						
Module 2	PCC Pavements	Case Study	Data Collection	8 Sessions		
Topics: Portland Cement Concrete (PCC): Introduction, Plant operations, Paving techniques, Curing and Sawing and Traffic management on PCC pavements						
Module 3	Bituminous pavement maintenance	Assignment	Data Collection	7 Sessions		
Topics: Highway Maintenance, repair & Overhaul: Introduction, Highway maintenance components, common types of road failures, their causes and remedies. Maintenance of Bituminous pavements (patch work and surfacing)						
Module 4	RCC maintenance	Assignment	Data Collection	8 Sessions		
Topics: Rigid Pavement Maintenance, repair & Overhaul: Maintenance of concrete roads, filling cracks, repairing joints, maintenance of shoulder (berm). Mechanized maintenance of roads, Maintenance management system (MMS)						
Targeted Application & Tools that can be used: Application Area is in the field of Highway projects under Public sector (NHAI, AAI) or private sector as Supervising Engineers to ensure that roads are constructed in accordance with the technical specifications, optimizing use of available materials thus minimizing project cost. They can also be employed in Quality control (QC) sector having knowledge of various tests and desirable properties of the construction materials.						

Professionally Used Software: Python, MATLAB	
Text Books 1. Khanna, S.K and Justo, C.E.G., "*Highway Engineering*", Nem Chand and Bros. Roorkee (U.P), 1998. 2. Dar-Hao Chen and Cindy Estakhri, *"Material, Design, Construction, Maintenance, and Testing of Pavement"*, Geotechnical Special Publications, American Society of Civil Engineers, 2009. 3. Freddy L. Roberts and Kandhal, P.S., *"Hot Mix Asphalt Materials, Mixture Design and Construction*", University of Texas Austin, Texas, NAPA Education Foundation Lanham, Maryland, 1991.	
References 1. A T Papagiannakis and E A Masad, *"Pavement Design and Materials"*, John Wiley & Sons, 2008. 2. Web link: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=156634368&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": HMA and PCC plant operations for development Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Navneet Singh/Mr Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3023	Course Title: Intelligent Transportation Systems Type of Course: Discipline Elective & Theory only	L-T-P- C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1] CIV2501 Transportation Engineering 2] Traffic Engineering 3] Urban Transport Planning Basic insights into transport planning and traffic characteristics.					
Anti-requisites	NIL					
Course Description	This course deals with the fundamental concepts of Intelligent Transportation Systems (ITS) and its utility in designing transportation infrastructure and vehicles. In addition, the course covers concepts of sustainable mobility, travel demand management, electronic toll collection and road-pricing. Apart from technology discussions, this course will include topics related to policy, economics, safety and security, as well as transport planning for smart cities using ITS. The course aims at applying engineering theories, principals and standards in the performance, control and management of transportation systems using ITS.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Intelligent Transportation Systems and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the importance of intelligent transportation systems. 2] Illustrate major applications of intelligent transportation systems. 3] Show how ITS can be used in fleet oriented services. 4] Interpret the role of technology in ITS and security issues involved.					
Course Content:						
Module 1	Introduction to Intelligent Transportation Systems (ITS)	Case study	Data Collection	5 classes		
Topics: Basic Concepts: Importance of Intelligent Transportation Systems (ITS). Definition, Roles and Responsibilities, Evolution Architecture Components and Standards, ITS across the globe. Applications of Intelligent Transportation Systems in smart cities						
Module 2	Mature Applications of ITS	Assignment	Data Collection	9 classes		
Topics: Automatic Traveler Information Systems, Automatic Transportation Management Systems: Traffic Detection, Signals, Incident detection and management, Ramp Metering, Tolling, Congestion pricing, Electronic Road Pricing and Automatic Vehicle Classification						
Module 3	Fleet Oriented ITS Services	Assignment	Data Collection	8 classes		
Topics: Advanced Public Transportation Systems (APTS), BRT, Commercial Vehicle Operations (CVO), Intermodal Freight , including International Operations and Supply Chains						
Module 4	ITS and Technology, Safety and Security	Assignment	Simulation	8 classes		
Topics: Automated highway systems(AHS), Sensors, ITS Standards, Regionally scaled deployment in smart cities Critical ITS issues: ITS and security, safety, human factors, privacy, sustainability and future						
Targeted Application & Tools that can be used Application areas: The course caters to employability of graduates in the niche fields of traffic systems engineering using modern tools such as Internet of Things and Artificial Intelligence. In addition, the course directly feeds the smart cities concept of the Government of India where engineers are required for developing smart transportation systems. It also helps nurture skills of students to apply concepts learnt manually in the transportation field using latest technology.						

The course caters to environment and sustainability by helping design efficient traffic management systems which can reduce congestion on roads, encourage public transport, reduce emissions and create a positive impact on the environment.

Professionally used software: DIRECTView-AMS, Intelligent Network Flow Optimization Analysis, Modeling, and Simulation (AMS)

Text Books

1. Mashrur A. Chowdhury and Adel Sadek, Artech House, "*Fundamentals of Intelligent Transportation Systems Planning*", Inc., 2003.
2. Sussman and Joseph, "*Perspectives on Intelligent Transportation Systems (ITS)"*, NY: Springer, 2010.

References

1. Kan Paul Chen, John Miles, *"ITS Hand Book 2000: Recommendations for World Road Association (PIARC)"*, Artech House Books, 2000.
2. US Department of Transportation, *"National ITS Architecture Documentation"*, 2007 (CD-ROM).
3. Web link: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2401173&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Mature Applications of ITS, Fleet Oriented ITS Services, ITS and Technology, Safety and Security for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Aayush Kumar/Mr Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code:
CIV3025</td><td colspan="3">Course Title: Environmental Geotechnics
Type of Course: Discipline elective &
Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">CIV2512 Geotechnical Engineering, Environmental Engineering</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course addresses the problems of industrial world and impact on health and welfare in relation to pollution of ground.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Environmental Geotechnics and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:
1) Relate the application of soil mechanics principles to Environmental Geotechnics and characterization of different waste.
2) Demonstrate the natural and manmade contamination of soil and its mitigate measures.
3) List the landfill types and liner concepts and design principles.
4) Discuss the transport phenomena concepts and contaminated ground water and seepage.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Environmental geotechnics</td><td>Assignment</td><td colspan="3">Collection of data of Hazardous wastes and analysis.</td><td>10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Introduction to environmental geo-technics: The role of soil mechanics in Environmental Geo-technics, Production and classification of wastes. Hazardous wastes, physical, chemical and Mineralogical characterization.</td></tr>
<tr><td>Module 2</td><td colspan="2">Geo environmental Hazards</td><td>Assignment</td><td colspan="3">Collection of data of natural and manmade hazards and analysis.</td><td>6 Sessions</td></tr>
<tr><td colspan="9">Topics:
Geo environmental Hazards: Natural and manmade, Mitigate measures and soil pollutant interaction.</td></tr>
<tr><td>Module 3</td><td colspan="2">Waste disposal and Remediation</td><td>Assignment</td><td colspan="3">Design a Municipal Landfill and Reuse of Industrial wastes</td><td>16 Sessions</td></tr>
<tr><td colspan="9">Topics:
Waste disposal facilities: Landfills, Transport phenomena, contaminated ground water and seepage, Stabilization/ Solidification, Waste Remediation, Recycle and Reuse of Industrial Waste.</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used:
This course would most benefit persons who are working in the field of environmental geotechnics, as well as individuals in other professional areas such as chemical engineering, environmental engineering.
Professionally Used Software: Plaxis 2D and 3D, MS Office</td></tr>
<tr><td colspan="9">Text Book:
T1. D.S.Hari and R.R.Krishna — Geoenvironmental Engineering, Site remediation, waste containment and emerging waste management technologies, Wiley, 2005.</td></tr>
<tr><td colspan="9">References
R1. S. Oweiss & R.P.Khera, — Geotechnology of waste management, 2nd Edition, PSW publishing, 2004
R2. Sarsby, R., Environmental Geotechnics, Thomas Telford, 2000 3. Bagachi, A., Design, Construction and Monitoring of Landfills, Wiley Interscience, 1994.</td></tr>
</table>

Website: https://nptel.ac.in/courses/105/102/105102160/ Notes/ PPT: https://nptel.ac.in/courses/105/103/105103025/ E Resources Presidency University: https://web.s.ebscohost.com/ehost/resultsadvanced?vid=18&sid=57767159-f9ca-4528-a4e1-8b54660fcea6%40redis&bquery=Geo+environmental+engineering&bdata=JmRiPWUwMDB4d3cmdHlwZT0xJnNlYXJjaE1vZGU9U3RhbmRhcmQmc2l0ZT1laG9zdC1saXZl https://media.wiley.com/product_data/excerpt/96/04712159/0471215996.pdf	
Topics relevant to "Development of Skill": Stabilization/ Solidification, Waste Remediation, Recycle and Reuse of Industrial Waste for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Jagadish B. Biradar Dr. Madhavi T
Recommended by the Board of Studies on	BOS NO: 14th BOS held on 30/7/22
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 3/8/22

Course Code: CIV3026	Course Title: Advanced Soil Mechanics Type of Course: Discipline elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2512 Geotechnical Engineering					
Anti-requisites	NIL					
Course Description	This Course is intended to cover the most advanced aspects and properties of soil as an engineering material and its effect in laying foundation systems. The students need to have a prior knowledge of Foundation engineering to pursue the Course.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Advanced Soil Mechanics and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Describe the behavior of soil under effective stress conditions 2) Evaluate the various factors governing the consolidation behavior of soils 3) Analyze appropriate type of shear strength parameters for design of geotechnical structures					
Course Content:						
Module 1	Effective Stress	Assignment	Collection of data	08 Sessions		
Topics: The principle of effective stress, Total stress, Porewater pressure and their variations, Effective stresses in partially saturated soils, effective stress in soil mass under hydrostatic conditions, effective stress in soil mass with capillary fringe, effective stress in soil mass with surcharge at ground level.						
Module 2	Compressibility and consolidation	Assignment	Collection of data	08 Sessions		
Topics: Compressibility and Consolidation: One-, two- and three-dimensional compression, Oedometer test, parameters – coefficient of volume change, constrained modulus, compression index, swell for loading and unloading, maximum past consolidation stress, Over-consolidation ratio, Primary and secondary compression, consolidation - One-, two- and three-dimensional problems, Consolidation of partially saturated soils, Creep/Secondary Consolidation.						
Module 3	Consolidation	Assignment	Collection of data	05 Sessions		
Topics: Secondary consolidation, Radial consolidation, pre-compression of clay deposits with and without sand drains, secondary consolidation - factors affecting, related problems.						
Module 4	Shear Strength of Soil	Case study	Data collection	10 Sessions		
Topics: Mohr-Coulomb theory; measurement of shear strength, drainage conditions, stress paths, pore pressure parameters, Hvorslev's strength theory.						
Targeted Application & Tools that can be used: This course emphasizes the importance of soil parameters used in construction of foundations, roads, railways and open excavations. Professionally Used Software: PLAXIS 2D						
Text Book: 1. B.M. Das, Advanced Soil Mechanics, CRS Press, 4th edition, 2013						

2. Terzaghi and Peck, Soil Mechanics in Engineering Practice, John Wiley & Sons, 3rd edition, 1996	
References 1. Bowles, J.E. – Foundation Analysis and Design, 5th Edition, BBS Publisher, 2009. 2. Mitchell J.K, Fundamentals of soil Behaviour, John Wiley & Sons, 3rd edition, 2013 E Resources Presidency University: https://web.s.ebscohost.com/ehost/resultsadvanced?vid=2&sid=57767159-f9ca-4528-a4e1-8b54660fcea6%40redis&bquery=soil+mechanics&bdata=JmRiPWUwMDB4d3cmdHlwZT0xJnNlYXJjaE1vZGU9U3RhbmRhcmQmc2l0ZT1laG9zdC1saXZl	
Topics relevant to "EMPLOYABILITY SKILLS": Collection of data on soil strength for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Jagdish B Biradar Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3028	Course Title: Stability of Slopes Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2514 Foundation Engineering					
Anti-requisites	NIL					
Course Description	The course aims at providing geotechnical engineers with a comprehensive view on soil slope stability. It addresses landslide types and mass movement classification; slope failure mechanisms and methods for slope stability analysis are discussed; remedial measures and risk analysis are presented.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Stability of Slope and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Analyze of the slope stability under various loads. 2) Choose mechanics of limit equilibrium procedures. 3] Select the method of stability analysis. 4] Prepare the design reinforced slope.					
Course Content:						
Module 1	Slope Stability Conditions for Analysis	Assignment	Collection of data		06 Sessions	
Topics: Slope Stability Conditions for Analysis: Introduction, end-of-construction stability, long-term stability, rapid (sudden) drawdown, earthquake, partial consolidation and staged construction, other loading conditions- Rapid Flood Loading, Surcharge Loading.						
Module 2	Mechanics of Limit Equilibrium Procedures	Assignment	Data Analysis task		06 Sessions	
Topics: Mechanics of Limit Equilibrium Procedures: Equilibrium conditions, single free-body procedures- infinite slope procedure, logarithmic spiral procedure.						
Module 3	Stability analysis of slope	Assignment	Plaxis 2D software		10 Sessions	
Topics: Stability analysis: Stability analysis by the Swedish slip circle method, Stability analysis by friction circle method, Taylor's stability number and stability curves, Wedge method, Stability analysis during steady seepage, during sudden drawdown and during & immediately after construction. Special design problems and details: Design considerations during earthquake, Partial Submergence and Intermediate Water Level and analysis cases for earth and rockfill dams.						
Module 4	Reinforced Slopes and Embankments	Assignment	Study of behaviour of Reinforced slopes using Plaxis 2D		10 Sessions	
Topics: Reinforced Slopes and Embankments: Introduction, limit equilibrium analyses with reinforcing forces, factors of safety for reinforcing forces and soil strengths - method a equations, method b equations, types of reinforcement, reinforcement forces - creep, installation damage, and deterioration in properties over time, pullout resistance, allowable reinforcement forces and factors of safety, orientation of reinforcement forces, reinforced slopes on firm foundations and embankments on weak foundations.						
Targeted Application & Tools that can be used: This course would most benefit persons who are involved in the design and analysis of slope stability for various civil engineering projects such as roadways, railway and earthen dams. Professionally Used Software: Plaxis 2D and 3D						

Text Book: 1. Soil Strength and Slope Stability, 2nd Edition, J. Michael Duncan Stephen G. Wright Thomas L. Brandon.	
References: 1. Soil Mechanics and Foundation Engineering by V N S Murthy, CBS Publishers and Distributors, New Delhi, First edition 2007. 2. Shulka and Yin, Fundamentals of Geosynthetic Engineering Taylor and Francis group, London 2010. Website: https://www.youtube.com/watch?v=e8WUMP6Rt94 E book: file:///C:/Users/Admin/Downloads/Duncan2014Soilstrengthandslopestability.pdf Notes/PPT: https://nptel.ac.in/content/storage2/courses/105101001/downloads/L20.pdf E Resources Presidency University: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=395261&site=ehost-live&ebv=EB&ppid=pp_163	
Topics relevant to "EMPLOYABILITY SKILLS": Assisting with the design of slopes; Design of embankments for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3029	Course Title: Ground Improvement Techniques Type of Course: Discipline Elective & Theory Only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2514 Foundation Engineering					
Anti-requisites	NIL					
Course Description	The Course deals with the concepts of improvement of construction sites that are not suitable for supporting physical infrastructure such as buildings, bridges, highways, tunnels and dams. When such conditions arises then soil needs to be treated using ground improvement techniques. Ground improvement methods improve the engineering properties of the soil mass which is treated to meet project performance requirements.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Ground Improvement Techniques and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Identify the problems associated with the existing ground condition and problematic soils. 2) Demonstrate various techniques of ground modifications. 3] Analyze the history, application potential, basic principles and mechanism of geo-synthetics. 4] Analyze the field problems critically and to suggest the methods of ground improvement techniques.					
Course Content:						
Module 1	Introduction to Ground Improvement Technique	Assignment	Collection of data/Excel	07 Sessions		
Topics: Introduction to Ground Improvement Techniques, Definition, Objectives of ground improvement, need for ground improvement techniques, Classification of ground improvement techniques, Emerging trends in ground improvement techniques, soil distribution in India, Alteration of ground after formation, Reclaimed soils.						
Module 2	Mechanical Ground Modifications	Assignment	Collection of data/Excel	06 Sessions		
Topics: Compaction- Definition, Effect of compaction on various properties of soil, Smooth wheel rollers, Sheep foot rollers, and Pneumatic tired rollers. Deep compaction- Blasting, Vibratory probe, vibratory compactors and vibroflotation, compaction quality control, Engineering behaviour of compacted fine grained soil.						
Module 3	Hydraulic modification	Assignment	Software/ Plaxis 2D software	07 Sessions		
Topics: Introduction, seepage, Filter requirement, Hydraulic modification- Purpose of dewatering, open sump methods, well point system, Electro-kinetic stabilization, Preloading and types of vertical drains, Chemical modification with the addition of admixtures-Lime, fly-ash and bitumen. Physical modification- Purpose of grouting and aspects of grouting.						
Module 4	Inclusion methods of Ground Improvement	Assignment	Software/ Plaxis 2D	10 Sessions		

Topics: Soil reinforcement-Geo-synthetics, Geo-synthetics types, Functions and applications of geo-synthetics. Stone columns, Ground anchors-Types of ground anchors and its applications, soil nailing-Purpose of soil nailing, Applications of soil nailing, Micro-piles-Advantages of micro-piles, Rock bolts-Principles of rock bolts and their functions.	
Targeted Application & Tools that can be used: The most technically challenging and time critical infrastructure projects and transportation sectors in the portfolio of roads, rail, water and building development projects. Professionally Used Software: Plaxis 2D and 3D	
Text Book: 1. Manfired R. Hausmann, "Engineering Principles of Ground Modification", McGraw-Hill Pub, Co. 2. P. Purushothama Raju, "Ground improvement Techniques", USPT3. S. Ramamrutham, R. Narayan, "Theory of Structures", Dhanpat Rai Publishing Company.	
References 1. Koerner, R. M., "Designing with geosynthetics", Prentice Hall Inc. 2. K. Krisch & F. Krisch (2010) – Ground Control and Improvement, John Wiley & Sons 1994 Website: https://nptel.ac.in/courses/105/108/105108075/ e-book- https://books.google.co.in/books?id=cDGIhh7ttMcC&printsec=copyright#v=onepage&q&f=false Notes/PPT: https://nptel.ac.in/courses/105/105/105105210/ E Resources Presidency University: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1805050&site=ehost-live&ebv=EB&ppid=pp_4_1	
Topics relevant to "EMPLOYABILITY SKILLS": Advising on procedures required and the suitability of construction materials; Analysis of sites for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code: CIV4005</td><td colspan="4">Course Title: Reinforced Earth Structures
Type of Course: Discipline elective Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">CIV2514 Foundation Engineering</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">This course caters to Mechanically stabilized earth walls (MSEWs) are cost effective and aesthetically pleasing. The basic concept behind MSEWs is to combine soil, reinforcing materials made of steel or polymers, and appropriate facing to produce a composite system with engineering properties that are ideal for roadway applications, construction of steep embankments.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Reinforced Earth Structures and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of this course the students shall be able to:
1] Analyze the past history, application potential, basic principles and mechanism
2] Examine the appropriate material properties and parameters used in design.
3] Analyze the Various applications of geosynthetics.
4] Prepare the design of reinforced earth retaining walls.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to reinforced soil structures</td><td>Assignment</td><td colspan="3">Collection of data of Historical background of reinforced earth structures and analysis.</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Introduction to reinforced soil structures: Historical back ground, comparison with reinforced cement concrete structures, Principles, concepts and mechanisms of reinforced earth.</td></tr>
<tr><td>Module 2</td><td colspan="3">Types of Geosynthetic materials and their testing</td><td>Assignment</td><td colspan="3">Collection of data of applications of various types of geosynthetics and analysis.</td><td colspan="2">6 Sessions</td></tr>
<tr><td colspan="10">Topics:
Types of geosynthetic materials used and their properties, laboratory testing, constructional details, metallic strips, metallic grids, geotextiles, geogrids, geomembranes and geocomposites, their functions and design principle.</td></tr>
<tr><td>Module 3</td><td colspan="3">Application of Geotextiles</td><td>Assignment</td><td colspan="3">Performance analysis of geotextile reinforced retaining structures with Plaxis 2D software</td><td colspan="2">7 Sessions</td></tr>
<tr><td colspan="10">Topics:
Application of Geotextiles – Pavements, Clay Liners, Soil erosion Introduction, Design methods, Function and Mechanism, Geotextile properties and test methods. – Physical, Mechanical and Hydraulic properties, Construction methods and techniques using Geotextiles.</td></tr>
<tr><td>Module 4</td><td colspan="3">Design applications of reinforced soil structures</td><td>Assignment</td><td colspan="3">Study of behavior of Reinforced slopes using Plaxis 2D</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Design applications of reinforced soil structures: Bearing capacity Improvement, Reinforced Earth Walls.</td></tr>
<tr><td colspan="10">Targeted Application & Tools that can be used:
This course would most benefit persons who are involved in the design and construction of earth retention structures for various civil engineering projects.
Professionally Used Software: Plaxis 2D and 3D</td></tr>
</table>

Text Book: 1. Koerner, R.H. Designing with geosynthetics, Prentice Hall Inc, 5TH Edition, 2005.	
References 1. Jones, C.J.F.P. Reinforcement and soil structures, Thomas Telford, 1996. 2. Jewel, R.A. Soil reinforcement with geotextiles (Special publication), CIRIA, 1996. 3. Ingold, J.S. and Miller, K.S., Geotextiles hand book, Thomas Telford Ltd, 1988 4. Shulka and Yin, Fundamentals of Geosynthetic Engineering Taylor and Francis group, London 2010 Website: https://nptel.ac.in/courses/105/108/105108075/ Notes/ PPT: https://nptel.ac.in/courses/105/106/105106052/	
Topics relevant to "Employability Skill": Assisting with the design of reinforced walls; Bearing capacity improvement in railways and road ways for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Madhavi T Mr. Jagadish B. Biradar
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV4006	Course Title: Advanced Foundation Design Type of Course: Discipline elective & Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2514 Foundation Engineering, Design of RCC and PSC Structural Elements					
Anti-requisites	NIL,					
Course Description	The course will review the related geotechnical knowledge and apply theory to foundations. The design examples are illustrated and will show application of theory into practice. All key concepts related to foundation will be explained and emphasis will be placed on the practical application of the information provided.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Advanced Foundation Design and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Select appropriate foundations type based on available soil conditions. 2) Determine the load carrying capacity of each type of foundation. 3) Analysis and design of reinforced concrete shallow foundations, pile foundations, well foundations, and machine foundations.					
Course Content:						
Module 1	Shallow Foundations	Assignment	Collection of data/ Excel	12 Sessions		
Topics: Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil, Bearing Capacity of Foundations with Uplift or Tension Forces, Bearing Capacity Based on Building Codes (Presumptive Pressure), Safety Factors in Foundation Design, - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings.						
Module 2	Pile Foundations	Assignment	Software/ Plaxis 2D	05 Sessions		
Topics: Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles – different shapes of piles cap – structural design of pile cap.						
Module 3	Caisson Foundations	Case study	Data collection/Excel	06 Sessions		
Topics: Types of Caisson foundation – Standard Caisson – Pneumatic Caisson – construction of standard caissons –Final positions of caissons, Functions.						
Module 4	Machine Foundations	Case study	Collection of data/	09		
Topics: Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation’						
Targeted Application & Tools that can be used: This course is emphasizes the analysis and design of foundations based on different soils. Professionally Used Software: Plaxis 2D						
Text Book: 1. V.N.S.Murthy, Advanced Foundation Engineering, CBS publishers & distributors, first edition (2007) 2. Tomlinson, M. J. and Booman, R. Foundation Design and Construction, Prentice Hall Publishing, 2001.						

References 1. Bowles, J.E. – Foundation Analysis and Design, 5th Edition, BBS Publisher, 2009. 2. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012 E Resources Presidency University: https://web.s.ebscohost.com/ehost/resultsadvanced?vid=6&sid=680fe419-e0f6-4c8d-b6ac-7777ec3d0447%40redis&bquery=geotechnical+engineering&bdata=JmRiPWUwMDB4d3cmZGI9bmxlYmsmdHlwZT0xJnNlYXJjaE1vZGU9U3RhbmRhcmQmc2l0ZT1laG9zdC1saXZl	
Topics relevant to "EMPLOYABILITY SKILLS": Advising on design and the suitability of foundation along with its construction materials for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Jagdish Biradar Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV4007	Course Title: Earth and Earth Retaining Structures Type of Course: Discipline elective Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2514 Foundation Engineering and Design of RCC and PSC structural Elements					
Anti-requisites	NIL					
Course Description	The course will review the related geotechnical knowledge and apply theory to retaining walls. The design examples are illustrated and will show application of theory into practice. All key concepts will be explained and emphasis will be placed on the practical application of the information provided.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Earth and Earth Retaining Structures and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Compute the lateral earth pressure acting on retaining structures. 2) Prepare the design of rigid retaining walls. 3] Discuss the functions and Mechanics of Braced cuts. 4] Compute the earth pressure in Braced cuts.					
Course Content:						
Module 1	Earth Pressure Theories	Assignment	Collection of data/ Excel	10 Sessions		
Topics: Earth Pressure Theories: Introduction, active and passive earth pressures, earth pressure at rest, Rankine's theory for determination of active and passive earth pressure, coefficient of earth pressure at rest, earth pressure distribution, total earth pressure and its point of application, determination of tension cracks and critical height for unsupported excavation, effect of water table on earth pressure, Coulomb's theory of active and passive earth pressure, Culmann's and Rebhann's graphical methods for determination of active and passive earth pressures.						
Module 2	Rigid retaining structures	Assignment	Software/Python	06 Sessions		
Topics: Rigid Retaining Structures: Types of retaining walls, Stability (sliding, overturning, bearing capacity) of gravity and cantilever walls, design principles of retaining walls, Effect of backfill material and drainages, Empirical methods and Stability analysis.						
Module 3	Flexible retaining structures	Case study	Data collection/ Excel	06 Sessions		
Topics: Flexible Retaining Structures: Sheet pile walls, Construction methods- Cantilever and Anchored sheet pile wall.						
Module 4	Coffer dams	Case study	Data collection/ Excel	08 Sessions		
Topics: Coffer dams & Cellular coffer dams: Introduction – types of coffer dams - Design of cellular coffer dams on rock and Soil.						
Targeted Application & Tools that can be used: This course emphasizes the design of earth retaining structures used in construction of roads, railways and open excavations. Professionally Used Software: Plaxis 2D and 3D						

Text Book: 1. Clayton, C.R.I., Woods, R.I., Bond, A.J., Milititsky, J. – Earth Pressure and Earth-retaining structures, CRC Press, Taylor and Francis group, 2013. 2. Budhu, M. – Foundations and Earth retaining structures, John Wiley & Sons, Inc., 2008.	
References 1. Bowles, J.E. – Foundation Analysis and Design, 5th Edition, BBS Publisher, 2009. 2. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012 Website: https://nptel.ac.in/content/storage2/courses/105101083/download/lec26.pdf E-book: https://pdfcookie.com/documents/foundations-and-earth-retaining-structures-muni-budhu-9lgry89n8y2o Notes/PPT: https://nptel.ac.in/courses/105/101/105101083/ E Resources Presidency University: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=249294&site=ehost-live&ebv=EB&ppid=pp_205	
Topics relevant to "EMPLOYABILITY SKILLS": _ Assisting with the design of retaining structures; Design of Braced cuts for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV4007	Course Title: Earthquake Resistant Design of Foundations Type of Course: Discipline elective Theory only		L-T-P-C	3	0	0	3
Version No.	1.1						
Course Pre-requisites	CIV2514 Foundation Engineering						
Anti-requisites	NIL						
Course Description	The course will review the related geotechnical knowledge and apply theory to earthquake structures. The design examples are illustrated and will show application of theory into practice. All key concepts will be explained and emphasis will be placed on the practical application of the information provided. This Course is intended to cover the various concepts of earthquake design of foundations.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Earthquake Resistant Design of Foundations and attain Employability Skills through Problem Solving methodologies.						
Course Outcomes	On successful completion of this course the students shall be able to: 1) Analyse and design of foundation under earthquake loading by considering the influence of various design parameters 2) Discuss the liquefaction of soils due to earthquake 3) Evaluate the shallow foundation response for seismic condition 4) Evaluate the deep foundation response for seismic condition						
Course Content:							
Module 1	Dynamic properties of soils	Assignment	Collection of data/Excel	08 Sessions			
Topics: Basic design parameter, Dynamic properties of soils and its evaluation, strength and deformation characteristics of soils under earthquake loading, liquefaction hazard evaluations and remedial measures, geotechnical failure of foundations during earthquake, provision of IS 1893 and IS 13920.							
Module 2	Shallow foundation	Assignment	PLAXIS 2D Software	07 Sessions			
Topics: Design requirements – bearing capacity theory under earthquake loading – bearing capacity analysis for liquefied soil – bearing capacity analysis for cohesive and cohesionless soils - seismic settlement of foundation.							
Module 3	Deep foundation	Case study	Data collection/ Excel	07 Sessions			
Topics: Earthquake loading – inertial and kinematic loading - performance of piles during earthquake loading – theories of pile failure in liquefiable soils – failure based on bending mechanism/buckling instability.							
Module 4	Structural design of foundation	Case study	Case study	10 Sessions			
Topics: Introduction – loads acting on foundations during earthquake – fundamental failure mechanisms of foundations – essential criteria for design of foundations in liquefiable soils – structural design of foundations subjected to earthquake loading.							
Targeted Application & Tools that can be used: This Course is intended to cover the various concepts of earthquake design of foundations. The students need to have a prior knowledge of Geotechnical engineering to pursue the Course.							

Professionally Used Software: Plaxis 2D
Text Book: 1. Design of foundation in seismic areas: Principles and some applications by Bhattacharya S. (eds), Published by NICEE [National Centre for Earthquake Engineering (India)]. ISBN: 81-904190-1-3, 2007. 2. Basic geotechnical earthquake engineering by Kamalesh Kumar, New Age International Publishers, New Delhi, 2008.
References 1. Geotechnical Earthquake Engineering by Day R. W., handbook, McGraw – Hill, New York, 2002. 2. Design of Pile Foundations in Liquefiable Soils by Gopal Madabhushi, Jonathan Knappett and Stuart Haigh, Imperial College Press, London 2010. 3. Soil dynamics by Prakash, S., McGraw Hill, New York, 1981. E Resources Presidency University: https://web.s.ebscohost.com/ehost/resultsadvanced?vid=2&sid=5c2a6e67-f72e-4930-a9aa-2967a5662539%40redis&bquery=soil+mechanics+and+foundation+engineering&bdata=JmRiPWlpaCZ0eXBlPTEmc2VhcmNoTW9kZT1TdGFuZGFyZCZzaXRlPWVob3N0LWxpdmU%3d
Topics relevant to "EMPLOYABILITY SKILLS": Advising on earthquake resistant design and the suitability of foundation along with its construction materials for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Jagdish Biradar
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3050	Course Title: Pavement Management System Type of Course: Discipline Elective Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Pavement Design					
Anti-requisites	Nil					
Course Description	A pavement management system (PMS) is a planning tool used to aid pavement management decisions. PMS software programs model future pavement deterioration due to traffic and weather, and recommend maintenance and repairs to the road's pavement based on the type and age of the pavement and various measures of existing pavement quality. Measurements can be made by persons on the ground, visually from a moving vehicle, or using automated sensors mounted to a vehicle. PMS software often helps the user create composite pavement quality rankings based on pavement quality measures on roads or road sections. Recommendations are usually biased towards predictive maintenance, rather than allowing a road to deteriorate until it needs more extensive reconstruction.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Pavement Management System and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 1] Illustrate the significance of pavement Management System in improving riding quality for long time at reasonable cost. 2] Learn various techniques of assessment of data management, pavement performance etc. 3] Evaluate the knowledge of overlay design, optimum design and related computer application.					
Course Content:						
Module 1	Pavement Management & Maintenance Method	Assignment	Data Collection	11 Sessions		
Topics: Pavement management system concept and application, Levels of pavement Management - Network & Project level, Function- Data need, life cycle of pavement, pavement performance assessment, evaluation of pavement structural capacity, distress & safety, combined measures of pavement quality, data management.						
Module 2	Design at Project Level	Assignment	Data Collection for overlay design	13 Sessions		
Topics: Framework for pavement design, characterization of physical design inputs, basic structural response models –variability, reliability and risk – generating alternate design strategies, rehabilitation design procedures, Overlay design, economic evaluation of alternate pavement design strategies-selection of optimal design strategy.						
Module 3	Implementation of Pavement Management System	Assignment	Data analysis/ Software	8 Sessions		
Topics: Major steps in implementing PMS- Pavement construction management & pavement maintenance management- information, research needs, cost and benefit of pavement						

management – future directions and need for innovations in pavement management, Highway Design Manual applications.

Targeted Application & Tools that can be used:

The module contents are designed to achieve economy in transportation of goods as well as passenger, and importance of efficient network. Pavement Management system improve riding quality for given distance at reasonable cost. It helps to build knowledge among students about possible pavement management system aspect.

Professionally Used Software: PAVER

Text Books

T1. Sharma & Shrama, Principles and Practice of Highway Engineering.

T2. S K Khanna and C.E.G Justo , Highway Engineering, Khanna Publications, New Delhi.

References

R1. Susan Brown, Pavement Management Systems, Transportation Research Board, 1993.

R2. Yang H Huang 'Pavement Analysis and Design, Pearson.

R3. IRC– 37, 2001, 2012 and IRC – 58-1998, 2002.

Website: https://nptel.ac.in/courses/105106115/26

Notes/PPT: https://www.pavementpreservation.org/video_library/pavement/PMS.html

E Resources Presidency University:

1. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=710371&site=ehost-live
2. *https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=121367&site=ehost-live*

Topics relevant to "EMPLOYABILITY SKILLS": Designing Pavement Management System using different software for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Jagdish B Biradar
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3057	Course Title: Designing of soil structures with Geosynthetics Type of Course: Discipline Elective & Theory only		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CIV2512 Geotechnical Engineering and CIV2514 Foundation Engineering					
Anti-requisites	Nil					
Course Description	This course caters to geosynthetics as construction materials in civil engineering projects. It will introduce the concept of geosynthetics, their manufacture, behavior and applications in different civil engineering designs. Geosynthetics have emerged as exciting materials in wide array of applications such as transportation, Geotechnical, environmental, hydraulics and all activities which include soil, rocks and water are included.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Designing of soil structures with Geosynthetics and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of this course the students shall be able to: 1] Illustrate the principles and mechanisms of reinforced soil. 2] Evaluate applications of reinforced soil. 3] Design different type of structures using reinforcement / geosynthetics					
Course Content:						
Module 1	Introduction and need for geosynthetics	Assignment	Data Collection/Excel	10 Sessions		
Topics: Historical back ground - Introduction to geosynthetics reinforced soil structures, comparison of geosynthetics reinforcement with reinforced cement concrete structures, Principles, concepts and mechanisms of geosynthetic reinforced soil.						
Module 2	Polymers in Geosynthetics and Manufacturing Techniques	Assignment	Data Collection/Excel	10 Sessions		
Topics: Materials used and their properties such as physical properties, mechanical and chemical properties, laboratory testing and constructional details, geotextiles, geogrids, geomembranes and geocomposites, their functions and design principles.						
Module 3	Strength Analysis of Reinforced Soils	Assignment	Data analysis/ Software	9 Sessions		
Topics: Design applications of reinforced soil structures such as separation, reinforcement. Filtration, drainage, containment and combination: Bearing capacity Improvement, Reinforced Earth Walls, Slopes, Soil Nailing.						
Targeted Application & Tools that can be used: The module contents emphasize the application of the principles of geosynthetics reinforced soil, Reinforced earth has so many applications in construction work. Some of the applications include its use in stabilization of soil, construction of retaining walls, bridge abutments for highways, industrial and mining structures. Professionally Used Software: Plaxis 2D and 3D						
Text Books T1. Koerner, R.H. Designing with geosythetics, Prentice Hall Inc, 5TH Edition, 2005.						
References R1. Jones, C.J.F.P. Reinforcement and soil structures, Thomas Telford, 1996. Website: https://nptel.ac.in/courses/105106052 Notes/PPT: https://archive.nptel.ac.in/content/syllabus_pdf/105106052.pdf E-Resources Presidency University:						

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1805050&site=ehost-live&ebv=EB&ppid=pp_3_1	
Topics relevant to "EMPLOYABILITY SKILLS": Measuring and modeling: Soil Hydraulic Characteristics, Measurement of Shear Strength and determination of phase properties of unsaturated soil for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV 2054	Course Title: Road Safety and Traffic Management Type of Course: Discipline Elective & Theory Only		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The objective of this course will help in training students in the domain of traffic Engineering related to road safety. The course on Pavement Materials will deal with the basic and fundamental traffic regulations and control measures. Generate awareness about traffic rules and characteristics of accident. Evaluation of road safety and Interpretation accident data using statistical analysis.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Road Safety and Traffic Management and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Recognize the effect of driver characteristics, roadway characteristics, and climatic factors on highway safety. 2] Illustrate the accident data and suggest safety measures. 3] Interpret accident data using statistical models					
Course Content:						
Module 1	Road accidents	Assignment	Programming Task	10 Sessions		
Topics: Road accident: causes, scientific investigations and data collection. Analysis of individual accidents to arrive at real causes; statistical methods of analysis of accident data, application of computer analysis of accident data.						
Module 2	Safety in Road Design	Assignment	Data Collection/ Excel	10 Sessions		
Topics: Safety in Road Design: Accident prevention through better planning and design of roads, planning road networks by land use planning, route planning, traffic planning for different land uses etc. Junction design for safety, Operating the road network for safety, highway operation and counter-measures, road safety audit, principles- procedures and practice, code of good practice and checklists.						
Module 3	Road safety issues and various measures for road safety	Assignment	Programming/Data analysis task	10 Sessions		
Topics: Road safety issues and various measures for road safety. Engineering, education and enforcement measures for improving road safety. Short term and long term measures. Road safety education and training. Traffic calming techniques and innovative ideas in road safety.						
Targeted Application & Tools that can be used: analysis of accident data & Road safety audit data collection and interpretation Professionally used software – Mat lab/Excel						
Text Book T1 Geetam Tiwari and Dinesh Mohan, Transport Planning and Traffic Safety, CRC Press T2 S K Khanna and C.E.G Justo , Highway Engineering, Khanna Publications, New Delhi.						
References Weblink: https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=3&sid=5c76d52e-7747-4339-af01-						

4a8d4d32233f%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=139125581&db=iih https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=5c76d52e-7747-4339-af01-4a8d4d32233f%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=151185337&db=iih	
Topics relevant to "EMPLOYABILITY SKILLS": Analysis of accident data & Road safety audit data collection and interpretation for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3053	Course Title: Design of Pile Foundations Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CIV2512 Geotechnical Engineering and CIV2514 Foundation Engineering					
Anti-requisites	Nil					
Course Description	The objective of this course caters to design of pile foundation in civil engineering projects involving problematic soils. Pile foundations are deep foundations principally used to transfer the loads from superstructures, through weak, compressible strata or water onto stronger, more compact, less compressible and stiffer soil or rock at depth, increasing the effective size of a foundation and resisting horizontal loads.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Design of Pile Foundations and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of this course the students shall be able to: 1] Illustrate the mechanism of pile foundations. 2] Evaluate applications of pile foundations. 3] Design different type of piles using various design methods. 4] Analyze the efficiency of pile group.					
Course Content:						
Module 1	Introduction and need for pile foundations	Assignment	Data Collection/ Excel	11 Sessions		
Topics: Introduction, Classification of Piles, Uses of Piles, Selection of Pile, Installation of Piles, vertical load bearing capacity of a single vertical pile, General Considerations, Methods of Determining Ultimate Load Bearing Capacity of a Single Vertical Pile, Dynamic Formula, Static formula, Pile load tests, Negative skin friction, Numerical.						
Module 2	Pile group	Assignment	Data Collection/ Excel	13 Sessions		
Topics: Pile Group Efficiency, Number and Spacing of Piles in a Group, Vertical Bearing Capacity of Pile Groups Embedded in Sands and Gravels, Settlement of Pile Groups in Cohesive Soils, Allowable Loads on Groups of Piles, Numerical.						
Module 3	Behaviour of laterally loaded vertical and batter piles	Assignment	Data analysis/ Software	9 Sessions		
Topics: Introduction, Winkler's Hypothesis, The Differential Equation, Non-dimensional Solutions for Vertical Piles Behavior Subjected to Lateral Loads of Laterally Loaded Batter Piles in Sand, Case studies, Numerical.						
Targeted Application & Tools that can be used: The module contents emphasize the application of the pile foundations which has so many applications in weak soil strata for foundation construction. Some of the applications include its use in reduced settlement of soil, construction of machine foundations and multistorey structures. Professionally Used Software: DeepFND						
Text Books T1. V. N. S. Murthy, "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors.						
References R1. Das, B. M. "Principles of Foundation Engineering", Thomson India Edition, New Delhi. R2. J.E. Bowles, "Foundation Analysis and Design", McGrawHill Pub. Co. New York.						

Website: https://nptel.ac.in/courses/105105176 Notes/PPT: https://archive.nptel.ac.in/content/syllabus_pdf/105105176.pdf E Resources Presidency University: https://web.s.ebscohost.com/ehost/resultsadvanced?vid=21&sid=57767159-f9ca-4528-a4e1-8b54660fcea6%40redis&bquery=PILE+FOUNDATION&bdata=JmRiPWUwMDB4d3cmdHlwZT0xJnNlYXJjaE1vZGU9U3RhbmRhcmQmc2l0ZT1laG9zdC1saXZl	
Topics relevant to "EMPLOYABILITY SKILLS": Designing Pile Foundation using different software for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Jagdish B Biradar
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2056	Course Title: Pavement Materials Type of Course: Discipline Elective & Theory Only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Properties of soil and aggregates and Concrete Mix design					
Anti-requisites	NIL					
Course Description	The objective of this course will help in training students in the domain of material engineering related to pavement application. The course on Pavement Materials will deal with the basic and fundamental understanding about the behaviour of various materials used in the construction of pavements. Characterization, tests and engineering properties of these materials will be elaborated in context with its field application. Current practices and future trends in the area of pavement materials will be discussed.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Pavement Materials and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Recognize the behaviour of various materials used in the construction of pavements 2] Illustrate the tests and engineering properties of pavement materials in context to its field application 3] Explain the Current practices and future trends in the area of pavement materials					
Course Content:						
Module 1	Soil and aggregates	Assignment	Programming Task			10 Sessions
Topics: Soil: Introduction to soil as a highway material; Classification of soils; Consistency Limits; Soil compaction and role of moisture; Mechanical properties of soil (Shear strength, Unconfined compressive strength, Resilient modulus, California bearing ratio, Modulus of subgrade reaction etc.); Introduction to expansive soils, relevant tests, and soil stabilization techniques. Aggregates: Aggregate origin, types, production, and quarrying operation; Classification of aggregates; Aggregate gradation and gradation parameters; Theories of aggregate blending; Mineralogy of aggregates and its importance; Aggregate shape and texture: quantification and importance; Aggregate strength properties, and relevant tests.						
Module 2	Bitumen and Bituminous Mixtures	Assignment	Data Collection/Excel			10 Sessions
Topics: Bitumen, Modified bitumen, Bitumen emulsion and Cutback bitumen: Bitumen as a binding agent, Production of bitumen, Physical and rheological properties of bitumen. Introduction to viscoelasticity, Chemistry of bitumen, Ageing of bitumen, Grading of bitumen, and relevant tests. Penetration grade, Viscosity grade, Performance grade. Bitumen modification: Need, Types and Importance; Introduction of bitumen emulsion: Theory of emulsification, Uses, Grading of emulsions, and Relevant tests; Introduction to cutback bitumen: Types, Uses, and relevant tests. Bituminous Mixtures: Production of bituminous mixtures: Laboratory and Plant; Role of bituminous mixture and desirable properties; Volumetric of bituminous mixture; Mix design of bituminous mixture.						
Module 3	Concrete Mix Design and Alternative Pavement Materials	Assignment	Programming/ Data analysis task			10 Sessions
Topics: Concrete proportioning and importance of various constituents; Introduction and mix design of pavement quality concrete, Dry lean concrete and Pervious concrete						

Alternative Pavement Materials: State of the art on various alternative materials for construction of flexible and rigid pavements.
Targeted Application & Tools that can be used: Grading of aggregates and mix design of pavement concrete. Professionally used software – Mat lab/Excel
Text Book T1 S K Khanna and C.E.G Justo, Highway Engineering, Khanna Publications, New Delhi. T2. Yang H Huang, '*Pavement Analysis and Design, Pearson*. T3. Dar-Hao Chen and Cindy Estakhri, "Material, Design, Construction, Maintenance, and Testing of Pavement", Geotechnical Special Publications, American Society of Civil Engineers, 2009.
References R1: Freddy L. Roberts and Kandhal, P.S., "Hot Mix Asphalt Materials, Mixture Design and Construction", University of Texas Austin, Texas, NAPA Education Foundation Lanham, Maryland, 1991. Weblink: W1:https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=710371&site=ehost-live&ebv=EB&ppid=pp_Cover W2:https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=681254&site=ehost-live&ebv=EB&ppid=pp_Cover
Topics relevant to "EMPLOYABILITY SKILLS": Tests and Engineering properties of pavement materials for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3058	Course Title: Unsaturated Soil Mechanics Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CIV2512 Geotechnical Engineering and CIV2514 Foundation Engineering					
Anti-requisites	Nil					
Course Description	The understanding of unsaturated soil mechanics principles is of interest to a wide spectrum of geotechnical problems associated with soils above water table and compacted soils, stress state variables and constitutive equations based on the unsaturated soil mechanics principles. This course caters to the basic concepts for characterization of unsaturated soils and measurements of matric suction (or negative pore-water pressures). The application of unsaturated soil mechanics theories includes slope stability, measurement soil hydraulic characteristics and determination of shear strength					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Unsaturated Soil Mechanics and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of this course the students shall be able to: 1] Discuss the various concepts of unsaturated soil mechanics, typical profiles of unsaturated soils and their Origin and formation. 2] Estimate the State Variables for Unsaturated Soils. 3] Analyze flow through unsaturated soils.					
Course Content:						
Module 1	Theory to Practice of Unsaturated Soil Mechanics	Assignment	Data collection/ Software	10 Sessions		
Topics: Introduction, Application of Unsaturated Soil Mechanics in Engineering Practice, Application Areas for Unsaturated Soil Mechanics, Engineering protocols for Unsaturated soils, Definition of Unsaturated soil mechanics, Unsaturated Soil as Four-Phase Mixture, Distinctive Features of Contractile Skin, Designation of Deformation State Variables, Typical Profiles of Unsaturated Soils, Tropical Residual Soil Profile, Expansive Soil Profile, Phase properties and soil classification.						
Module 2	State Variables for Unsaturated Soils and measurement	Assignment	Data collection/ Excel	10 Sessions		
Topics: Basis for Stress State Variables, Stress State Variables for Unsaturated Soils, Representation of Stress States, Measurement of Soil Suction, Measurement of Total Suction, Measurement of Osmotic Suction, Measurement of In Situ Water Content, Estimation of Soil Suction.						
Module 3	Theory of Water Flow through Unsaturated Soils and Shear Strength of Unsaturated Soils	Assignment	Software	9 Sessions		
Topics: Introduction to Theory of Flow of Water, Darcy's Law for Unsaturated Soils, Partial Differential Equations for Steady-State Water Flow, Soil Water Characteristic Curve, water retention mechanism, Theory of Shear Strength, Measurement of Shear Strength, Triaxial Test Procedures for Unsaturated Soils, Interpretation of Triaxial Test Results and Direct Shear Tests.						
Targeted Application & Tools that can be used: The module contents emphasize the application of the principles of geotechnical engineering to classify the unsaturated soil, various concepts of unsaturated soil mechanics, typical profiles of unsaturated soils and their Origin and formation, stress state variables, determination of shear strength of unsaturated soil by using excel and permeability. Professionally Used Software: Plaxis 2D and 3D						
Text Books						

T1. D. G. Fredlund, H. Rahardjo, M. D. Fredlun, Unsaturated Soil Mechanics in Engineering Practice.	
References R1. N. Lu and W. J. Likos, Unsaturated Soil Mechanics, John Wiley & Sons, Inc., 2004. Website: https://nptel.ac.in/courses/105103139 Notes/PPT: https://archive.nptel.ac.in/content/syllabus_pdf/105103139.pdf E Resources Presidency University: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2178969&site=ehost-live&ebv=EB&ppid=pp_1	
Topics relevant to "EMPLOYABILITY SKILLS": Measuring and modelling: Soil Hydraulic Characteristics, Measurement of Shear Strength and determination of phase properties of unsaturated soil for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Madhavi T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2027	Course Title: Environmental Pollution and Control Type of Course: Discipline Elective & Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CHE7601 Environmental Studies					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to improve the understanding of various pollution control strategies and the application skills of remediation techniques for different environmental components i.e. air, water and soil. Professional environmental engineers have a significant role and benefits to guard the quality of our environmental resources in many ways including: environmental cleanup, water quality treatment, smart waste disposal and preventing industrial air and noise pollution. They chose and design water and sewage treatment plants that clean water for human use. This is a theory based course which will give an idea of different sources, effects and control of pollution, Environmental Hygiene etc.					
Course objective	The objective of the course is to familiarize the learners with the concepts of Environmental Pollution and Control and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Identify the various sources of water pollution and control methods. 2] Discuss the behavior of air pollutants in atmosphere and its control strategies. 3] Infer the impact and control measures of industrial noise Pollution.					
Course Content:						
Module 1	Water Pollution and Control	Assignment	Data Collection/ Interpretation	14 Sessions		
Topics: Definition, Sources and effects of Water Pollution. Water borne diseases. Drinking water quality Characteristics and standard limits. Water Quality index. Langelier and Ryznar indices. Biodegradation: aerobic and anaerobic decomposition processes. Oxygen sag curve. Control Techniques: Methods of Waste water treatment. Water Quality index. Water (Prevention and Control of Pollution) Act, 1974 and Rules.						
Module 2	Air Pollution and Control	Assignment	Data Collection/ Interpretation	12 Sessions		
Topics: Definition, Sources, classes and effects of air pollution. Air borne diseases. Air quality characteristics and standard limits. Formation and effects of photochemical smog and PAN particles. Types of inversion, Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, Plume Rise, Gaussian dispersion model. Control Techniques: Particulate matter and gaseous pollutants- settling chambers, cyclone separators, scrubbers, filters & ESP. Air quality index. Air (Prevention & Control of Pollution) Act, 1981 and Rules.						
Module 3	Noise and Soil Pollution and control	Case study	Data Interpretation / Analysis	10 Sessions		
Topics: Concept of Sound. Decibel levels of common noises. Hazards of noise pollution. Effects of noise-physiological and psychological effects, Measurement of noise levels. Engineering description of noise and sound, sound pressure level, frequency, and propagation. Sound Level and Noise standards. Principles of Noise reduction. Noise reduction possibilities. Noise protecting equipments. Control of industrial noise pollution in industries.						
Targeted Application & Tools that can be used: This course helps the students to understand the basic principles of measurement and monitoring techniques of environmental parameters.						

Professionally Used Software: WaterCAD, SewerCAD, StromCAD, MS office	
Text Books: T1. M N Rao and H V N Rao, *Air pollution, Tata McGraw-Hill publishing company limited, New Delhi*. 1990. T2. C.S. Rao, *Environmental Pollution Control Engineering, New Age International*. 2007. T3. De A.K., *Environmental Chemistry", New Age Publisher International Pvt Ltd*. 2016.	
References: R1. Brady N.C., *The Nature and Properties of Soil, Prentice-Hall India*. 1996. R2. Eckenfelder W, *Industrial Pollution Control, McGraw Hill Int. Ed*. 1999. Web sources: https://web.p.ebscohost.com/ehost/detail/detail?vid=8&sid=b4ee81da-8105-4ec1-9f5c-46d35545a001%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#	
Topics relevant to development of "Employability": Environment laws, water quality index, air quality index. Regulatory bodies: SPCB, CPCB for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Ms. Shwetha A / Dr. Venkatesha Raju K
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

<table>
<tr><td>Course Code:
CIV2028</td><td colspan="3">Course Title: Urban Air Pollution and Control
Type of Course: Discipline Elective &
Theory Only Course</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">CHE7601 Environmental studies</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">Nil</td></tr>
<tr><td>Course Description</td><td colspan="8">The purpose of this course is to demonstrate the need for urban air pollution and control and to develop the basic abilities of understanding of sources and effects of air pollution, air pollutants and their effects, air pollution episodes, meteorology, plume behavior, wind rose diagrams, sampling techniques, air pollution control equipment for particulate matter & gaseous pollutants.</td></tr>
<tr><td>Course Objective</td><td colspan="8">This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
1] Classify air pollution, pollutants, sources and effects
2] Identify Plume dispersion, sampling and analysis techniques for air quality assessment
3] Discuss the various techniques of air pollution control</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td>Introduction</td><td>Case Study</td><td>Data Collection</td><td>15 Sessions</td></tr>
<tr><td colspan="5">Topics:
Air Pollution – Definitions, Scope and Significance, Air Pollutants – Classifications – Natural and Artificial – Primary and Secondary, Characteristics of air pollutants and Emission sources.
Effects of Air pollutants on man, material, vegetation and animals; Global effects of air pollution – Green House effect, Heat Islands, Acid Rains, Ozone Holes, air pollution episodes.</td></tr>
<tr><td>Module 2</td><td>Meteorology</td><td>Assignment/ Case Study</td><td>Programming task and Data collection.</td><td>10 sessions</td></tr>
<tr><td colspan="5">Topics:
Meteorology and plume Dispersion: properties of atmosphere, Wind forces, Moisture and relative Humidity, Influence of Meteorological phenomena on Air Quality, wind rose diagrams. Lapse Rates, Winds and moisture plume behaviour and plume Rise Models, Sampling methods and analysis techniques for air quality assessment.</td></tr>
<tr><td>Module 3</td><td>Control of air pollution-Particulates and Gaseous</td><td>Assignment</td><td>Data Collection</td><td>10 sessions</td></tr>
<tr><td colspan="5">Topics:
Control of particulates – Control at Sources, Process Changes, Equipment modifications, Control Equipment’s – Settling Chambers, Inertial separators, Centrifugal separators, Fabric filters, Dry and Wet scrubbers, Electrostatic precipitators
Control of gaseous Pollutants-Absorption and adsorption techniques.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Application area of urban air pollution and control in controlling air pollution in industries, Central and state air pollution control board etc.
Professionally used software: ArcGIS.</td></tr>
<tr><td colspan="5">Text Book
1) M N Rao, “Air pollution and control”, McGraw Hill Publication-2017</td></tr>
<tr><td colspan="5">References
1) C S Rao, “Environment pollution and control Engineering”, New age international publishers-2018.
Web Source:
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=632999&site=ehost-live</td></tr>
<tr><td colspan="5">Topics relevant to Employability Skill: Sampling methods and analysis techniques for air quality assessment Control of gaseous Pollutants-Absorption and adsorption techniques. for developing</td></tr>
</table>

Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Bhavan Kumar
Recommended by the Board of Studies on	12th BoS on 07 August 2021
Date of Approval by the Academic Council	16th Academic Council on 23 October 2021

Course Code: CIV2029	Course Title: Groundwater Hydrology Type of Course: Discipline Elective Theory only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	CIV2503 Fluid Mechanics Basics of Soil Mechanics					
Anti-requisites	NIL					
Course Description	This Course deals with the study of water that flows below the ground surface and gives detailed idea about the behavior of water below the ground level. The Course includes aquifer and types, surface investigation by various methods, flow of water, secular and seasonal variations, fluctuations due to Evapo-transpiration, meteorological phenomena, tides, role of sea water in ground water, occurrence of sea water intrusion, prevention and control of seawater intrusion etc. The course will benefit the students in developing understanding about groundwater movement occurrence and distribution. The nature of this course is theory based only.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Groundwater Hydrology and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Explain distribution and occurrence of groundwater and impact of fluctuations in the water table. 2) Estimate hydraulic conductivity, specific yield and other aquifer properties 3) Identify practical problems of well design and pumping test.					
Course Content:						
Module 1	Introduction to Ground water	Case Study	Data Collection/ Data Analysis	15 Sessions		
Topics: Introduction, Historical background, Utilization, Groundwater in hydrological cycle, groundwater budget, Fluctuations in Groundwater level and influences, Data and Resources, Groundwater resources of India, Summarizing the changes in groundwater level from the annual report CGWB. Rock properties affecting groundwater, Distribution of subsurface water, Geological formations, Aquifers Properties: hydraulic conductivity, storage coefficient, transmissibility, specific yield and retention, Types of Aquifers, Movement of groundwater, Darcy Law.						
Module 2	Well Hydraulics	Assignment	Data Collection/ Data Analysis	14 Sessions		
Steady and Unsteady Flow through confined and unconfined Aquifer, Dupuit's theory, Theis Recovery, Specific capacity and Safe yield, Well losses, Well development, Pumping test for aquifer parameters, Solving pumping test data for aquifer parameters by excel and software.						
Module 3	Groundwater quality and management	Quiz	Data Collection/ Data Analysis	12 Sessions		
Groundwater quality: Measurement, Contamination and its control, Geophysical Investigations of groundwater, Sea water intrusion, Fresh-saline water: Control and prevention, Conjunctive Use and Groundwater management techniques: Artificial recharge and Roof top water harvesting, Introduction to Estimation of groundwater potential zones using ArcGIS.						
Targeted Application & Tools that can be used: Application Area is Groundwater recharge and management, Groundwater quality Professionally Used Software: MODFLOW						

Text Books T1. Raghunath H.M., "*Ground Water Hydrology"*, New-Age International, 2nd Edition T2. Agarwal V.C. "*Groundwater Hydrology*", PHI Learning Private Limited, New Delhi.	
References R1. Todd, D.K., and Mays, L. W., "*Groundwater Hydrology"*, John Wiley and Sons, Singapore. R2. Chahar R Bhagu "*Groundwater Hydrology"*, McGraw Hill Education; First edition, New Delhi R3. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=152368126&site=ehost-live Web resources: https://onlinecourses.nptel.ac.in/noc22_ce44/preview	
Topics relevant to development of "Employability": Pumping test for aquifer parameters for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Aashi Agarwal
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: CIV2030	Course Title: Climate Change and Sustainable Development Type of Course: Discipline Elective/ Theory Only Course			L-T-P- C	3	0	0	3
Version No.	1.1							
Course Pre-requisites	CHE7601 Environmental Studies							
Anti-requisites	NIL							
Course Description	The purpose of this course is to enable the students to provide a general concept within the dimensions of climate change and challenges to Sustainable Development.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Climate change and Sustainable development and attain Employability Skills through Participative Learning techniques.							
Course Outcomes	On successful completion of the course the students shall be able to: 1] Outline the key concepts on Sustainable development and Climatic change. 2] Generalize the climatic mitigations and risk involved in climate change for sustainable development. 3] Distinguish the relationship between climate change and sustainable development. 4] Identify tools for analysis and Development for Sustainable development. 5] Infer on Climatic adaptations for attaining risk Resilience							
Course Content:	Introduction to Climatic change, Social Issues with Climate change, Climatic mitigations, Climate change and sustainable development, Tools for analysis and Development for Sustainable development and climatic adaptation.							
Module 1	Introduction to Climatic change	Assignment	Data Collection/ analysis	6 Sessions				
Topics: Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion Nuclear Accidents & Nuclear Holocaust. The Environment Protection Act. Issues involved in Enforcement of Environmental Legislation. Public Awareness.								
Module 2	Social Issues with Climate change	Assignment	Data Collection/ analysis	8 Sessions				
Topics: From Unsustainable to Sustainable Development. Urban Problems Related to Energy. Water Conservation, Rainwater Harvesting and Watershed Management. Resettlement & Rehabilitation of People: It's Problems & Concerns.								
Module 3	Climatic mitigations	Assignment	Data Collection/analysis	7 Sessions				
Topics: Green House Gas Emission, Energy supply and consumption, Forestry and Renewable Energy.								
Module 4	Climate change and sustainable development	Assignment	Data Collection/analysis	7 Sessions				
Topics: Relationship between climate change and sustainable development, Economic, social and environmental risks arising from climate change, Vulnerability, adaptation and adaptive capacity, Mitigation and mitigative capacity, tunnelling to restructure growth more sustainably and Relevant principles for policy formulation.								
Module 5	Tools for analysis and Development for Sustainable development and climatic adaptation	Assignment	Data Collection/analysis	8 Sessions				
Topics: Relationship between climate change and sustainable development, Economic, social and environmental risks arising from climate change, Vulnerability, resilience, adaptation and								

adaptive capacity, Mitigation and mitigative capacity. National Action Plan, Water Security, Food Security, Health Risk Resilience, Urban Risk Resilience and Disaster Risk Resilience.
Targeted Application & Tools that can be used: This course helps the students to understand the basic concepts of climate change & its mitigation, with special reference to India's commitment towards climate change and policy. Professionally Used Software: MS office
Text Book T1 R.K. Pachauri, "*Climate Change and Sustainable Development"*, OXFORD University Press.
References R1 Mohan Munasinghe, "Climate Change and Sustainable Development". R2 M.L. Narasaiah, "Biodiversity and sustainable Development", Discovery publishing House, New Delhi. Website: www.moef.gov.in E book link 1: https://web.s.ebscohost.com/ehost/detail/detail?vid=3&sid=709883ad-0413-418a-a30b-6aa7dbcb5ff6%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d# E book link 2: https://web.s.ebscohost.com/ehost/detail/detail?vid=4&sid=709883ad-0413-418a-a30b-6aa7dbcb5ff6%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
Topics relevant to "EMPLOYABILITY SKILLS": Urban Risk Resilience and Disaster Risk Resilience, adaptation and adaptive capacity, Mitigation and mitigative capacity, Industry visits for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Shwetha A / Dr. Venkatesh Raju
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV2031	Course Title: Urban Waste Management Type of Course: Discipline Elective/ Theory Only Course		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course demonstrates to get on broader understandings on various aspects of solid waste management in terms of collection, transfer, transport and management of urban solid waste.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Urban Waste Management and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Learn basic concepts of solid waste management, beginning from source generation to collection and transport of solid waste in a system. 2. Develop understanding on various technological applications for processing of waste and their disposals in various ways. 3. Acquire knowledge on waste to energy productions in the perspectives of sustainable development. 4. Apply basic concepts in waste disposal and management for urban areas.					
Course Content:						
Module 1	Nature of urban Solid Waste	Assignment	Data Collection/ Interpretation	7 Sessions		
Topics: Definition of solid wastes – types of solid wastes – Sources - Physical and Chemical composition of municipal solid waste. Generation rate, Numerical Problems. Solid waste management 2000 rules with, 2016 amendments. Concepts of waste reduction, recycling and reuse.						
Module 2	Sources, collection, treatment and disposal of urban solid Waste	Assignment	Data Collection/ Interpretation	7 Sessions		
Topics: Sources, collection, treatment and disposal: - Biomedical waste, E-waste, construction and demolition waste. Determination of composition of MSW Waste collection systems, analysis of collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.						
Module 3	Processing techniques and Energy recovery	Assignment	Data Collection/ Interpretation	7 Sessions		
Topics: Purpose of processing, Mechanical volume reduction (compaction), Mechanical size reduction (shredding), Aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators						
Module 4	Disposal of Solid wastes	Assignment	Data Collection/ Interpretation	6 Sessions		
Topics: Land farming, deep well injections. Landfills: Design and operation including: site selection, Geoenvironmental investigations, engineered sites, liners and covers, leachate control and treatment, gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation						
Module 5	Management of Urban Waste Services	Assignment	Data Collection/ Interpretation	8 Sessions		
Topics: Present scenario of SWM in Urban Local Bodies: Current practices and deficiencies; Case studies of some of the successfully operating Waste to Energy plants; Role of informal sectors in SWM. Salient Features of Solid Waste Management Rules, 2016: Duties and responsibilities of waste						

generators and other stakeholders (Ministries, Pollution control boards, Local authorities, Manufacturers, Industries, etc.); Criteria for setting up solid waste management facilities; Time frame for implementation and monitoring etc.
Targeted Application & Tools that can be used: This course helps the students to understand the basic principles of life cycle assessment of urban solid waste management. Professionally Used Software: MS office
Text Book T1 Tchobanoglous, G., Theisen, H., & Vigil, S. A. (2014). Integrated Solid Waste Management: Engineering Principles and Management Issues. New Delhi: McGraw-Hill Education (India) Private Limited. T2 Peavy, H. S., Rowe, D. R., &Tchobanoglous, G. (2010). Environmental Engineering. New York: McGraw-Hill. T3 Khan, I. H., & Ahsan, N. (2012). Textbook of solid waste management. New Delhi: Satish Kumar Jain for CBS Publisher and Distributors.
References R1 CPHEEO (2000). Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development, Govt. of India, New Delhi. R2 Notification on "Municipal Solid Waste Management Rules, 2016 and its amendments, MoEF & CC, Govt. of India". E book link 1: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2725403&site=ehost-live E book link 2: https://web.s.ebscohost.com/ehost/detail/detail?vid=5&sid=f1b77acd-745d-4c69-9143-3c723105b92e%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
Topics relevant to development of "Employability skill": Waste collection systems, analysis of collection system, visit to solid waste dumping sites for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Shwetha A / Dr. Venkatesh Raju
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2032	Course Title: Urban Flood Analysis and Control Type of Course: Discipline Elective Theory Only Course		L-T-P-C	3	0	0	3
Version No.	1.2						
Course Pre-requisites	Basic concepts of hydrology, Disaster Management, Climate change.						
Anti-requisites	Nil						
Course Description	The purpose of the course is to give an understanding of the concepts of hydrology under the implications of climate change. The course also provides insights about urban flood and its analysis. It also emphasizes the concepts of Hydrology in conjunction with climate change and it implication on flood occurrences and mitigation. The nature of the course is theory based and it discusses the concept of climate change in hydrology and its control and management.						
Course Objective	This course is designed to develop Employability skills by using problem solving methodologies.						
Course Out Comes	On successful completion of the course the students shall be able to: 1. Explain the influence of urban density on floods 2. Discuss the key uncertainties of climate and expected consequences of climate change 3. Explain the impacts of land use change on runoff. 4. Elaborate the concept of Resilience, Vulnerability, Robustness & Sustainability of flood response 5. Analyze and design the SUDS systems and FFWRS						
Course Content							
Module 1	Introduction	Quiz	Case study	8 Sessions			
Introduction: The influence of climate, causes of flooding, types of flooding, fluvial/pluvial flooding, principles of land use planning Climate Change: Key uncertainties and Robust Findings: A review of the past, signs of change, Expected consequences							
Module 2	Hydrology of cities	Assignment	SWMM	6 Sessions			
Urban hydrological cycle, Land use & runoff, Urban flood risk assessment, Tangible & intangible damages, Loss of life estimation in flood risk assessment, flood risk mapping Urban drainage systems: A historical perspective, Major & Minor flows, SUDS/LIDS, Practices in water sensitive urban design							
Module 3	Responding to Flood Risk	Assignment 2	Case study	8 Sessions			
Responses, Resilience, Vulnerability, Robustness & Sustainability, SPR Model, Confronting flood management with land use planning, Building types, infrastructure & public open spaces Enhancing coping & recover capacity: Flood forecasting warning and response, Emergency Planning, Management & Evacuation							
Targeted Application & Tools that can be used: To design and optimize urban drainage system for mitigating Flood, SWMM (Storm water Drainage Model)							
Text Book T1. Chris Zevenbergen, Adraian Cashman, Erik Pasche and Richard Ashely. —Urban Flood Management‖, CRC Press-2010 Edition							

T2. Richard Ashley, Stephen Garvin, Erik Pasche, Andreas Vassilopoulos, Chris Zevenbergen. - Advances in Urban Flood Management‖ CRC Press-2007 Edition.	
References R1. Wheater, H. S., Mcintyre, N., Jackson, B. M., Marshall, M. R., Ballard, C., Bulygina, N. S., Reynolds, B. and Frogbrook, Z. —Multiscale Impacts of Land Management on Flooding‖, Wiley-Blackwell, Oxford, UK, (2010). R2. Arun Kumar. —Handbook of Flood Management: Flood Risk Simulation, Warning, Assessment and Mitigation‖, SBS Publisher, India, Vol. 1 2009 R3.https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=152368126&site=ehost-live Web resources: https://www.edx.org/course/flood-risk-management	
Topics related to "Employability Skills": Flood Management in Urban areas: case study, LID practices to Urban drainage systems for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Aashi Agarwal
Recommended by the Board of Studies on	12th BoS on 07 August 2021
Date of Approval by the Academic Council	16th Academic Council on 23 October 2021

<table>
<tr><td>Course Code:
CIV2033</td><td colspan="3">Course Title: Integrated watershed management
Type of Course: Discipline Elective/
Theory Only Course</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Version No.</td><td colspan="8">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Basic concepts of hydrology and hydrogeology, Water resource management.</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">Nil</td></tr>
<tr><td>Course Description</td><td colspan="8">The course is interdisciplinary in nature, the technical concepts of hydrology, hydrogeology are intertwined with integrated approach in resource management concepts for efficient management of water sources for a sustainable development.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Integrated watershed management and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
1. Understand and apply integrated approach techniques for water resource management.
2. Comprehend and apply concepts of conjunctive use for efficient water resource management.
3. Understand the concept and need for rainwater harvesting systems</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Integrated watershed resource management</td><td>Case study</td><td colspan="2">Data Collection/ Data Analysis</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">Introduction to integrated approach: Issues and challenges, Natural systems, Human systems, Interaction of natural and human systems, IWRM Principles, concepts and planning, Implementation, Development and management, community participation and local capacity building, IWMA models and case study of IWRM adaptions in urban cities.</td></tr>
<tr><td>Module 2</td><td colspan="2">Conjunctive use of water</td><td>Assignment 1,
Case study</td><td colspan="2">Data Interpretation / Analysis</td><td colspan="2">12 Sessions</td></tr>
<tr><td colspan="9">Introduction, Surface and groundwater, Conjunctive use; Necessity, Indian scenario on consumption status of groundwater and surface water resources, Advantages, limitations, management, schemes, Mechanisms, Modelling of water resources management systems, Case study.</td></tr>
<tr><td>Module 3</td><td colspan="2">Rainwater harvesting systems and Roof catchment system</td><td>Assignment 2,
Case study.</td><td colspan="2">Interpretation</td><td colspan="2">08 Sessions</td></tr>
<tr><td colspan="9">Introduction, Hydrological aspects, Hydrogeological aspects, Groundwater recharge, Integrated systems, Case study. Rainwater harvesting system, Roof water catchment system, Urban water scarcity, RWH; Costs, safety and water quality, maintenance, case study</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used: IOT Applications in smart water management.</td></tr>
<tr><td colspan="9">Text Book
1. K. Subramanya, Engineering Hydrology, Tata McGraw Hill Publishers, New Delhi.
2. H.M. Raghunath, Ground Water, Wiley Eastern Publication, New Delhi.
3. Daniel P. Loucks and Eelco van Beek, Water Resources Systems. Planning and Management, UNESCO Publication</td></tr>
</table>

References

1. Lal, Ruttan.Integrated Watershed Management in the Global Ecosystem. CRC Press, New York.
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York

E book link R1: https://web.s.ebscohost.com/ehost/detail/detail?vid=15&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

E book link R2: https://web.s.ebscohost.com/ehost/detail/detail?vid=16&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

E book link R3: https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=543f92bf-0b83-4c38-920f-46755d05e915%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

Topics relevant to "EMPLOYABILITY SKILLS": Rainwater Harvesting System Designing for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Dr. Venkatesh Raju
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2034	Course Title: Environmental Hydraulics Type of Course: Discipline Elective Course/ Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2503 Fluid Mechanics and hydraulics and open channel flow – Properties of fluids Flow through pipes, Conservation of mass and Energy equations, open channel flow					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Environmental Hydraulics and attain Employability Skills through Participative Learning techniques.					
Anti-requisites	NIL					
Course Description	The course provides basic knowledge of hydraulics for application in quantitative water management (e.g. design of rivers, flood protection measures and hydraulic structures). By concentrating on a detailed explanation of the laws of conservation of mass, momentum and energy, turbulent mixing and dispersion in rivers and estuaries, the course aims at providing the student a clear understanding of steady water flow through conduits, rivers and canals.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Identify the hydraulic behaviors of open channels and their causes 2) Define the turbulent mixing and dispersion in rivers and estuaries 3) Analyze a Turbulent dispersion and mixing in Vertical and transverse direction 4) Explain the process of turbulent dispersion in natural systems					
Course Content:						
Module 1	Introduction to open channel flow	Assignment	Program to calculate area and discharge of different channel sections	06 classes		
Introduction: Fluid properties, Fluid statics, Open channel flows, Fundamentals of open channel flows, Fundamental principles, Open channel hydraulics of short, frictionless transitions, the hydraulic jump, Open channel flow in long channels, Channel transitions including bed and width changes.						
Module 2	Turbulent Mixing and Dispersion in Rivers and Estuaries	Case study	Case study on mixing and dispersion in rivers	06 classes		
Introduction to mixing and dispersion in natural waterways, Laminar and turbulent flows, turbulent shear flows jets and wakes, Boundary layer flows, fully developed open channel flows, mixing in turbulent shear flows Diffusion: basic theory, Basic equations and Applications, Mathematical aids, Advective diffusion: Basic equations, Basic applications, Two- and three-dimensional applications						
Module 3	Turbulent dispersion and mixing: Vertical and transverse mixing	Assignment	Calculation of boundary share stress and the shear velocity	08 classes		
Introduction, Flow resistance in open channel flows, Vertical and transverse (lateral) mixing in turbulent river flows, Turbulent mixing applications, Friction factor calculations, Turbulent mixing in hydraulic jumps and bores.						
Module 4	Turbulent dispersion and mixing: Longitudinal dispersion, Turbulent dispersion in natural systems	Assignment	Numerical problems on longitudinal dispersion	08 classes		
Introduction, One-dimensional turbulent dispersion, Longitudinal dispersion in natural streams, Approximate models for longitudinal dispersion, Design applications , Longitudinal dispersion in natural rivers with dead zones, Dispersion and transport of reactive contaminants, Transport with reaction						
Targeted Application & Tools that can be used:						

Professionally Used Software: MS Excel and Java	
Textbooks 1. Hubert Chanson, "Environmental Hydraulics of Open Channel Flows", Elsevier Butterworth-Heinemann publications.	
References 1. Zheng, C. and Bennett, G. D., Applied contaminant Transport Modeling, A John wiley & sons, inc, publication, Newyork, 2002. 2. Martin, L.J. and McCucheon, S.C, Hydrodynamics of transport for water quality modeling, Lewis Publishers, Boca Raton, 1999. 3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=189593&site=ehost-live&ebv=EB&ppid=pp_Cover	
Topics relevant to "EMPLOYABILITY SKILLS": Longitudinal dispersion in natural stream for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr Santhosh M B
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3030	Course Title: Industrial Wastewater Treatment Type of Course: Discipline Elective Theory Only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1) Self-purification process in flowing water 2) Various physical, chemical and biological treatment units 3) Effluent Water Quality Standards					
Anti-requisites	NIL					
Course Description	Industrial wastewater treatment covers the mechanisms and processes used to treat waters that have been contaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use. The focus of this course is on management of industrial wastewater including topics such as cleaner production, industrial water management, toxicity, physical chemical processes, anaerobic industrial wastewater treatment, and sludge management and treatment.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Industrial Wastewater Treatment and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Discuss the self-purification streams. 2] Describe the different treatment methods for various types of industrial wastewater. 3] Explain Process flow sheet showing origin / sources of waste water for selected industry.					
Course Content:						
Module 1	Stream Quality	Case Study	Data Collection/ Data Analysis	10 Classes		
Topics: Introduction: Domestic and Industrial Wastewater, Effect on Streams and on Municipal Sewage Treatment Plants, Stream Sampling, effluent and stream Standards, Self-Purification of natural streams, Zones of Pollution, Stream Quality Dissolved oxygen Sag Curve in Stream.						
Module 2	Treatment Methods	Assignment	Data Collection/ Data Analysis	10 Classes		
Topics: Volume Reduction, Strength Reduction, Neutralization, Equalization and Proportioning. Removal of Inorganic suspended solids, organic Solids, suspended solids and colloids, Treatment and Disposal of Sludge Solids, Combined treatment.						
Module 3	Treatment- Industrial Wastewater	Case Study	Data Collection/ Data Analysis	15 Classes		
Topics: Process flow sheet showing origin / sources of waste water- Tanning industry, Distillery and Sugar Industry, Paper and Pulp Industry, Textile Industry and Steel industry.						
Targeted Application & Tools that can be used: Application Area is Sewage Treatment Plants, Effluent treatment plants. Professionally Used Software: EFOR, BioWin.						
Text Book T1. Rao and Datta, "Industrial Waste Treatment", Oxford and IBH Publishing Co.Pvt.Ltd., NewDelhi. T2. Dr. A. D. Patwardhan, "Industrial Waste Water Treatment", Prentice Hall of India.						
References R1. Metcalf & Eddy, "Wastewater engineering: treatment and reuse" McGraw Hill Publications. R2. Nelson Nemerow, "Industrial Waste Treatment", Addison –Wesley. Web source:						

https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1084472&site=ehost-live	
Topics relevant to development of "Employability": Treatment methods of Industrial Wastewater for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Bhavan Kumar, Dr. Mohammad Shahid G
Recommended by the Board of Studies on	BoS No. 11 held on 05 September 2020
Date of Approval by the Academic Council	Academic Council Meeting No. 13 held on 06 November 2020

Course Code: CIV3031	Course Title: Open Channel Flow Type of Course: Discipline Elective Theory based Course		L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	CIV2503 Fluid Mechanics Hydrology					
Anti-requisites	NIL					
Course Description	The purpose of this course demonstrates the concept of free surface flows. It shall apply the fundamental laws of mechanics (conservation of mass, momentum, and energy) to a wide variety of flows, categorized by their spatial and temporal variability. It will help students to develop an understanding of free surface flow and they will be able to analyze the flow conditions and flow profiles at control sections. This is a theory based course which will give basic understanding of flow through open channels.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Open Channel Flow and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the specific energy curve and its applications in channel transitions. 2] Analyse the flow profiles under gradually varied flow. 3] Outline the various energy dissipators.					
Course Content:						
Module 1	Introduction to Free surface flow	Case Study	Data Collection/ Data Analysis	10 Sessions		
Topics: Basic concepts of free surface flows, velocity and pressure distribution, Mass, energy and momentum principle for prismatic and non-prismatic channels, Review of Uniform flow: Standard equations, hydraulically efficient channel sections, Energy-depth relations: Concept of specific energy, specific force, critical flow, critical depth, hydraulic exponents, and channel transitions. HEC-RAS for computing energy-depth relations.						
Module 2	Gradually Varied Flow	Assignment	Data Collection/ Data Analysis	9 Sessions		
Topics: Equation of gradually varied flow and its limitations, flow classification and surface profiles, Control sections, Computation methods and analysis: Integration of varied flow equation by analytical method. Using HEC-RAS for determining the water surface profiles at various reaches.						
Module 3	Rapidly Varied flow	Case Study	Data Collection/ Data Analysis	11 Sessions		
Topics: Rapidly Varied Flow: Concepts, hydraulic jump in rectangular channels, classification of jumps, characteristics of jump – length location height, application of hydraulic jump stilling basins, shape type-2 and type-4. Hydraulic jump in rectangular channels, Sloping channels, Jump in non-rectangular channels, application of hydraulic jump as energy dissipator. Design of energy dissipators.						
Targeted Application & Tools that can be used: Application Area is Critical flow, Channel design, Energy dissipation Professionally Used Software: HEC-RAS, HEC-HMS.						

Text Books T1 Chow,V.T.” Open Channel hydraulics” McGraw Hill Publication T2 Subramanya, K., Flow through Open Channels, TMH, New Delhi
References R1. Rajesh Srivastava, Flow through Open Channels , Oxford University Press R2. Streeter, V.L.& White E.B., ”Fluid Mechanics” McGraw Hill Publication W1: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=189585&site=ehost-live W2: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=196291&site=ehost-live
Topics related to “Employability Skill”: Design of energy dissipators for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Aashi Agarwal/Mr. Santhosh B
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3032	Course Title: Design of Hydraulic Structures Type of Course: Discipline Elective and Theory only	L-T-P-C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	Flow profiles, Hydraulic jump, Hydrostatic pressure					
Anti-requisites	NIL					
Course Description	The main idea of this course is to understand the design of hydraulic structures. The course covers the major topics such as design of canals, canal head works, regulation works, and cross-drainage works. Design principles of hydraulic structures like Gravity Dam, Earth Dam, and Spillway are introduced. The course demonstrates the concept of seepage theories of hydraulic structures and will be able to design the hydraulic structures such as canals and dams. The nature of the course is theory based with an objective to give understanding of design of hydraulic structures.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Design of Hydraulic Structures and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Explain various types of irrigation canals and their alignments. 2) Illustrate the design concepts of the various minor irrigation structures 3) Analyse the causes of failure, design criteria and stability analysis of different types of dams					
Course Content:						
Module 1	Canals	Quiz	Data Collection/ Data Analysis	15 Sessions		
Topics: Canals: Definition. Irrigation Canals, Types of canals, Alignment of canals. Design of canals by Kennedy's and Lacey's theories. Canal regulators: Classification and suitability. Canal drops: Classification. Hydraulic design principles for notch type drop. Cross drainage works: Classification. Hydraulic design principles for an aqueduct.						
Module 2	Diversion Headworks	Assignment	Data Collection/ Data Analysis	14 Sessions		
Topics: Diversion head works- layout and functions of components, Weir and barrage- Causes of failure of weirs on permeable soils - Bligh's theory. Determination of uplift pressure- Various Correction Factors –Design principles of weirs on permeable foundations using Creep theories - exit gradient, U/s and D/s Sheet Piles - Launching Apron. Khosla's theory of independent variables- Khosla's corrections-Use of Khosla's charts.						
Module 3	Dams and Spillways	Case study	Data Collection/ Data Analysis	18 Sessions		
Topics: Dams: Types, Gravity dam – selection of site- forces acting - stability analysis and modes of failure – Principal and shear stresses- Problems - Elementary profile –limiting height of gravity dams-high and low dams- Practical profiles, joints and galleries in dam. Spillways: Spillways-Types. Effective length of spillway- Ogee type spillway-profile. Energy dissipation below spillways - Stilling basins- Indian standard Type I and Type II						
Targeted Application & Tools that can be used: Application Area is Dam break analysis, Channel design, Energy dissipation, river training. Professionally Used Software: Aquaterra, Brics CAD, BOSS DAMBRK						

Text Books T1. Irrigation Engg. and Hydraulic Structures by S.K. Garg, Khanna Publishers. T2. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd. 2010.	
References R1. Theory and Design of Hydraulic structures by Varshney, Gupta & Gupta. R2. Asawa. G.L. Irrigation and Water Resources Engineering, New Age International, 2000	
Topics relevant to "EMPLOYABILITY SKILLS": Design of Canals, River Water Training for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Aashi Agarwal/ Santhosh M B
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

<table>
<tr><td>Course Code: CIV3033</td><td colspan="3">Course Title: Water Resources Management
Type of Course: Discipline Elective
Theory only course</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Knowledge of Hydrology and Water Resources engineering
Irrigation Engineering</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The purpose of this course is to introduce water resources planning and management. It involves the processes in hydrologic cycle that includes measurement, computation, estimation and determination in each area. The benefit of the course is learning concepts like integrated water resources management and develop best low impact developmental practices to improve watershed as an entity. The nature of the course is theory based and deals with water resources problems, its control and utilization.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Water Resources Management and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:

1] Outline the issues related to planning and management of water resources.

2] Describe the implementation of IWRM in different regions.

3] Discuss various water harvesting techniques.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Water resources Planning</td><td>Case study</td><td colspan="3">Data Collection/ Data Analysis</td><td>15 Sessions</td></tr>
<tr><td colspan="9">Topics:
Water Resources Planning and Management: Necessity, System components, planning scales, Approaches, planning and management aspects, Analysis, Models for impact prediction and evaluation, Adaptive Integrated Policies, Post Planning and management Issues</td></tr>
<tr><td>Module 2</td><td colspan="2">Integrated Water Resources Management</td><td>Assignment</td><td colspan="3">Data Collection/ Data Analysis</td><td>10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Integrated Water Resources Management: Definition of IWRM, Principles, Implementation of IWRM, Legislative and Organizational Framework, Types and Forms of Private Sector Involvement.</td></tr>
<tr><td>Module 3</td><td colspan="2">Water Management</td><td>Case Study/Quiz</td><td colspan="3">Data Collection/ Data Analysis</td><td>15 Sessions</td></tr>
<tr><td colspan="9">Topics:
Water Harvesting and Conservation: Water Harvesting Techniques – Micro-catchments -Design of Small Water Harvesting Structures – Farm Ponds – Percolation Tanks – Yield from a Catchment, Rain water Harvesting-various techniques related to Rural and Urban area.</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used:
Application Area is Integrated watershed management, Watershed modelling
Professionally Used Software: HEC-HMS, WEAP, MIKE</td></tr>
</table>

Text Books T1. K. Subramanya, Engineering Hydrology, Tata McGraw Hill Publishers, New Delhi. T2. Mollinga, P. et al, Integrated Water Resources Management, Water in South Asia Volume I, Sage Publications, 2006	
References R1. Lal, Ruttan.Integrated Watershed Management in the Global Ecosystem. CRC Press, New York. R2. Dhruva Narayana, G. Sastry, V. S. Patnaik, Watershed Management, CSWCTRI, Dehradun, ICAR Publications, 1997 Web link: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1350573&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": IWRM and Water quality modelling for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Aashi Agarwal
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3034	Course Title: Advanced Fluid Mechanics Type of Course: Discipline Elective Theory Only Course	L-T-P- C	2	1	0	3
Version No.	1.0					
Course Pre-requisites	Concepts of Engineering Mechanics, Computational modelling, Vector calculus and Differential Equations.					
Anti-requisites	Nil					
Course Description	This is an advanced course in Fluid Mechanics. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principle. This course is a well-balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. The course will provide a strong fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Advanced Fluid Mechanics and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Recognize the concepts of fluid motion to practical problems. 2) Formulate concepts by dimensional and model analysis. 3) Deploy the concept of compressible and viscous flow and CFD Applications. 4) Deploy flow in laminar and turbulent state and Concepts of boundary layer theory.					
Course Content:						
Module 1	**Fluid mechanics and open channel flow**	Assignment	Data analysis	11 Sessions		
Topics: Review on Fluid Properties, Concept of fluid kinematics; Methods of describing fluid motion, Fluid Dynamics; Momentum equation, force exerted by a flowing fluid on a Pipe-Bend, Moment of Momentum equation, Introduction to Navier Stokes equation. Open Channel flow**:** Introduction, Continuity equation. Uniform flow Chezy's and Manning's equations for uniform flow in open channel, velocity distribution, most efficient channel section. Energy and Momentum Principles Critical depth, concepts of specific energy and specific force, Channel Transitions (Hump and Width reduction) **Notches and Weirs:** Classification, discharge over rectangular, triangular, trapezoidal notches, Cippoletti notch, broad crested weirs						
Module 2	**Dimensional analysis and Model Analysis**	Assignment	Data analysis	8 Sessions		
Topics: **Dimensional analysis:** Need for dimensional analysis, Dimensions and units, Dimensional Homogeneity and dimensionless ratios, methods of dimensional analysis, Rayleigh's method, Buckingham Pi theorem, Similitude and Model studies. Numerical problems. **Model Analysis:** Similitude and types, Types of forces acting in moving fluid, Dimensionless numbers, Models laws or similarity laws.						
Module 3	**Compressible Flow and Viscous flow**	Quiz	Data analysis	10 Sessions		

Topics: **Compressible Flows:** Introduction, thermodynamic relations of perfect gases, internal energy and enthalpy, speed of sound, pressure field due to a moving source, basic Equations for one-dimensional flow, stagnation and sonic Properties, normal and oblique shocks. **Viscous flow:** Reynold's Number, Entrance flow and Developed flow, Laminar flow between parallel plates, Poiseuille equation – velocity profile, Couette flow, Fully developed laminar flow in circular pipes, Hagen - Poiseuille equation, related numerical. **Introduction to CFD:** Necessity, limitations, philosophy behind CFD, and applications.				
Module 4	Mechanics of Laminar and Turbulent flow, Boundary layer theory	Assignment	Data Analysis/ Programming/ Simulation	9 Sessions
Topics: Introduction; Laminar and turbulent flows; viscous flow at different Reynolds number - wake frequency; laminar plane Poiseuille flow; stokes flow; flow through a concentric annulus structure and origin of turbulent flow. Introduction; Boundary layer equations; displacement and momentum thickness, shape factor; flow over a flat plate similarity transformation, integral equation for momentum and energy ; skin friction coefficient and Nusselt number; separation of boundary layer; critical Reynolds number; control of boundary layer separation.				
Targeted Application & Tools that can be used: [Computational fluid Dynamics is a science that uses data structures to solve issues of fluid flow, Applications: cavitation prevention, aerospace engineering, HVAC engineering				
Text Book 1. P N Modi and S M Seth, "Hydraulics and Fluid Mechanics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi 2. R.K. Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi				
References S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, New Delhi E book link 1: https://web.s.ebscohost.com/ehost/detail/detail?vid=11&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d# E book link 2: https://web.s.ebscohost.com/ehost/detail/detail?vid=12&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#				
Topics relevant to "EMPLOYABILITY SKILLS": Computational Fluid Dynamics, Dimensional Analysis for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Ms. Shwetha A / Dr. Venkatesh Raju			
Recommended by the Board of Studies on	BOS Meeting No: 21, Dated: 8th July 2023			
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023			

Course Code: CIV2051	Course Title: Soil and water conservation Type of Course: Discipline Elective & Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CHE7601 Environmental studies, CIV2503 Fluid Mechanics.					
Anti-requisites	Nil					
Course Description	The purpose of this course is to demonstrate the causes and agents of soil and water erosion along with their conservation, measurement techniques for soil loss and wind erosion, principles of erosion control, irrigation water measurement and equip with underground pipeline systems, micro irrigation system and their designs.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Soil and water conservation and attain Employability Skills through Participative Learning techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe the concept of soil, wind and water erosion and their conservation practices. 2. Comprehend the concept of irrigation water measurement, micro irrigation, and underground pipeline system along with their designs. 3. Demonstrate various water harvesting techniques and their role in current climate change scenario.					
Course Content:						
Module 1	Introduction to soil and water conservation and causes of soil erosion	Case Study	Data Collection	15 sessions		
Topics: Introduction to soil and water conservation and causes of soil erosion: Definition and agents of soil erosion, water erosion - Forms of water erosion Gully classification and control measures. Soil loss estimation by universal soil loss equation - Soil loss measurement techniques. Principles of erosion control - Introduction to contouring, strip cropping. Contour bund - Graded bund and bench terracing. Grassed water ways and their design. Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures.						
Module 2	Irrigation water measurement	Assignment / Case Study	Programming task and Data collection.	15 sessions		
Topics: Introduction to irrigation - Classification of irrigation projects. Importance of irrigation water measurements - Volumetric, area velocity, discharge methods, Weirs, orifice, flumes. Open channel hydraulics - Discharge calculations. Types of wells - Water lifting devices - Classification of pumps, their capacity, power requirement and discharge calculations. Functional components and working principle of underground pipeline systems. Functional components of micro irrigation systems and its design like drip, sprinkler irrigation systems.						
Module 3	Water harvesting techniques	Assignment	Data Collection	6 sessions		
Topics: Water harvesting techniques - Lining of ponds, tanks and canal systems						
Targeted Application & Tools that can be used: Application area of oil and water conservation is related to any department which includes Environmental conservation. Tools includes chain survey instruments and GPS. Professionally used software: ArcGIS.						
Text Book						

<table>
<tr><td colspan="2">2) Ghanshyam Das., 2012. Hydrology and Soil Conservation Engineering, including Watershed Management. Second edition, PHI Learning Private Limited, New Delhi - 110001
3) Murthy, V. V.N., 2004. Land and Water Management Engineering. Kalayani Publishers, New Delhi</td></tr>
<tr><td colspan="2">References
1. Troeh F.R., Hobbs J.A., Donahue R.L, “Soil and Water Conservation for Productivity and Environmental Protection”
2. S.K. Garg, “Irrigation Engineering and Hydraulic Structures”, Water Resource engineering (Volume II), Khanna Publishers, New Delhi-110002.
Web Source:
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=362385&site=ehost-live</td></tr>
<tr><td colspan="2">Topics relevant to “EMPLOYABILITY SKILLS”: Water harvesting techniques Irrigation water measurement for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout</td></tr>
<tr><td>Catalogue prepared by</td><td>Mr. Bhavan Kumar</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BoS No. 14 held on 30 July 2022</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 18 held on 03 August 2022</td></tr>
</table>

Course Code: CIV3051	Course Title: Statistics in Hydrology Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic Mathematics and Basics of Hydrology					
Anti-requisites	-Nil-					
Course Description	This purpose of the course is to provide an overview on understanding the use of statistics in hydrologic systems. The course will benefit the students as it will develop insights about analysis of hydrologic extremes. It also benefits the student to understand the concepts of Hydrology in context of uncertainty and to develop forecasting models. The nature of the course is theory based and it discusses the concept of statistics in hydrology.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Statistics in Hydrology and attain Employability Skills through Problem Solving methodologies					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Analyse hydrological data 2) Compute frequency analysis of hydrologic extremes 3) Perform hypothesis testing using chi square and KS tests.					
Course Content:						
Module 1	Introduction to Statistical Hydrology	Assignment	Case Study	10 Sessions		
Topics: Deterministic and Stochastic Hydrology, review of concepts of probability, probability axioms, Random variables and their properties, probability distribution and probability density function, Discrete and continuous probability distributions used in hydrology, moments and expectations of distributions.						
Module 2	Analysis of hydrologic extremes	Assignment	Data collection and analysis	14 Sessions		
Topics: Frequency analysis of extreme events, extreme value distributions, analysis of floods, droughts and other natural hazards, regional flood frequency analysis. Correlation analysis and correlation coefficient, Simple linear regression, Multivariate regression analysis, Correlation coefficient and its significance in regional analysis, analysis of variance, applications – rainfall-runoff analysis.						
Module 3	Hypothesis testing and Time series analysis	Assignment	Data collection and analysis	12 Sessions		
Topics: Hypothesis testing, goodness test of fit tests, Chi Square test and KS test, Hydrologic Time Series Analysis, Hydrologic time series, components of hydrologic time series, analysis of hydrologic time series.						
Targeted Application & Tools that can be used: This Course helps student to apply the fundamentals of statistical techniques in hydrologic systems and help to understand the forecasting models.						
Textbook T1. Hann, C.T., "Statistical Methods in Hydrology", First EastWest Press Edition, New Delhi, 1995.						
References R1. Clarke, R.T., "Statistical Models in Hydrology", John Wiley, Chinchester,1994. Web Source: https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=8459efd5-754d-49e5-98ed-d395ec913af4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d# https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=8f1dd173-e7d7-4bdd-ab36-7df6b823570b%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#						

Topics relevant to "EMPLOYABILITY SKILLS": Correlation analysis, Frequency analysis of extreme events, extreme value distributions, analysis of floods, droughts and other natural hazards, for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Ms. Aashi Agarwal
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3054	Course Title: Environmental management Systems and Audits Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CHE7601 Environmental Studies					
Anti-requisites	-Nil-					
Course Description	This course will introduce the students to the basics of environmental management systems and their role in reducing overall environmental impacts within industry and business operations. The concepts of this course provide an overview of the purpose of an EMS model and ISO 14001 systems and how companies adopt/implement them. This course also focus on auditing process in terms of using the audit as a management tool for environmental performance.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Environmental management Systems and Audits and attain Employability Skills through Participative Learning techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Recognize environmental management system (EMS) concepts, guidelines and requirements of the ISO 14001 standard. 2] Discuss the stages of EMS implementation, best practice techniques and principles to achieve continual improvement in an organization 3] Identify various tools and techniques such life cycle assessment, environmental audits, evaluation of environmental performance for environmental decision-making					
Course Content:						
Module 1	Introduction to Environmental Management system	Assignment	Case Study	12 Sessions		
Topics: Overview of the state of the global environment, the earth's natural systems, sustainability and sustainable development–Case study. Evaluation tools of environmental management system (EMS), organizational barriers, management responsibility, elements and extent of application, EMS structure						
Module 2	ISO 14000 and ISO140001	Assignment	Data collection and analysis	12 Sessions		
Topics: ISO 14000-Background, the ISO 14000 series, business and standards, voluntary standards and ISO 14000 and world practice, international chamber of commerce principles, ISO in developing world; ISO 14001 & elements of EMS-environmental policy, planning, implementation and operation checking & correction action and management review–Case study						
Module 3	Audit and Life Cycle Assessment	Assignment	Data collection and analysis	12 Sessions		
Topics: Scope and objectives, standards for auditing, registration, implementing the audit, procedures, benefits, environmental auditing as a management tool-Case study. Components of LCA, measuring environmental impact life-cycle stages, strategic framework for LCA and LCA-a tool for sustainability-Case study.						
Targeted Application & Tools that can be used: This Course helps student to assess effects of anthropogenic activities on environmental components and learn to combat environmental issues through apposite measures and management strategies.						
Text Book T1. Tinsley Stephen. 2009. Environmental Management Systems, Taylor and Francis, United Kingdom.						
References R1. Ajith Sankar, 2015. Environmental Management, Oxford University, Web Source:						

https://web.s.ebscohost.com/ehost/detail/detail?vid=3&sid=7d4d85f1-eabc-4503-ad63-06d8335dcf19%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#	
Topics relevant to "EMPLOYABILITY SKILLS": Environmental auditing as a management tool. Components of LCA, measuring environmental impact life-cycle stages, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Dr. Venkatesha Raju K.
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code:
CIV2036</td><td colspan="3">Course Title: Introduction to Infrastructure System and Planning
Type of Course: Discipline Elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8"></td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The purpose of this course is to enable the students to appreciate the need for Infrastructure, which is instrumental in promoting economic growth of any country. The course is conceptual in nature where the students learn what is Infrastructure, types and challenges and the planning. This helps the students to develop the critical thinking pertaining to the infrastructure development and corresponding usage to the mankind.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Introduction to Infrastructure System and Planning and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:
1) Define terms associated with the types of Infrastructure systems.
2) Discuss steps in scheduling and management of activities associated with infrastructure projects.
3) Apply the concepts of financial evaluations in the infrastructure project and project the cash flows.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Infrastructure</td><td>Case Studies</td><td colspan="2">Data collection/ Software</td><td colspan="2">12 Sessions</td></tr>
<tr><td colspan="9">Topics:
Definitions of infrastructure; Types of Infrastructure systems, Phases in Infrastructure Planning, Transportation Infrastructure (Roads, Bridges, Airports, Ports, Waterways), Transportation Research using GIS, Urban and Rural Infrastructure, Water and Sanitation Infrastructure (Water Supply Systems, Sewage treatment systems), Public –private partnerships (PPP) in Water and sanitation, Energy Infrastructure (Dams, power plants, power distribution and transmission facilities, pipelines)</td></tr>
<tr><td>Module 2</td><td colspan="2">Infrastructure Planning</td><td>Case Study</td><td colspan="2">Primavera and MS projects, MS excel</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Typical infrastructure planning steps; Planning and appraisal of major infrastructure projects; Screening of project ideas; Life cycle analysis; multi-criteria analysis for comparison of infrastructure alternatives Procurement strategies; Scheduling and management of planning activities.</td></tr>
<tr><td>Module 3</td><td colspan="2">Concepts of Infrastructure Planning</td><td>Assignments</td><td colspan="2">MS excel, MSP, ERP software</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Financial Evaluation - Time value of money, Investment criteria, Project cash flows – elements and basic principles of estimation, Financial estimates and projections, Cost of capital, Rate of return; Project risk analysis; Political and social perspectives of infrastructure planning; Case studies</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used:
Application in: Water and Sanitation Infrastructure (Water Supply Systems, Sewage treatment systems), Energy infrastructure (Dams, power plants, power distribution and transmission facilities, pipelines)
Professionally Used Software: MSP/ Primavera.</td></tr>
<tr><td colspan="9">Textbooks:
T1. A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.</td></tr>
</table>

T2. J. Parkin and D. Sharma, *Infrastructure planning, Thomas Telford, London, 1999.*

References:

R1. A. S. Goodman and M. Hastak, *Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.*

R2. J. D. Finnerty, *Project financing - Asset-based financial engineering, John Wiley & Sons, New York, 1996*

R3. A. S. Goodman and M. Hastak, *Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.*

Web Resources:

1. https://www.india.gov.in/ (National portal for Infrastructure in India)
2. NPTEL Swayam MOOC course relevant to Module 3 can be accessed through https://onlinecourses.nptel.ac.in/noc22_hs64/preview
3. Coursera certification course link https://www.coursera.org/learn/managing-urban-infrastructures-1

E-BOOKS:

Energy Infrastructure and Exploration Areas: Characteristics, Relationships, and Local Acceptance

https://web.p.ebscohost.com/ehost/detail/detail?vid=15&sid=df00d162-177f-4522-8e85-4d07adbaee49%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1606082&db=nlebk

Geographic Information Systems in Transportation Research
https://web.p.ebscohost.com/ehost/detail/detail?vid=25&sid=df00d162-177f-4522-8e85-4d07adbaee49%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=91152&db=nlebk

Infrastructure Investments: Politics, Barriers and Economic Consequences
https://web.s.ebscohost.com/ehost/detail/detail?vid=29&sid=75dced1d-8682-4283-be1c-20875abe641c%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1488020&db=nlebk

Topics relevant to development of "EMPLOYABILITY SKILL": Planning and appraisal of major infrastructure projects, Scheduling and management of planning activities for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Ajay H A/Mrs. Divya Nair
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2037	Course Title: Urban Planning and Design Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites						
Anti-requisites	NIL					
Course Description	Urban Planning and Design focuses on the correlation between the built environment and social, economic and institutional forces. The course delivers a profound and broad knowledge on the multiple factors in sustainable urban development. The Project works associated with the course enhances strong practical skills. The course is conceptual in nature that offers the planning and design practices to the environmental conditions and societal needs of the future.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Urban Planning and Design and attain Employability Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) State the important topics on Urban Planning and fundamentals. 2) Discuss how to develop Plans and with Developmental Regulations. 3) Apply the concepts of urban planning and Governance in various cases.					
Course Content:						
Module 1	Definitions of Planning	Case Studies	Computer Aided Design (CAD) in Planning		13 Sessions	
Topics: Various definitions of town and country planning; Goals and objectives of planning; Components of planning; Benefits of planning, Defining what counts as planning knowledge: various sources of planning knowledge, Reasoning and its various forms in planning; Space, place and location, Orthodoxies of planning including the Lamps of Planning, Components of sustainable urban and regional development. Theories of Urbanization: Concentric Zone theory, Sector theory, Multiple Nuclei Theory, Land use and Land Value Theory of William Alonso.						
Module 2	Development Plans and Development Regulations	Case Study	Computer Aided Design (CAD) in Planning		14 Sessions	
Topics: Definition of development plan; Types of development plans: master plan, city development plan, structure plan, district plan, action area plan, subject plan, town planning scheme, regional plan, sub-regional plan; Planning Advisory Group report and the UDPFI Guidelines; Sector plans and spatial plans; Defining development and development control regulations, types of development control; Implications of violations of development control regulations; Conforming and Nonconforming land uses; Compatible and non-compatible land uses, LULU and NIMBY						
Module 3	Governance of Planning	Assignments	Computer Aided Design (CAD) in Planning		11 Sessions	
Topics: Local government in India; District Planning Committees and Metropolitan Planning Committees; Introduction to Internationalization and globalization of planning: meanings and forms of globalization; Characteristics of a global city; City as a physical entity, social entity and political entity confirming land uses, Principles for planning for a global city; Case studies						
Targeted Application & Tools that can be used: Target Application: Construction, Planning and Design of Villas, Planning of Layouts Professionally Used Software: Computer Aided Design (CAD) in Planning.						
Text Books:						

T1. A. S. Goodman and M. Hastak, *Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.*
T2. Rao. M. P, *Urban Planning: Theory and Practice, CBS Publication (1), 2009.*

References:
R1. J. D. Finnerty, *Project financing - Asset-based financial engineering, John Wiley & Sons, New York, 1996*
R2. State Urban Regulations: Urban Development-12th Five year Plan (2012-17) https://niti.gov.in/planningcommission.gov.in/docs/plans/planrel/fiveyr/12th/pdf/12fyp_vol1.pdf

Web Resources:
1. https://www.india.gov.in/ (National portal for Infrastructure in India)
2. NPTEL Swayam MOOC course relevant to Module 1, 3 can be accessed through https://nptel.ac.in/courses/124107158
3. Coursera course link: https://www.coursera.org/courses?query=urban%20planning

E-BOOKS:
1. Smart Urban and Rural Planning Techniques

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1355890&site=ehost-live

2. Urban Design: Three Types of Continuity, Case Studies
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=860111&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Governance of Planning for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Divya Nair
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code: CIV2038</td><td colspan="4">Course Title: Construction Equipment and Machinery
Type of Course: Discipline Elective
Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">CIV2100 Building Materials and Concrete Technology</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">This course deals with different construction equipment and processes in practice. It also highlights on different machinery/ equipment and their role in the construction industry. This course is conceptual in nature and requires the knowledge of different building materials for selecting the right equipment for a specific task. The course demonstrates how best to use each piece of equipment.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Construction Equipment and Machinery and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of the course the students shall be able to:
1) Identify different Construction equipment.
2) Recognize the modern techniques used in construction.
3) Identify suitable formworks that supports the structures during construction.
4) Select a suitable construction equipment for the completion of a construction task</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="3">Basics of Construction Equipment</td><td>Assignment</td><td colspan="2">Case study</td><td colspan="2">06 Sessions</td></tr>
<tr><td colspan="10">Topics:
Conventional construction methods Vs Mechanized methods, Factors affecting the selection of equipment, purchase and service life of equipment, Maintenance of an equipment. Causes of damage and deterioration of Machinery/Equipment, Preventive measures against damage of an equipment. Use of Construction equipment in Dangerous Working Environment: Complications, Safety and Hygiene.</td></tr>
<tr><td>Module 2</td><td colspan="3">Construction Equipment & Machinery</td><td>Case Study</td><td colspan="2">Data Collection</td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="10">Topics:
Excavating equipment- Power Shovels, Back Hoe, Drag line, Clamshell – Excavating and Earth Moving Equipment – Scrapers, Bull Dozers, Tractors, Hauling Equipment – Dump trucks, Dumpers Loaders, truck.
Earthwork equipment, Hoisting and Lifting equipment, Material handling Equipment, Concrete mixing equipment, Transporting and Placing , Cranes, Dewatering Equipment
Drones – Use of Drones in Construction Projects, Benefits, Challenges, Human handling Vs Drones</td></tr>
<tr><td>Module 3</td><td colspan="3">Principles of construction</td><td>Case Study</td><td colspan="2">Data Collection</td><td colspan="2">09 Sessions</td></tr>
<tr><td colspan="10">Topics:
Formworks, Centering and Shuttering of sheet piles, moving the forms, Joints in concrete, Plastering and Pointing, Shoring and Scaffolding, underpinning, submerged structures</td></tr>
<tr><td>Module 4</td><td colspan="3">Structure Prefabrication</td><td>Assignment</td><td colspan="2">Data Collection</td><td colspan="2">09 Sessions</td></tr>
<tr><td colspan="10">Topics:
Prefabricated panels and structures, Transporting and Erection of structures, Fire resistance in construction, Damp proofing, Termite proofing, Sound insulations, Ventilation</td></tr>
<tr><td colspan="10">Targeted Application & Tools that can be used:</td></tr>
</table>

Equipment and Formworks application in: Dams, Bridges, Construction projects etc.
Tools used: - Construction equipment management software like Geniebelt

Text Book

T1. Sharma S.C, *Construction Equipment and Management, Khanna Publishers, New Delhi, 2013.*
T2. Peurifoy R.L, Schexnayder J.C and Shapira. A, *Construction Planning, Equipment and Methods, Tata McGraw Hill, New Delhi, 2010.*

References

R1. Sharma &Kaul, *Building Construction, S. Chand & Company Pvt, New Delhi, 1998*
R2. Varghese P.C, *Building Constructions, Prentice Hall*
R3. Arora S. P and Bindra S. P*, A Text Book of Building Construction ,Dhanpat Rai Publication, New Delhi, 2013.*
R4. Mahesh Varma, *Construction Equipment and its Planning and Applications", Metropolitan Book Co.(P) Ltd., New Delhi. India*.

Weblinks:
https://onlinecourses.nptel.ac.in/noc21_ce21/preview
https://www.coursera.org/lecture/systems-engineering/module-7-part-1-tzOCY

E-BOOKS:

Hoist & Haul 2010 : Proceedings of the International Conference on Hoisting and Haulage

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=439078&site=ehost-live
Construction and Building: Design, Materials, and Techniques
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=780870&site=ehost-live
Organizing Safety and Hygiene in Dangerous Working Environments: Case Studies
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1879361&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Maintenance of an equipment, Formworks, Centering and Shuttering of sheet piles, moving the forms, Plastering and Pointing, Shoring and Scaffolding, underpinning, submerged structures, Transporting and Erection of structures, Damp proofing, Termite proofing, Concrete mixing , Transporting and Placing for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Divya Nair/Mr. Ahamed Sharif
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV2039	Course Title: Construction Quality and Safety Type of Course: Discipline Elective and Theory Only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CIV2100 - Building Materials and Concrete Technology					
Anti-requisites	NIL					
Course Description	The purpose of this course is to deal with the significance of Quality, Risk and Safety in Construction and to develop the basic abilities of risk management. The course is more of conceptual in nature and needs fair knowledge of causes for construction accidents, risk identification. This course mainly focusses on management aspects of construction project such as organization, quality management and safety management. The course develops the construction site safety skills by attaining quality. The course also enhances the programming abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Construction Quality & Safety and attain Employability Skills through Participative Learning techniques					
Course Outcomes	On successful completion of the course the students shall be able to: **1)** Describe construction project management process and various engineering roles involved in project organization. **2)** Discuss total quality management and safety for construction projects. **3)** State aspects of Safety, safety rules. **4)** Identify risks involved in construction projects.					
Course Content:						
Module 1	Project Organization Management	Assignment	Data Collection	12 Sessions		
Topics: Construction Projects: Concept, Project Categories, Characteristic of projects, project life cycle phase, Project Management- Project Management Function, Role of Project Manager, Organizing for Construction - Principles of organization, type of organization structure.						
Module 2	Construction Quality Management	Case Study	Data Collection	10 Sessions		
Topics: Construction Quality, Inspection and Testing, Quality control, Quality Assurance, Total Quality Management, Benchmarking, Quality philosophy. Standards, manual, Quality philosophy. Quality Certification for companies and laboratories, ISO Certification.						
Module 3	Safety Management	Case Study	Data Collection	12 Sessions		
Topics: Safety in Construction: Causes, classification, cost of an accident, safety program for construction, protective equipment, accident report. Types of injuries, Factors affecting safety. Personal & Structural safety. Recording injuries Safety Performance on Construction Sites, Safety Auditing and Its Use in Proactive Prevention of Accidents.						
Module 4	Construction Risk Management	Term paper	Data Collection	8 Sessions		
Topics: Certainty, Risk and Uncertainty Reasons for the risks, Types of Risks, Risk Management Identification and Nature of Construction Risks, Minimizing risks and mitigating losses, Risk mitigation						
Text Books 1. "Construction Project Management", Kumar Neeraj Jha, Pearson. Second Edition.						

2. "Construction Planning and Management Paperback", 2018, by P.S. Gahlot, B. M. Dhir

References

1. "Safety Management in construction and Industry", David Gold Smith, Mc Graw Hill
2. "Construction Safety Management", K N Vaid, NICMAR, Bombay
3. "Management for Total Quality", N. Logothetis, Prentice Hall 2.
4. "Project Management Body of Knowledge" (PMBOK® GUIDE, Guide, A.), Project Management Institute, 2001.
5. Managing Risk in Construction Projects, 3rd Edition by Nigel J smith.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_ce16/preview
2. https://onlinecourses.nptel.ac.in/noc22_mg55/preview
3. https://nptel.ac.in/courses/110/105/110105094/

E-Resources

1. https://web.p.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMjQ2NDA2OF9fQU41?sid=3281a842-6740-4e2b-a3d5-36b396d796c3@redis&vid=4&format=EB&rid=4
2. https://web.p.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMzIyMDcyX19BTg2?sid=3281a842-6740-4e2b-a3d5-36b396d796c3@redis&vid=5&format=EB&rid=1

Topics relevant to development of "Employability Skills": Project Management- Project Management Function, Role of Project Manager, Organizing for Construction, Principles of organization Safety & risk management for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mrs. Sowmyashree T/ Mr. Ahamed Sharif
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code: CIV3036</td><td colspan="4">Course Title: Project Management in Infrastructure Development
Type of Course: Discipline elective & Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">Basic knowledge of different civil engineering structures and Basic Engineering mathematics.</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">The purpose of this course is to introduce the real world risks and challenges in managing infrastructure. The course briefly describes the infrastructure planning process as well as the state of infrastructure across sectors in India. It helps students in understanding various risks that plague infrastructure projects and the solutions or fixes that can help us execute infrastructure projects better. The course is replete with real-world case studies to ensure that what is being discussed is practically applicable. The course is both conceptual and analytical in nature.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Project Management in Infrastructure Development and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of the course the students shall be able to:
1] Explain Infrastructure management at all levels.
2] Prepare Plan for infrastructure systems that provide resilience against natural and man-made hazards.
3] Prepare life cycle analysis of Infrastructure projects.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to Infrastructure</td><td>Assignment</td><td colspan="3">Data collection and Analysis task</td><td colspan="2">09 Hours</td></tr>
<tr><td colspan="10">Topics:
Introduction to Infrastructure Projects: Transportation infrastructure, power, water and telecom sectors, Rural and Urban Infrastructure Sectors, Players and Phases in an Infrastructure Project. Introduction to Project, Phases of a Project, Activities involved in a project, Stake holders of a Project, Structure of a project Organization, Traits of a Project Manager</td></tr>
<tr><td>Module 2</td><td colspan="3">Project Management in Infrastructure</td><td>Assignment</td><td colspan="3">Simulation in MS project</td><td colspan="2">13 Hours</td></tr>
<tr><td colspan="10">Topics:
Concepts of Work breakdown structure, planning terminologies, Bar Charts, Network diagram and logic, Duration estimation of an activity, Network analysis, Float of an activity and its types, Planning technique - Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Planning and scheduling of infrastructure projects, Resource management in infrastructure, Construction and maintenance of infrastructure, Public private partnerships Risk management in infrastructure projects, Infrastructure economics and finance.</td></tr>
<tr><td>Module 3</td><td colspan="3">Life cycle Analysis</td><td>Assignment</td><td colspan="3">Data collection</td><td colspan="2">10 Hours</td></tr>
<tr><td colspan="10">Topics:
Project Governance, Data base Management, Design for infrastructure service life, Life cycle cost and benefit analysis, Maintenance of infrastructure – case studies, Privatization in infrastructure sector.</td></tr>
<tr><td colspan="10">Targeted Application & Tools that can be used:
Infrastructure projects like Highways, Aviation, Power and Energy, Railways, Water infrastructure etc.
Professionally Used Software: MSP/ Primavera</td></tr>
<tr><td colspan="10">Textbooks:</td></tr>
</table>

<table>
<tr><td colspan="2">1. Grigg, Neil, Infrastructure engineering and management, Wiley (1988)
2. Hudson, Haas, Uddin , Infrastructure management : integrating design , construction, maintenance , rehabilitation and renovation , McGraw Hill ,(1997)</td></tr>
<tr><td colspan="2">References:
1. A. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.
2. Sharma S.C. “Construction Equipment and Management”, Khanna Publishers, Delhi, 1988.

E-Resources
1. Scheduling techniques in Projects: https://swayam.gov.in/nd1_noc19_ce24/preview
2. Project Planning and Control: https://swayam.gov.in/nd1_noc19_ce30/preview
3. Project Management: https://swayam.gov.in/nd1_noc19_mg30/preview
4. https://web.p.ebscohost.com/ehost/detail/detail?vid=3&sid=aa3f4cfb-5a2a-4e2e-9223-85dc6aaca2d6%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=158304555&db=iih
5. https://web.p.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=1&sid=4ff0644e-0280-4927-948b-ec59c13adab9%40rediscurve</td></tr>
<tr><td colspan="2">Topics relevant to “EMPLOYABILITY SKILLS”: Infrastructure management, risk management, project planning for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Catalogue prepared by</td><td>Mr. Ahamed Sharif/ Ms. Sowmyashree T</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BoS No. 14 held on 30 July 2022</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 18 held on 03 August 2022</td></tr>
</table>

Course Code: CIV3037	Course Title: Construction Practices and Challenges in Infrastructure Projects Type of Course: Discipline Elective and Theory Only		L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	Introduction to Infrastructure System and Planning					
Anti-requisites	NIL					
Course Description	This course deals with different construction practices and the challenges involved in Infrastructure projects. This course highlights the Sequence of activities in construction such as Site Clearance, Marking at site, Earthwork Masonry, Flooring, Building Foundation etc. This course is conceptual in nature and exhibits the legal and contractual issues in infrastructure projects. Different strategies are also acknowledged in the course so as to mitigate risks in projects.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Construction Practices and Challenges in Infrastructure Projects and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: **1)** Identify the sequence of activities in the construction practices with different infrastructure projects. **2)** Explain the different types and stages of an infrastructure project. **3)** Identify the legal and contractual issues along with the challenges and risks involved in Infrastructure projects. **4)** Describe the strategies to mitigate risk in an infrastructure project.					
Course Content:						
Module 1	Construction Practices	Assignment	Case study	10 Sessions		
Topics: Sequence of activities and construction co-ordination – Site Clearance, Marking at site, Earthwork Masonry – stone masonry, Bond in masonry, concrete hollow block masonry ; Flooring – damp proof courses, construction joints, movement and expansion joints ; Building foundations – basements, temporary shed; Centering and shuttering – slip forms, scaffoldings , de-shuttering forms – Fabrication and erection of steel trusses, frames , braced domes.						
Module 2	Introduction to Infrastructure Projects	Assignment	BIM and MS Projects, MS Excel	8 Sessions		
Topics: Types of Infrastructure projects. Role of Infrastructure-The Urban infrastructure in India, The Rural infrastructure in India, Special Economic Zones, Organizations and layers in the field of infrastructure, Stages of an Infrastructure Project Lifecycle, Data management of an Infrastructure Lifecycle.						
Module 3	Challenges to Infrastructure Projects	Assignment	Case Study	8 Sessions		
Topics: Mapping and Facing the landscape of risks in Infrastructure projects, Economic and demand risks: Case study for Political Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.						
Module 4	Strategies for Successful Infrastructure Project Implementation	Assignment	Primavera/ Data based	09 Sessions		
Topics: Risk Management framework for Infrastructure projects, Shaping the Planning phase of Infrastructure projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating on Multiple stakeholders on Infrastructure projects.						

Innovative design and Maintenance of Infrastructure facilities- Capacity building and improving the Governments' role in Infrastructure implementation, Integrated framework for successful infrastructure planning and management-Future Directions
Targeted Application & Tools that can be used: Infrastructure projects like Highways, Aviation, Power and Energy, Railways, Water infrastructure etc. Professionally Used Software: MSP/ Primavera
Text Book T1. Grigg, Neil, *Infrastructure engineering and management, Wiley (1988)* T2. Hudson, Haas, Uddin , *Infrastructure management : integrating design , construction, maintenance , rehabilitation and renovation , McGraw Hill ,(1997)*
References R1. Antil J. M. *Civil Engineering Construction, McGraw Hill Book Co.* R2. Sharma S.C., *Construction Equipment and Management, Khanna Publishers, Delhi, 1988* R3. Frank Harris, *Modern Construction Equipment and methods, John Wiley and Sons, 1994.* R4. Peurifoy R L, *Construction Planning, Equipment and Methods, Mc Graw Hill* Weblinks: https://onlinecourses.nptel.ac.in/noc19_ce29/preview https://fr.coursera.org/lecture/construction-project-management/challenges-and-opportunities-in-the-construction-industry-HTkSH E-BOOKS: 1. Concrete Technology and Good Construction Practices https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2721708&site=ehost-live 2. Modern Practices in Formwork for Civil Engineering Construction Works https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1227253&site=ehost-live 3. Negotiation in Groups https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=375905&site=ehost-live
Topics relevant to "EMPLOYABILITY SKILLS": Construction co-ordination – Site Clearance, Marking at site Building foundations – basements, temporary shed; Centering and shuttering – slip forms, scaffoldings, de-shuttering forms – Fabrication and erection of steel trusses, frames, braced domes for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mrs. Divya Nair/ Ms. Sowmyashree. T
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3038	Course Title: Construction Economics and Finance Type of Course: Discipline Elective and Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to includes knowledge of Construction economics is a branch of general economics. It consists of the application of the techniques and expertise of economics to the study of the construction firm, the construction process and the construction industry. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics. The course develops the critical thinking for decision making and analytical skills to choose construction resources for the construction project. By participating in the course students will be able to understand the economics of construction projects, idea of decision making to make the project monitoring more efficient by understanding profit or loss.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Construction Economics and Finance and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: **1)** Distinguish the different methods of comparison. **2)** Express the economy of equipment based on its life cycle cost. **3)** Propose plans for dispute resolution in construction contracts.					
Course Content:						
Module 1	Construction Economics	Assignment	Data Collection	15 Hours		
Topics: Engineering economics: Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future, Present payment compared to uniform series payments, Future payment compared to uniform series payments, Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return						
Module 2	Equipment economics	Case Study	Data Collection	12 Hours		
Topics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis. Depreciation, Inflation and Taxes. Benefit-cost analysis.						
Module 3	Estimate & Contract Changes	Case Study	Data Collection	8 Hours		
Topics: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, parametric estimate and Life cycle cost. Breach of the Contract, Contract Changes and Construction Contract Claims and Dispute Resolution.						
Text Books 1. Blank, L. T. and Tarquin,A. J.,"Engineering Economy", Fourth Edition, WCB/McGraw-Hill, 1998. 2. Collier, Kieth, "Managing Construction Contracts"						
References 1. K N Jha "Construction Project Management", Second edition, Pearson. 2. S. Ranaga Rao Contract Management and Dispute Resolutions Engineering staff College of India, Jan2008. Web Resources: https://onlinecourses.nptel.ac.in/noc21_ce16/preview						

https://onlinecourses.nptel.ac.in/noc22_mg55/preview https://nptel.ac.in/courses/110/105/110105094/ https://web.p.ebscohost.com/ehost/detail/detail?vid=0&sid=b1038f60-a4c7-4e04-bc41-75d380a0bac8%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=146827218&db=iih https://web.p.ebscohost.com/ehost/detail/detail?vid=0&sid=045b272b-9efe-4bd0-a63e-5a89d9ed7bba%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=122412782&db=iih	
Topics relevant to "EMPLOYABILITY SKILLS": Quantifying alternatives for decision making, Cash flow diagrams and Equivalence- Single payment in the future, Present payment compared to uniform series payments, Future payment compared to uniform series payments for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mrs. Sowmyashree T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3039	Course Title: Applications of Remote Sensing and GIS in Infrastructure Development Type of Course: Discipline Elective Theory		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CIV2101 - Surveying					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the student to recognize the importance of remote sensing and GIS methods in construction especially in the urban infrastructure development. Remote sensing technologies offers data on earth's resources in a spatial format, GIS co-relates various types of spatial data and their attribute data to use them Civil engineering. Different themes namely, terrain, geology, hydrology, land use that can be derived from remote sensing data. Some current uses of Remote Sensing and GIS in Civil projects are housing, sanitation, power, water supply, disposal of effluents, urban growth, Remote sensing and GIS are used to generate development models by integrating the information on natural resources, demographic and socio-economic data in a GIS domain with satellite data. The course will begin with introduction to Remote Sensing & GIS and their terminologies, The Remote essentials and GIS basics. Applications of remote sensing data and GIS tools for solving different problems in construction and infrastructural development.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Applications of Remote Sensing and GIS in Infrastructure Development and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Recognize the concept of remote sensing and GIS. 2) Review the importance of Remote Sensing and GIS in infrastructure development. 3) Integrating the Spatial and spatial data. 4) Produce a digital map, images, and to communicate information in a meaningful way to others.					
Course Content:						
Module 1	New techniques in Remote Sensing and GIS for Infrastructural development	Assignment	Data Analysis task	12 Hours		
Topics: Fundamental concept of Remote Sensing and GIS – Developments of Sensors, platforms, Resolutions, EMR interaction with earth surface materials. Introduction to digital data, Elements of Image interpretation and processing techniques. Characteristics of Landsat, WorldView, Cartosat, Sentinel, GeoEye, ERS, RADARSAT Satellites Orbital features, Data products. GIS – Basic concept, Essentials, Data types, Topology concept.						
Module 2	Digital image Processing and interpretation techniques.	Case Studies	Simulation / Modeling	11 Hours		
Topics: Basic concept of digital image processing - Principles, Image Rectification, Image enhancement and Mosaicking. Satellite Image classification - Supervised, Unsupervised, Ground truth data and training set manipulation, Classification and accuracy assessment. Interpretation of Multispectral Imagery and High resolution data for simulation or modeling.						

Remote Sensing applications in groundwater studies.				
Module 3	Overview to UAV remote sensing and its applications	Assignment	Data Collection and Analysis	08 Hours
Topics: Introduction to UAV remote sensing - techniques and prospects used in data collection. Applications in Civil Engineering and infrastructure development projects.				
Module 4	Geographical Information System and Data analyses.	Assignment	Model developments	09 Hours
Basic principles of GIS, Important components, Raster and vector data model and methods of data analysis. Non-spatial data and its types. Map projection, Topology creation, Digital cartography and Map making. GIS analyses for various applications. Techniques used to generate TIN and DEM model.				
Module 5	Google Earth and its Applications	Assignment	Data Analysis	04 Hours
Google earth – Introduction, Installations, tools used, and its various applications in Infrastructure developments. Vector overlay on Google maps. Geo-literacy as a fundamental life skill development for students				
Targeted Application & Tools that can be used: Application areas is analyses of data of a ward in Bangalore. The data can be used by BBMP for planning and development activities. Professionally used software: Satellite Image Processing software - ERDAS and GIS software such as ArcMap / QGIS, MS Excel word.				
Text Books T1 Remote Sensing and GIS - Lillysand and Kiefer, John Willey 2008. T2 Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015				
References R1. Remote Sensing and Geographic Information System, M. Anji Reddy, Fourth Edition, BS Publications. R2. Remote Sensing and Urban analysis: GISDATA-9 by Jean-Paul Donnay, Mike J. Barnsley, et al December 2000, CRC Press London. R3. Remote Sensing and GIS, by Basudeb Bhattia, Oxford publications, Second Edition, 2011 R4. "Concept and Techniques of Geographic Information Systems", C. P. Lo, Albert K. W. Yeung, Second Edition, Pearson, 2016. Web resources https://www.iirs.gov.in/ https://bhuvan.nrsc.gov.in/ http://edc.usgs.gov/ http://www.cr.usgs.gov/ http://www.earthsat.com/ https://www.gislounge.com/ https://www.esri.com/en-us/what-is-gis/overview https://www.usgs.gov/products/data-and-tools/gis-data https://www.qgis.org/ https://www.qgistutorials.com/				
Topics relevant to "EMPLOYABILITY SKILLS": Data collection & analyses for an assignment. The software's used will be ArcMap, QGIS, Image Processing, and MS EXCEL for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Dr.Chandankeri G G			
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022			

Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3040	Course Title: Environmental Impact Assessment for Infrastructure projects Type of Course: Discipline Elective Course Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Environmental Pollution and Control					
Anti-requisites	Nil					
Course Description	The main objective of this Course to assess the impact of any engineering projects on the environment. This Course introduces the methodology of environmental impact assessment (EIA) as a vital tool for sound environmental management and decision-making. The Course provides an overview of the concepts, methods, issues and various forms and stages of the EIA process. This course also provides environmental guidelines for Airport, highway and construction projects					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Environmental Impact Assessment for Infrastructure projects and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Explain the EIA notification and Environmental clearance process in India 2) Predict the impacts on Environment causing by any developmental projects 3) Discuss the role of stakeholders in obtaining environmental clearance. 4) Discuss the method of impact analysis and environmental audit.					
Course Content:						
Module 1	Scope and EIA process in India	Assignment	Data collection and analysis	08 Sessions		
Topics: Introduction, Purpose of EIA, Evolution & History of EIA, EIA- Guiding principles, Benefits of EIA ,EIA Notification 2006 and Amendments in EIA notification, Categorization of projects, Stages in Prior Environmental Clearance Process, Validity of EC						
Module 2	Prediction and Assessment of Impacts on the Environment	Case Study	Data Collection and Analysis	08 Sessions		
Topics: Prediction and Assessment of Impacts on the Environment: Air, Water, Noise, Biological, Cultural and Socioeconomic Environment						
Module 3	Public participation and EIA for various projects	Case study	Data Collection and Analysis	12 Sessions		
Topics: Introduction, Participation in the EIA process, objectives of public participation, Techniques of public participation, Advantages and disadvantages Environmental guidelines for Airport, highway and Construction projects						
Module 4	Impact analysis and Environmental auditing	Case study	Data Collection and Analysis	8 Sessions		
Topics: Impact Analysis methods- Adhoc, Checklist, Overlay, Matrices and Network. Environmental auditing: water audit, waste audit, material audit, energy audit, Green audit-Case studies						
Targeted Application & Tools that can be used: This Course helps student to assess impact of engineering projects on environment and to prepare EIA report on any projects Professionally Used Software: Java, MS Excel and Auto CAD						
Text Book						

T1. Larry W Canter, "Environment impact Assessment", McGraw Hill Publication T2. S K Khanna – M G Arora – S. S Jain "Airport planning and design", Nem Chand & Bros, Roorkee	
References R1. Jain R.K –Van, "Environment impact Analysis", Nostrand Reinhold Co. Web Source: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2228659&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": EIA report for Construction projects for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr Santhosh M B/ Dr. Venkatesha Raju K
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3055	Course Title: Infrastructure Projects Financing Type of Course: Discipline Elective & Theory Only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course introduces the characteristics of financing infrastructure projects. Furthermore, critical issues in infrastructure financing such as government role in infrastructure creation, regulation, frameworks for private sector participation, public private partnerships, and risk management are dealt in detail. The course includes few case studies to demonstrate the application of the theoretical concepts on infrastructure financing.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Infrastructure Projects Financing and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **1)** Describe Sources of financing infrastructure projects. **2)** Discuss PPP procurement process. **3)** Prepare the project financing plan.					
Course Content:						
Module 1	Infrastructure Development	Assignment	Data Collection	10 Sessions		
Topics: Definition of infrastructure; Multiplier effects of infrastructure development on economic development of the nation, Sources of financing infrastructure projects: Traditional and private investments; Various financial instruments, Limitations of traditional procurement system of infrastructure; Legal frameworks and Incentives for private sector participation in infrastructure development.						
Module 2	Public Private Partnerships	Case Study	Data Collection	12 Sessions		
Topics: Stakeholders' perspectives: Granting authority, Funders and Concessionaire, PPP procurement process; Lifecycle of PPP projects, Contractual package of PPP project; Bankable concession agreement, Case study – Procurement process of Indian PPP projects						
Module 3	Project Finance	Case Study	Data Collection	12 Sessions		
Topics: Introduction to project financing concept, Analysis of project viability, Designing security arrangements, Preparing the project financing plan.						
Targeted Application & Tools that can be used: Entrepreneurship, infrastructure ventures						
Project work/Assignment:						
Text Books: T1. Merna, T.,& Njiru, C.(2002). Financing infrastructure projects (First ed.). London: Thomas Telford. T2. Nevitt,P.K.,& Fabozzi, F. J.(2000).Project financing (7 ed.). London, UK:Euromoney Books. T3. Yescombe,E. R.(2002).Principles of Project Finance. California:Academic Press.						
References: R1. Kurowski, L.,& Sussman, D.(2011). Investment project design - A guide to financial and economic analysis with constraints. New Jersey: John Wiley & Sons. R2. Pretorius, F., Lejot,P., McInnis,A., Arner, D.,& Hsu,B. F.-C.(2008).Project finance for construction and infrastructure: Principles and case studies. Oxford Blackwell Publishing.						

Weblinks/e-resources: https://web.s.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMjExMzMzX19BTg2?sid=a54a2e0e-477d-49af-b5bf-51f3ca60df8a@redis&vid=4&format=EB&rid=2 https://web.s.ebscohost.com/ehost/ebookviewer/ebook/ZTAwMHh3d19fMjEyODY2N19fQU41?sid=a54a2e0e-477d-49af-b5bf-51f3ca60df8a@redis&vid=3&format=EB&rid=1	
Topics relevant to "EMPLOYABILITY SKILLS": Project Management- PPP procurement process; Lifecycle of PPP projects, Contractual package of PPP project; Bankable concession agreement for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mrs. Sowmyashree T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3056	Course Title: Geospatial Analysis in Urban Planning Type of Course: Discipline Elective and Theory Only		L-T-P-C	2	0	2	3
Version No.	1.0						
Course Pre-requisites	[1] CIV2101 Surveying						
Anti-requisites	NIL						
Course Description	This course empowers the students to discover the different methods where remote sensing techniques provide geospatial information which is appropriate, accurate, timely, accessible and available in a suitable format. New developments in Earth observation satellite like LIDAR, hyper-spectral sensors and Drone based remote sensing are increasing the prosperity of information. The course also covers the emerging technology like Digital Image processing method and its applications in urban planning. It is technical field concerned with how land is developed. To urban planners, the protection of the environment and the welfare of people are of the primary importance. Urban planning involves strategically designing infrastructure and transportation mechanisms. But it also takes into account how urban growth affects the environment including water quality, air quality, and habitat preservation. Remote sensing images, platforms and sensors, image interpretation and processing techniques and GIS tools are used in their work to more effectively create smart growth plans. The associated tutorial ensures better understanding of the topics covered in theory in theory portions.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Geospatial Analysis in Urban Planning and attain Employability Skills through Participative Learning techniques.						
Course Outcomes	On successful completion of this course the students shall be able to: 1) Provide planning professionals with a full understanding of GIS & RS concepts, principles and how they can be applied for Urban and spatial planning. 2. Utilize GIS tools and remote sensing & Drone techniques used to study urban growth trends, patterns and problems within the planning area. 3) Prepare geospatial data and integrate it with a GIS to create maps and images, to communicate spatial data and non-spatial information.						
Course Content:							
Module 1	Introduction to Remote Sensing	Assignment	Data Analysis task	09 Sessions			
Topics: Introduction to Remote sensing data types (satellite platforms, satellite images etc.) and GIS • Satellite/drone image resolution - spatial, temporal, spectral and radiometric resolution of an image and feature extraction etc. • Role of high-resolution satellite and drone images in spatial planning. • GIS Introductions, methods and tools used in different applications.							
Module 2	Digital image Processing and interpretation techniques.	Case Studies on image classification and interpretation using QGIS.	Data analysis task	07 Sessions			
Topics: Introduction to digital image: Image classification - Supervised, Unsupervised and its various applications, Ground truth data and training set manipulation, Classification accuracy assessment.							

<table>
<tr><td colspan="5">Interpretation of Multispectral Imagery and High-resolution data.</td></tr>
<tr><td>Module 3</td><td>Urban population growth and transport trends analysis</td><td>Assignment</td><td>Data Collection and Analysis</td><td>06 Sessions</td></tr>
<tr><td colspan="5">Topics:
Role of GIS and remote sensing in the creation of urban population growth models.
• Population growth study
• Smart or intelligent urban transport system
• Role of Geospatial technology in smart urban transport system.</td></tr>
<tr><td colspan="5">List of theory tasks:
Experiment No 1: Downloading and installation of QGIS from open-source website.
Experiment No 2: Downloading of sample satellite data
Experiment No 3: Uue of various tools of QGIS and their usage.
Experiment 4: Creation of vector data base from satellite data and other maps.
Experiment 5: Secondary data collection from government sources related to urban planning.
Experiment 6: Land use / land cover map preparation and generation of landuse statistics.
Experiment 7: Digital map creation.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
An application area is data collection of one taluk / district. The analyzed data can be used by Government department and Private companies to understand the urban growth trend and future planning purposes.
Professionally used software: ARCMap / QGIS, MS Office.</td></tr>
<tr><td colspan="5">Text Books
T1. GIS Fundamentals: A First Text on Geographic Information Systems, Paul Bolstad, XanEdu Publishing Inc; 5th edition;
T2. Introduction to Geographic Information Systems, Kang-tsung Chang, McGraw-Hill Education;
T3. Urban Analytics, Alex D. Singleton, Seth Spielman and David Folch</td></tr>
<tr><td colspan="5">References
R1 The City in History: Its Origins, Its Transformations, and Its Prospects, Lewis Mumford, Harcourt Brace International publisher.
R2 Happy City: Transforming Our Lives Through Urban Design, Charles Montgomery, Published by Doubleday Canada.

Websites:
http://Geo Spatial Analysis in Urban Planning - Course (nptel.ac.in)
http://Geospatial Analytics for Reassessing Urban Structures | by Freddy Fashridjal | Towards Data Science.

E-resources:
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=933799&site=ehost-live
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2153716&site=ehost-live
http://Geo Spatial Analysis in Urban Planning - Course (nptel.ac.in)</td></tr>
<tr><td colspan="5">Topics related to development of “EMPLOYABILITY”: The students can work in the Government Departments, Private sector as specialists to supports in urban planning and designing. The software used will be Open GIS and MS Excel for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td colspan="2">Catalogue prepared by</td><td colspan="3">Dr. Chandankeri G G</td></tr>
<tr><td colspan="2">Recommended by the Board of Studies on</td><td colspan="3">BoS No. 14 held on 30 July 2022</td></tr>
</table>

Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

<table>
<tr><td>Course Code:
CIV2040</td><td colspan="5">Course Title: Built Environment Design
Type of Course: Discipline Elective
Theory Only Course</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="10">1.2</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="10">Nil</td></tr>
<tr><td>Anti-requisites</td><td colspan="10">Nil</td></tr>
<tr><td>Course Description</td><td colspan="10">The objective of this course is to introduce Cultural Discourse in Built Environment Theory, Research, Practice and Education. To build the foundation and re-orient the students to use systems thinking and through interdisciplinary methods for bringing under one umbrella together the scientific, ecological, technological, and political dimensions of the subject of culturally responsive Built Environments.</td></tr>
<tr><td>Course Objectives</td><td colspan="10">The objective of the course is to familiarize the learners with the concepts of Built Environment Design and attain Employability Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="10">On successful completion of the course the students shall be able to:
1. Discuss the basic concepts of built environment.
2. Explain the present need of built environment in conjunction of with technology and development.
3. Describe the historical changes and evolution of built environment (Indian Scenario)</td></tr>
<tr><td>Course Content:</td><td colspan="10"></td></tr>
<tr><td>Module 1</td><td>Introduction</td><td colspan="4">Assignment 1</td><td>Report</td><td colspan="3">10 Sessions</td></tr>
<tr><td colspan="11">Built Environment: Definition, Principles and Concepts: Place and Space; Introduction to Vernacular Architecture: What is a Dwelling? Dimensions of culturally responsive built environment; 3D Laser Scanner in Built Environment; Winter Urbanism. Vernacular resources, materials and technology.</td></tr>
<tr><td>Module 2</td><td>Built up environment, Cultural disaster and risk</td><td colspan="4">Term Paper</td><td></td><td colspan="3">14 Sessions</td></tr>
<tr><td colspan="11">Power in built form, Spatial Analysis, Religious Architecture; a continuum of meaning, Understanding construction workers' Housing, Sustainable Habitat for Urban poor
Culture Disasters and Risk, Conservation: Principles and practices;</td></tr>
<tr><td>Module 3</td><td>Planning for culture, Social change in India</td><td colspan="4">Assignment 2</td><td>Report</td><td colspan="3">16 Sessions</td></tr>
<tr><td colspan="11">Cultural economies; Safeguarding intangible heritage, culturally responsive built environment: Architectural education; Summarizing culturally responsive built environment, Social Cohesion, Social change in India (Sanskritization & Westernization) and change towards modernization.</td></tr>
<tr><td colspan="11">Targeted Application & Tools that can be used: Application in sustainable buildings and Green Buildings</td></tr>
<tr><td colspan="11">Text Book
1. Bourdier, J. and Al Sayyad, N. (eds.) (1989). Dwellings, Settlement and Tradition. Lanham, Maryland: University Press of America
2. King, A. (ed.) (1997) Culture, Globalization and the World-System: Contemporary Conditions for the Representation of Identity. Minneapolis: University of Minnesota</td></tr>
<tr><td colspan="11">References
1. Lang, J, Desai, M. (ed.) (1997) Architecture and Independence: the search for identity – India 1880 to 1980, Oxford: Oxford University Press.
2. Oliver, P. (2003). Dwellings: The Vernacular House World Wide. London: Phaidon Press.
3. Oliver (2006) Built to meet needs: Cultural issues in vernacular Architecture, Oxford: Architectural press.
PU e-Library Resource</td></tr>
</table>

1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=539979&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": Spatial Analysis, Cultural Disaster risk, Culturally responsive built environment for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Adil Nadeem Hussain/Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2041	Course Title: Fundamentals of Smart City Type of Course: Discipline elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to introduce the students to the concept of Smart Cities. The course enables the students to gain insights into the modern-day smart city components and characteristics. This course will make an overall introduction to global smart city development in order to inform the leaders in smart cities and communities. The course will enable the students to make a step forward in developing an open, collaborative, citizen-centric, and digitally-enabled operating model for their city that realizes their vision of smart city toward sustainable, resilient, and prosperous future.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Smart City and attain Employability Skills through Participative Learning techniques					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Describe the technologies and the smart solutions for the development of smart cities. 2. Prepare a sustainable urban system plan to build smart, inclusive, sustainable cities. 3. Demonstrate the knowledge of implementing and operation of smart cities.					
Course Content:						
Module 1	Introduction to Smart cities	Assignment	Data collection	12 Sessions		
Topics: Smart City: Definition, Idea, Concepts and Necessity; Core components, Technologies, Conceptualizing cities as complex socio-technical systems, digitalization, Implications on digitalization on cities, Smart solutions, Dimensions of Smart city development - smart infrastructure and building, smart transportations, smart energy, smart water management system, smart waste management, smart healthcare, and smart environment. Smart city models.						
Module 2	Smart City planning	Term paper/Assignment	Data Collection	10 Sessions		
Topics: Sustainable urban system plan, Planning approaches, Strategic urban development plan, Smart city documentation, Reference framework, Smart city proposal, Urban resilience; Urban consultations; Case studies						
Module 3	Financing and Implementation	Term paper	Data Collection and Analysis	8 Sessions		
Topics: Government funding, Public private partnership, Convergence schemes; Implementation by SPV, Implementation by decentralization, Mission monitoring – Case studies						
Targeted Application & Tools that can be used: Knowledge of the Fundamentals of Smart cities will cater to the Skill of young graduates in the field of urban planning through consultation process.						
Text Books: 1. *Smart City Emergence 2019 Elsevier Inc.* *https://www.sciencedirect.com/book/9780128161692/smart-city-emergence*						
References:						

1. Saraju P Mohanty, Uma Choppali, Elias Kougianos, " *Everything you wanted to know about Smart Cities",* IEEE Consumer Electronics Magazine, July 2016 2. Barton A, Manning R. Smart Cities: Technologies, Challenges and Future Prospects. Nova; 2017. PU e-Library Resources 1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live	
Topics relevant to development of "Employability": Smart technologies and solutions, Smart city planning process and Urban consultation for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV2042	Course Title: Urban Mobility Type of Course: Discipline Elective Theory Only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	[1] CIV2501 Transportation Engineering [2] CIV2025 Urban Transport Planning Basic concepts of Transport modelling					
Anti-requisites	NIL					
Course Description	This course deals with the fundamental concepts of Urban mobility. It gives insights into the evolution of urban mobility, urban transits and planning. Modern challenges hindering the implementation of Urban mobility plans are also discussed. Process of Sustainable Urban mobility plan led by Europe is taken as a case study, the cumbersome process of implementation of Urban Mobility planning is explained step by step.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Urban Mobility and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the basic concepts of Urban Mobility. 2] Discuss the challenges faced in implementing Sustainable Urban Mobility Plan. 3] Explain Sustainable Mobility plans. 4] Discuss the implementation of Sustainable Urban Mobility plans					
Course Content:						
Module 1	Introduction to Urban Mobility	Case Study	Data Collection	8 Sessions		
Topics: Urban Mobility & its Evolution: Different forms of urban mobility, Collective transportation (public transit), Individual transportation, freight transportation. Evolution of urban transits. Sustainable transportation, Stakeholder consensus on transport improvements, Aligning local activities and societal goals						
Module 2	Challenges in Urban Mobility planning	Case Study	Data Collection	6 Sessions		
Topics: Challenges in mobility planning: Accuracy and completeness of transport data, Model development Scenario formulation and comparison, Reconciliation between vision and strategy, Policy instruments in Smart mobility						
Module 3	Sustainable Urban Mobility Plan	Assignment	Data Collection	8 Sessions		
Topics: Sustainable Urban Mobility Plans (SUMP), Main characteristics of a SUMP, Sustainable urban mobility planning process, Transport planning practise in Europe and India, common challenges of urban mobility planning in Europe and India, Smart mobility as catalyst for policy change towards low carbon						
Module 4	Implementation of Urban Mobility planning	Assignment	Data Collection	8 Sessions		
Topics: Urban mobility planning: Practical recommendations, Complete data collection, evaluation and representation, Integrating land use, Evaluating alternative scenarios, Time horizons and monitoring, Stakeholder participation in UMP preparation, Case Studies.						
Targeted Application & Tools that can be used: Having studied this course will enable students to work as a transport planner for consultancies and can also work as a government consultant.						
Text Book 2. Mashrur A. Chowdhury and Adell Sadek,"*Fundamentals of Intelligent Transportation Systems Planning*", , Artech House, Inc., 2003. 3. Sussman, Joseph, NY, "*Perspectives on Intelligent Transportation Systems (ITS)*": Springer, 2010.						
References						

<table>
<tr><td colspan="2">1. Federal Ministry for economic corporation and development “Urban Mobility Plans National Approaches and Local Practice” GIZ publishers,
2. “National ITS Architecture Documentation”, US Department of Transportation, 2007 (CD-ROM).

Web link: https://nptel.ac.in/courses/105/106/105106058/

PU e-Library Resources
1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2494839&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2721672&site=ehost-live</td></tr>
<tr><td colspan="2">Topics relevant to “EMPLOYABILITY SKILLS”: Planning for sustainable transport solutions, Sustainable urban mobility planning process for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Catalogue prepared by</td><td>Mr. Navneet Singh/Mr. Ajay H A</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>BoS No. 14 held on 30 July 2022</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>Academic Council Meeting No. 18 held on 03 August 2022</td></tr>
</table>

<table>
<tr><td>Course Code:
CIV2043</td><td colspan="3">Course Title: Urban sanitation and Hygiene
Type of Course: Discipline Elective
Theory Only Course</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course demonstrates to understand the necessity of hygiene and sanitation in urban localities, with urbanization trends and increasing population, there is an exponential need for managing sanitation waste generated by knowing fundamentals of personal hygiene.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Urban sanitation and Hygiene and attain Employability Skills through Problem Solving methodologies.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
1. Develop an insight into various aspects of urban sanitation planning.
2. Demonstrate knowledge of sanitation practices for buildings
3. Recognize the importance of personal hygiene</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to Urban Sanitation</td><td>Quiz</td><td colspan="2"></td><td colspan="2">10 Sessions</td></tr>
<tr><td colspan="9">Topics:
Sanitation – Overview and Issue, Need for participatory planning, Environmental policy, Environmental Impact Assessment 2006 and National Urban Sanitation Plan, Integrated municipal solid waste management, Decentralized waste management – Waste water, Solid waste, Plastic waste, Faecal sludge. Case study of Alapuzzha.</td></tr>
<tr><td>Module 2</td><td colspan="3">Sanitation in buildings and sanitary fittings</td><td>Assignment</td><td colspan="2">Report</td><td colspan="2">12 Sessions</td></tr>
<tr><td colspan="9">Importance and Requirement of Building Drainage, General Layout of Sanitary Fittings and House Drainage Arrangements for Single and Multi- Storied Buildings as Per B.I.S Code of Practice. Dual pipe system. Sanitary Fittings- Water Closets, Flushing Cisterns, Urinals, Inspection Chambers, Traps, Anti-syphonage. Inspection, Testing and Maintenance of sanitary fittings.</td></tr>
<tr><td>Module 3</td><td colspan="3">Personal Hygiene</td><td>Assignment</td><td colspan="2">Report</td><td colspan="2">8 Sessions</td></tr>
<tr><td colspan="9">Topics:
Hygiene – Basics, Concepts, Entry of microbes and Hygiene; Impact of sanitation on Health, Hygiene Interventions.
Food hygiene – Importance of food hygiene training, factors affecting food safety, Food handler’s personal hygiene, Hand hygiene, Oral hygiene, Skin hygiene; Global sanitation development for hygiene.</td></tr>
<tr><td colspan="9">Targeted Application & Tools that can be used: To eradicate lack of personal hygiene, open defecation, and improve lifestyle changes, and applying engineering techniques for proper sanitation processes.</td></tr>
<tr><td colspan="9">Text Book
1. Johns N (1991) Managing Food Hygiene, Palgrave Macmillan.
2. Sprenger RA (2000) The Food Hygiene Handbook, High Field Publication
3. Park K (2015) Park Textbook of preventive & social medicine 24th Ed., Banarsidas Bhanot Publ. Bedi YP (1977) A handbook of social and preventive medicine, Anand Publ.
4. Roday S (2011) Food Hygiene and Sanitation with case studies, 2nd Ed., TATA McGraw Hill Education Pvt. Ltd. New Delhi.</td></tr>
</table>

References

1. "Global Water Supply and Sanitation Assessment 2000 Report" from CD directory "Global monitoring: water supply and sanitation".
2. Crabtree, K.D. et al. 1997. "Waterborne adenovirus: a risk assessment". Water Science and Technology 35(11-12): 1-6.
3. Havelaar, AH and JM Melse. 2003. Quantifying public health risk in the WHO Guidelines for Drinking Water Quality: A burden of disease approach.
4. Haas, C and JNS Eisenberg. 2001. Risk Assessment. In Water quality - Guidelines, standards and health: Assessment of risk and risk management for water-related infectious disease, Lorna Fewtrell and Jamie Bartram, Eds. Published on behalf of the WHO by IWA Publishing, London.

Web Links

1. https://nptel.ac.in/courses/127101014

PU e-Library Resources

1. https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=5a8eba90-14b5-4b32-89fe-8a01b9a694e2%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
2. https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=cbd3c3f1-80b4-4487-ad16-5a5b34fd2ba7%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

Topics relevant to "EMPLOYABILITY SKILLS": Sanitation in buildings and sanitary fittings, Industry visits for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3006	Course Title: Smart Materials and Structures Type of Course: Discipline Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	1] CIV2100 Building Materials and Concrete Technology 2] CIV2500 Strength of Materials					
Anti-requisites	NIL					
Course Description	The objective of this course is to have students learn the basic aspects of smart structural systems including smart materials, sensor technology, signal processing methods, modelling of smart structures and structural control concepts and expose them diverse and rapidly expanding applications of smart materials and technologies. The course is both conceptual and analytical in nature and needs fair knowledge of Strength of Materials. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Smart Materials and Structures and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Understand the ideas about instrumented structures and response. 2] Perceive the strain measuring techniques using electrical strain gauge. 3] Demonstrate the working principles of sensors and actuators. 4] Know about signal processing and their control systems.					
Course Content:						
Module 1	Introduction	Term Paper		8 Sessions		
Topics: Introduction to Smart Materials and Structures; Micromechanics and Macromechanics of composites; Instrumented structures functions and response – Sensing systems – Self diagnosis – Actuation systems and effectors.						
Module 2	Measuring Techniques	Term Paper		8 Sessions		
Topics: Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.						
Module 3	Sensors and Actuators	Assignment		14 Sessions		
Topics: Smart Sensors – Introduction; Communications for Smart sensors; Control techniques, Wireless sensing; Standards for Smart sensing. Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Modelling a Magnetostrictive material; Magneto structure Material – Shape Memory Alloys –Electromagnetic actuation – Role of actuators and Actuator Materials; Concept of Self-Healing.						
Module 4	Signal Processing and Control Systems	Term Paper		8 Sessions		
Topics: Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non-Linear.						
Targeted Application & Tools that can be used: Application Area is Infrastructure developing companies, Structural Consultancy Servicing Firms, Central and state Research and development Structural Engineering laboratories.						

Professionally Used Software: Excel, MATLAB and ANSYS Software.

Text Book

T1. L. S. Srinath, "Experimental Stress Analysis", Tata McGraw-Hill, 1998.

T2. Brain Culshaw, "Smart Structure and Materials", Artech House – Borton. London, 1996.

References

R1. Srinivasan, A. V. and Michael McFarland, D., "Smart Structures: Analysis and Design", Cambridge University Press, 2009.

R2. Michelle Addington and Daniel L. Schodek, "Smart Materials and Technologies: For the Architecture and Design Professions", Routledge 2004.

R3. J. W. Dally and W. F. Riley, "Experimental Stress Analysis", Tata McGraw-Hill, 1998.

Web Resources

1. https://nptel.ac.in/courses/112/104/112104251/
2. https://nptel.ac.in/courses/112/104/112104173/

PU e-Library Resources

1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1020599&site=ehost-live
2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=157432220&site=ehost-live
3. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=248891&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Strain Measuring Techniques using Electrical strain gauges, Data Acquisition and Processing – Signal Processing and Control for Smart Structures for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	BoS No. 14 held on 30 July 2022
Recommended by the Board of Studies on	Academic Council Meeting No. 18 held on 03 August 2022
Date of Approval by the Academic Council	BoS No. 14 held on 30 July 2022

Course Code: CIV3041	Course Title: Smart Cities energy system and management Type of Course: Discipline elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Elements of Civil Engineering, Essentials of basic computing and networks					
Anti-requisites	NIL					
Course Description	This course is designed to create awareness about the modern-day smart city components and characteristics, how each sector could be transitioned via a smart approach making it more efficient and socially acceptable. Introduction to the smart city energy management system and the key challenges being faced worldwide are hereby discussed. Basic energy requirement of a smart cities is in form of a smart grid and its overview is also incorporated in this course.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Smart Cities energy system and management and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Understand the Smart city components and characteristics 2) Explain the concept of a Smart Energy City. 3) Discuss basic components of Energy management system in smart cities. 4) Discuss challenges faced by different sectors in Smart energy management					
Course Content:						
Module 1	Introduction to Smart cities	Assignment	Data collection	8 Sessions		
Topics: Smart City: Definition, Concepts and Necessity; broad overview of smart city components and characteristics, smart infrastructure and building, smart infrastructure depictions, smart transportations, smart energy, smart water and waste management, smart healthcare and smart technology.						
Module 2	Energy infrastructure of Smart Cities	Assignment	Data Collection	8 Sessions		
Topics: Requirements of a smart energy city, key technologies and concepts of a smart energy city, Smart grid and its overview, Smart energy system approach versus smart grid system, Smart buildings, Demand response programs, features of a smart building, low carbon society.						
Module 3	Energy management in Smart cities	Assignment	Data Collection and Analysis	8 Sessions		
Topics: Smart Energy Management, existing policies landscape, Basic concepts of Energy management system in smart cities, corner stone of successful energy management system practice, Edge computing for IoT based Energy Management in Smart Cities - A way forward for achieving the smart energy management in smart cities.						
Module 4	Smart Energy management in different sectors & challenges	Case Study	Data Collection	10 Sessions		
Topics: Smart Energy management in different sectors: Enhancing sustainable energy management of buildings, Home Energy management model, AI and its applications in Home Energy Management System (HEMS), Introduction to ISO 50001 Energy Management System (EnMS), improving the water-energy nexus, achieving smart and low carbon mobility, optimizing waste management processes, enhancing efficiency of public service delivery. Key challenges faced.						
Targeted Application & Tools that can be used: Knowledge of the Smart cities energy system and management will cater to the employability of young graduates in the field of policy making and as consultants and advisors to the service providers.						

Text Books: 1. *Smart City Emergence 2019 Elsevier Inc.* *https://www.sciencedirect.com/book/9780128161692/smart-city-emergence*	
References: 1. Saraju P Mohanty, Uma Choppali, Elias Kougianos, *"Everything you wanted to know about Smart Cities",* IEEE Consumer Electronics Magazine, July 2016 2. Zoran Morvaj, Luca Garcic and Boran Morvaj, "*Smart Energy Cities- Transition towards a low carbon society*, UNDP, March 2012 PU e-Library Resources 1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=140442973&site=ehost-live 2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=148946759&site=ehost-live	
Topics relevant to "EMPLOYABILITY SKILLS": Energy Management in Smart Cities, ISO 50001 Energy Management System (EnMS) – Implementation for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Navneet Singh/ Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3042	Course Title: IoT in Construction Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Elements of Civil Engineering, Essentials of basic computing and networks					
Anti-requisites	NIL					
Course Description	This course deals with the fundamental concepts of Internet of Things (IoT) and its specific applications in the construction industry. The course discusses essential concepts of IoT as a tool, its hardware and software followed by its applications. Further, role of IoT in project planning, management of machinery and labour and its utility in development of smart cities is discussed. This interdisciplinary course aims at applying concepts of computer science engineering, electronics and communication engineering and electrical engineering in the field of construction industry through IoT.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of IoT in Construction and attain Employability Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Explain the concept of Internet of Things (IoT) and its applications 2] Discuss how IoT can help in site planning and project management 3] Discuss how IoT can help with machinery and construction 4] Explain the role IoT can play in constructing Smart Cities					
Course Content:						
Module 1	IoT Technology and Applications	Case study	Data Collection	6 Sessions		
Topics: Basic Concepts: Definition, Evolution, Scope; Technical challenges and Solution, Artificial Intelligence and Machine Learning, Hardware Architectures for IoT, Communication and Networking Technologies in IoT, Applications.						
Module 2	IoT in Site Planning and Project Management	Assignment	Simulation	8 Sessions		
Topics: Augmented Reality, Building Information Modeling (BIM), Digital Twins; Material and manpower tracking, Security and Privacy, Budget optimization and scheduling, Resource and Asset Management, Construction waste management, IoT based framework for situational awareness in Construction Industry						
Module 3	IoT in machinery and construction	Assignment	Arduino	8 Sessions		
Topics: Optimization of machinery performance, Predictive Maintenance, Autonomous machines, IoT in Equipment Handling, Fleet management- optimizing transit routes. Robot based construction, 3-D Printing technology, IoT in Concrete curing, Structural health monitoring Construction safety- Site and worker safety, wearable devices, activity tracking, Hazard management.						
Module 4	IoT in Smart Cities	Case Study	Data Collection	8 Sessions		
Topics: Efficient water supply, electricity supply, sanitation-solid waste management, urban mobility, digitalization, sustainable environment, Industrial IoT, AI empowered IoT for Smart security, health and education.						
Targeted Application & Tools that can be used Application areas: The course caters to employability of graduates in the niche field of IoT in various construction firms, consultancies and town planning organizations. With the growth of interdisciplinary research and applications, engineers from various domains can come together						

to build customized solutions to various problems. The course directly feeds the smart cities concept of the Government of India where engineers are required for developing smart systems. It also helps nurture skills of students to apply concepts learnt in regular courses with an advanced technological approach.
Professionally used software: Revit, Arduino

Text Books

T1. Timothy Chou, A. Vincent Vasquez "*Precision Construction: Principles, Practices and Solutions for the Internet of Things in Construction*, Precision Story, 2018.

References

R1. Simone Cirani, Gianluigi Ferrari, Marco Picone, and Luca Veltri, *"Internet of Things: Architectures, Protocols and Standards"*, Wiley, 2018.

R2. Kanan, R., Elhassan, O., & Bensalem, R. "*An IoT-based autonomous system for workers' safety in construction sites with real-time alarming, monitoring, and positioning strategies."* Automation in Construction, 88(December 2017), 73–86.

R3. Azhar, S. (2011). "*Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry*." Leadership and Management in Engineering, 2011, 11(3), 241– 252.

Web link: https://onlinecourses.nptel.ac.in/noc21_cs17/preview
PU e-Library Resources
1. https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=149962766&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=156087416&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Cyber physical systems, Artificial Intelligence and Machine Learning, Building Information Modeling (BIM), Budget optimization and scheduling, Optimization of machinery performance, Predictive Maintenance, IoT in Smart Cities for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Aayush Kumar/Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3043	Course Title: Construction Economics and Financing for Smart Cities Type of Course: Discipline Elective and Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to includes knowledge of Construction economics is a branch of general economics. It consists of the application of the techniques and expertise of economics to the study of the construction firm, the construction process and the construction industry. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics. The course develops the critical thinking for decision making and analytical skills to choose construction resources for the construction project. By participating in the course students will be able to understand the economics of construction projects, idea of decision making to make the project monitoring more efficient by understanding profit or loss.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Construction Economics and Financing for Smart Cities and attain Employability Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: **1)** Distinguish the different methods of comparison. **2)** Express the economy of equipment based on its life cycle cost. **3)** Propose plans for dispute resolution in construction contracts.					
Course Content:						
Module 1	Construction Economics	Assignment	Data Collection	15 Hours		
Topics: Engineering economics: Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future, Present payment compared to uniform series payments, Future payment compared to uniform series payments, Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return						
Module 2	Equipment economics	Case Study	Data Collection	12 Hours		
Topics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis. Depreciation, Inflation and Taxes. Benefit-cost analysis.						
Module 3	Estimate & Contract Changes	Case Study	Data Collection	8 Hours		
Topics: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, parametric estimate and Life cycle cost. Breach of the Contract, Contract Changes and Construction Contract Claims and Dispute Resolution.						
Text Books 1. Blank, L. T. and Tarquin,A. J.,"Engineering Economy", Fourth Edition, WCB/McGraw-Hill, 1998. 2. Collier, Kieth, "Managing Construction Contracts"						
References 1. K N Jha "Construction Project Management", Second edition, Pearson. 2. S. Ranaga Rao Contract Management and Dispute Resolutions Engineering staff College of India January 2008. Web-based Resources						

https://onlinecourses.nptel.ac.in/noc21_ce16/preview https://onlinecourses.nptel.ac.in/noc22_mg55/preview https://nptel.ac.in/courses/110/105/110105094/ https://web.p.ebscohost.com/ehost/detail/detail?vid=0&sid=b1038f60-a4c7-4e04-bc41-75d380a0bac8%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=146827218&db=iih https://web.p.ebscohost.com/ehost/detail/detail?vid=0&sid=045b272b-9efe-4bd0-a63e-5a89d9ed7bba%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=122412782&db=iih	
Topics relevant to "EMPLOYABILITY SKILLS": Quantifying alternatives for decision making, Cash flow diagrams and Equivalence- Single payment in the future, Present payment compared to uniform series payments, Future payment compared to uniform series payments for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mrs. Sowmyashree T
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3044	Course Title: E-Governance Type of Course: Discipline Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course familiarize the students with the concept of e-Governance or electronic Governance. This course provides a basic understanding of e-governance strategies, its architecture and the technologies behind their implementation. It deals with conceptualization of ideas and development of service delivery models for improving the quality of service to citizens. It teaches how an effective strategic plan can be developed for implementing the concept of Smart Cities of the Government of India. Global case studies of e-Governance initiatives along with e-Kranti or the National e-Governance Plan 2.0 under Digital India would be dealt with in detail. The students would also be encouraged to provide innovative solutions in order to improve performance of such schemes.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of E-Governance and attain Employability Skills through Participative Learning techniques					
Course Out comes	On successful completion of the course the students shall be able to: 1] Explain the concept of e-Governance and its utility 2] Explain the various e-Governance and e-Government models 3] Show how e-Governance is implemented 4] Discuss the implementation of e-Governance in India					
Course Content:						
Module 1	E-Governance: Concepts and Evolution	Case study	Data Collection	6 Sessions		
Topics: E-Government and need of e-governance, Challenges and Measures; Role of ICT in e-governance, Gov. 3.0, Basic Concepts - Evolution, Smart City governance, Emerging Trends.						
Module 2	E-Governance Models	Assignment	Data Collection	8 Sessions		
Topics: E-Government Model Types, Smart governance interactions - Government to Citizen (G2C), Government to Business (G2B), Government to Government (G2G), Government to Employee (G2E) – Initiatives of GoI, E-Governance Models, E-Governance Benefits, E-Government Maturity Model, Mobile government, M-Governance versus E-Governance.						
Module 3	Implementation of e-Governance	Assignment	Programming	10 Sessions		
Topics: Implementation Elements, Implementation Models, Implementation strategies, Service Prioritization, Service Delivery Centers, Web-portals, Mobile implementation, Social networks, Software and Hardware Requirements, Data warehousing, Data mining and Business Intelligence; Open source usage, E-Government Project Costing, E-Government Project Financing.						
Module 4	E-Governance in India	Assignment	Data Collection	8 Sessions		
Topics: National e-Governance Plan (NeGP), e-Kranti (NeGP 2.0), Policies for e-Gov, State Data Centers, State Wide Network, Common Service Centre, Mission Mode Projects, Integration in Smart Cities, Case Studies.						
Targeted Application & Tools that can be used Application areas: The course caters to employability of graduates in the field of policy making as e-Governance consultants and advisors to the service providers. With rising influx of internet-						

based technologies, graduates can integrate ICT and provide applied solutions for implementing the Smart Cities idea of the Government of India. The course also helps in skill development of the graduates as they can utilize their conceptual knowledge of engineering to refine existing models of e-Governance with the help of technology.
E-Governance projects are increasingly becoming the new normal. Graduates can also become entrepreneurs by developing original and better e-Governance models having greater outreach to the masses.
Professionally used software: Java

Text Books

4. Shirin Madon , *"E-governance for Development : A Focus on Rural India"*, Palgrave Macmillan,2009
5. Ashok Agarwal, *"E-governance : Case studies"*, University Press India,2007
6. Kamalesh N. Agarwala and Murli D. Tiwari *"IT-e-Governance in India"*, Macmillan,2002
7. Subhash C. Bhatnagar *"E-Government : from Vision To Implementation: A Practical Guide With Case Studies"*, SAGE , 2004
8. C.S.R. Prabhu ,*"E-Governance: Concepts And Case Studies"*, PHI ,2011

References

1. Yu-Che Chen and Pin-Yu Chu ,*"Electronic Governance and Cross-Boundary Collaboration: Innovations and Advancing Tools"* , Information Science Reference, 2011
2. G. David Garson, *"Public Information Technology and E-Governance: Managing the Virtual State"*, Jones & Bartlett Learning, 2006
3. ed. Toshio Obi, *"E-governance: A Global Perspective on a New Paradigm"*, IOS Press, 2007
4. ed. Viktor Mayer-Schönberger and David Lazer, *"Governance and Information Technology From Electronic Government to Information Government"*, Massachusetts Institute of Technology, 2007

Weblinks

1. https://nptel.ac.in/courses/124107007

PU e-Library Resources

1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=209242&site=ehost-live
2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1406224&site=ehost-live
3. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2646009&site=ehost-live

Topics relevant to "Employability Skills": Role of ICT in e-Governance, E-Government, Data mining and Business Intelligence, Integration of e-Governance in Smart Cities for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Mr. Aayush Kumar/Dr. Jagdish Godihal/Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3045	Course Title: Big Data Analytics for Civil Engineers Type of Course: Discipline Elective	L-T-P-C	1	0	4	3
Version No.	1.1					
Course Pre-requisites	1] Introduction to Object Oriented Programming 2] Programming using Python					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students of civil engineering to appreciate the growing importance of big data in their domain. They would develop the basic abilities of modelling and analyzing civil engineering related data using programming. The course is both conceptual and analytical in nature and needs fair knowledge of basic programming skills. The course also enhances the programming abilities through assignments. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize and even predict how civil engineering projects, structures, etc. would look like in real time.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics for Civil Engineers and attain Employability Skills through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Explain the concept of big data analytics with its applications 2] Demonstrate the use of big data analytics in Geotechnical, Structural Engineering and Transportation Engineering 3] Demonstrate the use of big data analytics in Water Resources and Environmental Engineering 4] Demonstrate the use of big data analytics in the management of Smart Cities					
Course Content:						
Module 1	Basics of Big Data Analytics	Assignment	Data Collection	6 Sessions		
Topics: History and Evolution of Big Data, Characteristics of Big Data, Acquiring, Exploring, Pre-processing, analyzing data, communicating results and implementation; Programming models; Machine Learning and Artificial Intelligence, Neural networks, Real-world application examples						
Module 2	Applications in Geotechnical Structural Engineering and Transportation Engineering	Assignment	Simulation, Programming	10 Sessions		
Topics: Predictive Modeling of subsurface construction operations; Optimizations in design, Deterioration prediction and maintenance models; Optimal bridge inspection procedure, Augmented Reality, BIM, Automation in construction, Quality management, Risk control; Real time Analytics of traffic accidents, traffic volume data, connected and autonomous vehicles, speed tracking, Travel demand forecasting using Artificial Neural Networks, Urban link travel time predictions, Pavement Management Systems, Distress prediction models						
Module 3	Applications in Smart Cities	Assignment	Simulation, Programming	8 Sessions		
Topics: Statistical models to identify aging sewer pipes impacted by groundwater flooding, Movement of pollutants and chemicals inside soil, predicting storm surge events. Environmental Impact Assessment models, pollutant level monitoring and prediction Geographic Information Systems and resource mapping						
Module 4	Applications in Smart Cities	Term Paper	Simulation, Programming	6 Sessions		

Smart city Services analytics, Asset and Maintenance management, Connected vehicle, Connected Involved citizen, Smart Land use, Urban analytics, Strategic business models and partnering, Analytical performance management of smart cities.

List of Laboratory Tasks:

Task 01: Predictive Modeling using Python/MATLAB
Level No. 01: Try to code few predictive models using some input parameters.
Level No. 02: Design a predictive model for future energy consumption in the University with new student intake numbers/pavement distress prediction model.

Task 02: Simulation
Level No. 01: Simulate functioning of a rotary intersection in VISSIM.
Level No. 02: Predict functioning of a rotary with future traffic volumes

Task 03: GIS
Level No. 01: Prepare contour map of a particular area.
Level No. 02: Analyze the local area for suitability of construction using GIS.

Targeted Application & Tools that can be used:

Application Areas include positions of data scientists in construction companies, quality control and risk managers who can predict future project risks.
Professionally Used Software: Python/MATLAB/VISSIM/REVIT/Plaxis/ArcGIS

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *"The Elements of Statistical Learning: Data Mining, Inference and Prediction"*, Springer, 2001.
2. Christopher M. Bishop, *"Pattern Recognition and Machine Learning"*, Springer, 2006.

References

1. Alavi A.H. and Gandomi A.H. (2016), "Big data in civil engineering", *Automation in Construction*.

PU e-Library Resources

1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=139229469&site=ehost-live
2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=117497424&site=ehost-live
3. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1825911&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILLS": Machine Learning and Artificial Intelligence, BIM, Automation in construction, Quality management, Real time Analytics of traffic accidents, Travel demand forecasting using Artificial Neural Networks, Geographic Information Systems and resource mapping for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Aayush Kumar/Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3100	Course Title: Disaster Management and Mitigation Type of Course: Open Elective/ Theory only course		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	-					
Anti-requisites	NIL					
Course Description	The course introduces Disaster Management, focusing on natural disasters. The problem will be addressed in a holistic cross-sectorial and cross-disciplinary manner, including all stages of disaster management cycle: mitigation, preparation, response and recovery. This theory-based course also reveals participation by voluntary Agencies and Community at various stages of disaster management and disaster related infrastructure development.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Disaster Management and Mitigation and attain Skill Development through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Explain the basic concepts of disasters. 2) Discuss the technological systems for disaster minimization. 3) Infer the management practices to mitigate the disaster.					
Course Content:						
Module 1	Concepts of disaster	Assignment	Case studies	10 Sessions		
Topics: Occurrence, Cause and Impacts of natural and manmade disasters: Cyclone, flood, land slide, land subsidence, forest fire and earthquake, tsunami, river erosion, chemical spills, nuclear disasters, mine disasters.						
Module 2	Disaster Monitoring	Assignment	Case studies	12 Sessions		
Techniques of monitoring; forecasting and early warning; communications & ICT Tools; disaster risk reduction through prevention, preparedness, response, recovery, rehabilitation and reconstruction –Case study.						
Module 3	Management and Mitigation	Mini project	Comparison of management practices for disasters	14 Sessions		
Topics: management issues related to disaster, mitigation through capacity building, disaster mapping, assessment, pre-disaster risk & vulnerability reduction, post disaster recovery & rehabilitation; Participation by voluntary Agencies & Community in disaster management; Critical infrastructure in disaster management: Communications systems and networks, health facilities, emergency evacuation shelters, elements of transportation systems, waste disposal, water supplies. Methods for Disaster mitigation Case studies: Bhopal Gas disaster, Gujarat earthquake, Hiroshima and Nagasaki nuclear disaster, Tsunami disaster in Indonesia and Major floods in India.						
Targeted Application & Tools that can be used: Professionally Used Software: MS office, QGIS and GRASS						
Text Books: T1. Disaster Management and Mitigation, Spectrum Publication. Dr. U. Sai Jyoti., 2018. T2. Disaster Management and Mitigation Measures, Techknowledge Publication. Dr. Ravikant Pagnis, 2016						
References: R1. Disaster Management- Engineering and Environmental Aspects, Asiatech publishers, H Sarvothaman and K. J. Anandha Kumar, 2015.						

R2. Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme. (2009-2012).
R3. Disaster Risk Reduction in South Asia, Prentice Hall. Singh B.K., 2008,
R4. Handbook of Disaster Management: techniques & Guidelines, Rajat Publication. Ghosh G.K., 2006,
Web Source:
https://web.p.ebscohost.com/ehost/detail/detail?vid=6&sid=b4ee81da-8105-4ec1-9f5c-46d35545a001%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

Topics relevant to "SKILL DEVELOPMENT": Techniques of monitoring and design against disasters and forecasting, disaster recovery & rehabilitation and disaster rescue operations for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Venkatesha Raju K., Dr. Chandankeri G.G. and Dr. Jagdish Godihal
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3101	Course Title: Sustainability Concepts in Engineering Type of Course: Open Elective & Theory Only Course	L-T-P- C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course covers the fundamentals of sustainability as well as various perspectives on sustainable development and appropriate technologies for sustainable development. This course is important for all engineering discipline to derive significant benefits in the field of sustainability. The course also investigates aspects of improvements in health, and safety while using as few natural resources as possible and paying attention to the environment and resource sustainability. This is a theory-based course which will give an idea of different sustainable tools and Appropriate technologies for sustainable development.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Sustainability Concepts in Engineering and attain Skill Development through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **1]** Describe the sustainability concepts in engineering related to social-environmental and economic concepts. **2]** Summarize the various sustainability tools for sustainable development. **3]** Apply appropriate technologies for sustainable development.					
Course Content:						
Module 1	Introduction to Sustainability	Assignment	Data Collection/ Interpretation			15 Sessions
Topics: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Introduction to Ecological footprint, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act. Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs						
Module 2	Sustainable development tools	Case studies	Case studies			15 Sessions
Topics: Resource/Environmental degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print, Carbon sequestration – Carbon capture and storage (CCS). Life Cycle Analysis (LCA), Environmental management standards-ISO 14000 series, - Scope and Goal, Bio-mimicking.						
Module 3	Appropriate technologies for sustainable development	Quiz	Quiz			15 Sessions
Topics: Energy sources: Basic Concepts-Conventional and non-conventional, solar energy -Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans, Geothermal energy. Climate Change, Energy and Sustainable Development- Climate Change: A Threat to Sustainable Development, Adaptation to Current and Future Climate Regimes, The cause: The greenhouse effect, The consequences: crop failure. Solutions technology and lifestyle changes, Mitigating Climate Change Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis, Ways the oil and gas industry is becoming more sustainable, Domain related case studies.						

Targeted Application & Tools that can be used:
This course helps the students to understand the sustainable concepts and clean energy. Professionally Used Software: NAVEX ESG. 4.0. Environmental, Social and Governance (ESG) Insights, Environmental Management Software. (0), Metrio. 4.0, and MS office

Text Book

T1 Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies, Pearson*. 2011.

T2 Bradley. A.S; Adebayo, A.O., Maria, P., *Engineering applications in sustainable design and development, CL Engineering*. 2015.

References

R1 Jorge A. Vanegas, *Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers.* 2004.

R2 Twidell, J. W. and Weir, A. D., R*enewable Energy Resources, English Language Book Society (ELBS).* 1986

R3 Bureau of Energy Efficiency, *New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System.* ECBC Code 2007.

Case study link:
https://www.researchgate.net/publication/307567464_Sustainable_Development_in_Practice_Case_Studies_for_Engineers_and_Scientists_Second_Edition

E book link R1: https://web.s.ebscohost.com/ehost/detail/detail?vid=8&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

E book link R2: https://web.s.ebscohost.com/ehost/detail/detail?vid=9&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

Web resources:
https://nptel.ac.in/courses/105105157- IIT Kharagpur, Prof. Brajesh Kumar Dubey
https://nptel.ac.in/courses/112104225 - IIT Kanpur Dr. Deepu Philip, Dr. Amandeep Singh

Topics relevant to "SKILL DEVELOPMENT": Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Clean Development Mechanism (CDM) and Environmental legislations in India for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Ms. Shwetha A / Dr. Venkatesh Raju
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3102	Course Title: Occupational Health and Safety Type of Course: Open Elective/ Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the student to the study of workplace occupational health and safety. Occupational Safety and Health Act (OSHA) sets safety and health standards for many work environments, and ensures that employers comply with those standards. The major objective of this course is to help the students develop a solid understanding of the Occupational Health and Safety legislation, processes, procedures, and techniques involved in workplace hazard identification, assessment, and control.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Occupational Health and Safety and attain Entrepreneurial Skills through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: **1]** Explain the fundamentals of occupational safety, accident prevention, Health problems and solutions **2]** Discuss the impact of OSHA regulations on employee health, including risk management and safety issues. **3]** Infer the types of personal protective equipment (PPE), and the requirements for use in OSHA standards					
Course Content:						
Module 1	Occupational Hazard and Control Principles	Assignment	Data Collection/ Interpretation	12 Sessions		
Topics: Definition, Occupational Hazards and Risks. Key principles in occupational health and safety. National Safety Policy. Occupational Safety and Health Act (OSHA), Occupational Health and Safety Administration-Laws governing OSHA. Accident Prevention and Workers Compensation Scheme, investigation plan, Methods of acquiring accident facts, Importance of supervision in accident investigation, Indoor Pollution.						
Module 2	Ergonomics and safety at work place	Assignment	Case studies / Case let	12 Sessions		
Topics: Benefits, Task analysis, Work space envelops, Environmental conditions, standards, and ergonomic programs. Engineering controls and ergonomics application in industries. Hazard cognition and analysis-Human error analysis and fault tree analysis. Fire safety, Fire resistant construction electrical safety and product safety.						
Module 3	PPE and Occupational Health and Safety considerations	Assignment	Data Collection/ Interpretation	12 Sessions		
Topics: Occupational disease types and Health emergency. Personal Protective Equipment (PPE)-types and advantages. Effects and treatment for engineering industries and municipal solid waste. Environment management plans (EMP) for safety and sustainability. Handling of chemical and safety measures in water and wastewater treatment plants and construction sites						
Targeted Application & Tools that can be used: This course helps the students to understand occupational health and safety standards and identify hazards in work place/ industries. Professionally Used Software: MS Office						
Text Books: T1. "Occupational safety and Health for Technologists, Engineers and Managers" Goetsch D.L,						

Prentice Hall publishing. T2. "Essentials of safety management" Kaila and Singh, Himalaya publishing house. T3. "Fire safety in Buildings". V.K Jain, New-Age Publishers.
References: R1. "Industrial Safety and Pollution Control Handbook," National safety council and associate publishers Pvt Ltd. GOI Publication. R2. "Industrial Accident prevention." Heinrich H.W. McGraw hill publication R3. "Industrial Safety Management and Technology", Colling D.A. Prentice Hall Web source: https://web.p.ebscohost.com/ehost/detail/detail?vid=12&sid=b4ee81da-8105-4ec1-9f5c-46d35545a001%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
Topics relevant to "ENTREPRENEURIAL SKILLS": Accident and Incident investigations, Fire safety and Ergonomics at workplace for developing Entrepreneurial Skills through Participative Learning techniques This is attained through the Presentation as mentioned in the assessment component.

Catalogue prepared by	Dr. Venkatesha Raju/ Dr. Shwetha A
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3103	Course Title: Sustainable Materials and Green Buildings Type of Course: Open Elective/ Theory based Course	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	The purpose of the Course is providing an overview of emerging delivery systems for high performance green buildings and the basis on which their sustainability can be evaluated. There are various benefits and advantages of sustainable construction, deals with Cost Reduction, Increased productivity, Improved health, Waste minimization, better use of materials, Environmental protection, Lesser noise pollution, Higher quality of life Emerging market, and Room for experimentation. This is a theory-based course which will give an idea of what is sustainable construction and its advantages etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Sustainable Materials and Green Buildings and attain Skill Development through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Recognize the importance of sustainability and prepare Life Cycle Analysis. 2) Select the Green building materials for construction. 3) Explain the performance rating of green building, the harmful impact of Indoor air pollution and the Life cycle energy use.					
Course Content:						
Module 1	Introduction to sustainability and life cycle analysis	Assignment	Data Collection/ Data Analysis	10 Sessions		
Topics: Sustainability - Concept and Terms, Challenges and Opportunities, Embodied Energy – Concept, Components and Calculations for Building materials, Introduction to Ecological footprint. Life Cycle Analysis - Scope, Purpose, Stages; Environmental Management standards, ISO 14000 Series; Carbon Footprint, Carbon-dioxide Contribution from Construction materials.						
Module 2	Green Building construction and materials	Case study	Data Interpretation/ Analysis	18 Sessions		
Topics: Introduction to Green Buildings, Energy sources: Basic concepts-Conventional and Non-Conventional Energy, Solar, Wind, Bio-fuel Energy; Green building techniques Sustainable Materials: Supplementary Cementitious Materials (No/Low Cement Concrete), Recycled and Manufactured Aggregates, GGBS Concrete, High performance concrete, High volume Fly ash Concrete, Geopolymer Concrete, Green Concrete, Ferro-cement, etc., Case Studies.						
Module 3	Performance Rating of Green Buildings and Indoor Air Quality	Quiz	Interpretation	15 Sessions		
Topics: Introduction, Role of Quality Control and durability in Green Buildings, Green Building Certifications, LEED (Leadership in Energy and Environmental Design) ,GRIHA and IGBC certifications; Zero Energy Building –Introduction, design and construction, Case Studies.						

Indoor Air Quality, Indoor Air pollution – Causes, Sources, Consequences and Health Hazards, List of pollutants and their limits, Ventilation –Types; Control of Energy use in Buildings-Role of insulation, thermal properties of construction materials. Influence of moisture content and modelling.
Targeted Application & Tools that can be used: Professionally Used Software: MS office, Autodesk Insight 360, Autodesk Revit, and Autodesk FormIt 360.
Text Book T1 Charles J. Kibert, *Sustainable Construction: Green Building Design and Delivery*", Wiley Publication. 2016. T2 K. S. Jagadeesh, B. V. Venkatarama Reddy & K. S. Nanjunda Rao, *Alternative building material and technology,* New Age International Publishers. 2017.
References R1 Traci Rose Rider, "Understanding Green Building Guidelines: For Students and Young Professionals", W.W Norton and Company. 2010. R2 D S Chauhan, S K Sreevastava, "Non-conventional Energy resources", New age international publishers. 2017. Web Resources: https://nptel.ac.in/courses/105/102/105102195/ Web Resources: https://onlinecourses.nptel.ac.in/noc19_ce40/preview E book link R1: https://web.s.ebscohost.com/ehost/detail/detail?vid=3&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d# E book link R1: https://web.s.ebscohost.com/ehost/detail/detail?vid=4&sid=cbc51846-7bf7-482b-8aac-fbd99ab97ee4%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
Topics relevant to "SKILL DEVELOPMENT": Green Building Certifications, LEED (Leadership in Energy and Environmental Design), GRIHA and IGBC certifications; Zero Energy Building – Introduction, design and construction for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms. Shwetha A / Dr. Venkatesh Raju
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

Course Code: CIV3104	Course Title: Integrated Project Management Type of Course: Open Elective & Theory only		L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Understanding of Process of execution in projects of relevant engineering discipline.					
Anti-requisites	NIL					
Course Description	This course provides insights into the fundamentals of project management useful in any engineering discipline. It also covers planning and scheduling, as well as quality and safety standards for any project. The course is both conceptual and analytical in nature and needs fair knowledge of Mathematics and skills of logical reasoning. The course provides hands-on experience on leading project management software to build PERT, CPM, and other planning techniques. The course also covers concepts of safety, quality, and contract management projects.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Integrated Project Management and attain Entrepreneurial Skills through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1) Explain the basic concepts of project Management. 2) Prepare project plan, network and schedule for various projects. 3) Prepare resource management plan and quality management plans.					
Course Content:						
Module 1	Basics of Project Management	Assignment	Data collection	08 classes		
Topics: Introduction to Project, Phases of a Project, Activities involved in a project, Stake holders of a Project, Structure of a project Organization, Traits of a Project Manager, Competencies of a project manager, Cost estimates and budget: Client's and contractors perspective, contracts						
Module 2	Project Planning and Scheduling	Case study	Simulation and data analysis task	14 classes		
Topics: Concepts of Work breakdown structure, planning terminologies, Bar Charts, Network diagram and logic, Duration estimation of an activity, Network analysis, Float of an activity and its types, Planning technique - Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Introduction to Graphical evaluation and review technique (GERT).						
Module 3	Resource & Quality Management	Assignment	Data Collection and Analysis	08 classes		
Topics: Resource allocation, resource leveling and smoothening, Time-cost trade-off, Project control: S-curve, earn value analysis. Quality - Definition of Quality, Elements of quality, Quality control, Quality Assurance, Cost of Quality, Total quality management (TQM), ISO standards.						
Targeted Application & Tools that can be used: Application Area is Management of projects in terms of time, cost, quality and safety in any engineering discipline or any organization in general. Professionally Used Software: MS Project, Oracle Primavera.						
Textbooks: 1. K Nagarajan, "Project Management" seventh edition, New age International publishers 2. Dr. Sanjiv Marwah, "Project management" Dreamtech press.						

References: 1. "Project management body of knowledge" by Project management institute. Website: 1. Scheduling techniques in Projects: https://swayam.gov.in/nd1_noc19_ce24/preview 2. Project Planning and Control: https://swayam.gov.in/nd1_noc19_ce30/preview 3. Project Management: https://swayam.gov.in/nd1_noc19_mg30/preview https://web.p.ebscohost.com/ehost/detail/detail?vid=3&sid=aa3f4cfb-5a2a-4e2e-9223-85dc6aaca2d6%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=158304555&db=iih https://web.p.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=1&sid=4ff0644e-0280-4927-948b-ec59c13adab9%40rediscurve	
Topics relevant to development of "Entrepreneurship": Project life cycle, risk management, project planning for developing Entrepreneurial Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Mr. Ahamed Sharif/ Ms. Sowmyashree T
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

<table>
<tr><td>Course Code:
CIV3105</td><td colspan="3">Course Title: Environmental Impact Assessment
Type of Course: Open Elective/ Theory Only Course</td><td>L- T -P- C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">-</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">Nil</td></tr>
<tr><td>Course Description</td><td colspan="8">The main objective of this Course to assess the impact of any engineering projects on the environment. This Course introduces the methodology of environmental impact assessment (EIA) as a vital tool for sound environmental management and decision-making. The Course provides an overview of the concepts, methods, issues and various forms and stages of the EIA process. It examines the development of EIA overseas and in India. Different levels and systems of EIA are examined to highlight the diversity of approach and impact of the EIA process.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Environmental Impact Assessment and attain Entrepreneurial Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:

1] Explain the EIA notification and Environmental clearance process in India
2] Describe the different steps within environmental impact assessment
3] Describe the implications of current jurisdictional and institutional arrangements in relation to environmental impact assessment</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">EIA Scope and process in India</td><td>Assignment</td><td>Case study</td><td colspan="4">10 classes</td></tr>
<tr><td colspan="9">Topics:
Introduction, Purpose and scope of EIA, EIA- Guiding principles, REIA , CEIA, Relationship between EIA, EIS and FONSI, Benefits of EIA , Categorization of projects, Stages in Prior Environmental Clearance Process, Validity of EC</td></tr>
<tr><td>Module 2</td><td colspan="2">Prediction and Assessment of Impacts on the Environment</td><td>Case Study</td><td>Data Collection and Analysis</td><td colspan="4">12 classes</td></tr>
<tr><td colspan="9">Topics:
Prediction and Assessment of Impacts on the Environment: Air, Water and noise environment. Identification and analysis of impacts. Mitigation and Compensation: Objectives and Principles of mitigation, Compensation for impacts, Identification of Analysis of Potential Environmental impacts.</td></tr>
</table>

Module 3	Public participation and EIA for various projects	Assignment	Data Collection and Analysis	14 classes
Topics: Introduction, Participation in the EIA process, objectives of public participation, Techniques of public participation, Approaches to public participation. EIA for water resource development projects, Highway projects, nuclear power plant projects, Mining project (Coal, iron ore), Thermal power plants and Infrastructure constructional activities. Case studies in EIA.				
Targeted Application & Tools that can be used: This Course helps student to assess impact of engineering projects on environment and to prepare EIA report on any projects. GIS software for analysis of impact on lake and ground water quality				
Text Books: T1. Larry W Canter, "Environment impact Assessment", McGraw Hill Publication				
References: R1. Jain R.K –Van, "Environment impact Analysis", Nostrand Reinhold Co. **Web source:** https://presiuniv.knimbus.com/user#/searchresult?searchId=environmental%20impact%20assessment&_t=1740738006199				
Topics relevant to "ENTREPRENEURIAL SKILLS": EIA report for Construction projects for developing **Entrepreneurial Skills** through **Participative Learning techniques. This is attained through assessment component mentioned in course handout.**				
Catalogue prepared by	Dr. Venkatesha Raju K and Mr. Santhosh M B			
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021			
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021			

Course Code: CIV3106	Course Title: Infrastructure Systems for Smart Cities Type of Course: Open Elective and Theory only	L-T-P-C	3	0	0	3
Version No.	1.2					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course helps the students learn to identify urban problems, effective and feasible ways to coordinate urban technologies, various types of models and methods for effective implementation of smart cities concepts with new technologies for urban utilities, communication and dissemination. New forms of Urban Governance and Organization.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Infrastructure Systems for Smart Cities and attain Entrepreneurial Skills through Participative Learning techniques					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Identify the latest technology enabled systems for the management of cities. 2. Interpret the dynamic behavior of the urban system in context to physical appearance and by focusing on representations, properties and impact factors. 3. Demonstrate the urban infrastructure systems to benefit the citizens, based on smart cities concept as responsive cities.					
Course Content:						
Module 1	Urban Infrastructure	Assignment	Data Collection/ Programming	14 Sessions		
Topics: Components of Urban Infrastructure, Smart City: Concepts, Benefits and Challenges, Evolution of smart city; Dimensions of smart city development; Smart City Taxonomy; Smart city documentation of GOI; Smart Cities: Mission Statement and Guidelines; Disruptive technologies for smart city; Case Study - Smart Cities Lighthouse projects.						
Module 2	Planning interventions of Urban Infrastructure	Case Study	Programming	14 Sessions		
Topics: Urban Planning; Understanding Inclusive Planning: components; process of urban consultations; urban strategic planning for smart, sustainable, biophillic and resilient cities; Smart governance; Traffic dashboards; Data cycle for dashboards; Capability Framework and Maturity Model for Smart Cities.						
Module 3	Smart Urban Infrastructure	Minor projects	Presentation on Smart solutions	12 Sessions		
Topics: Innovative Approaches for Smart Cities; Perspectives: Technical infrastructure, Application domain, System integration, Data processing. Advanced Decision Support for Smart Governance; Smart mobility; Smart Living, Water supply, Sanitation, Environment and Safety, Energy, Urban disaster management.						
Targeted Application & Tools that can be used: Application areas: Decision Support for Smart Governance; city transport for all; water supply, sanitation, environment and safety, energy, urban disaster management. Professionally used software/Platform: MATLAB/GIS/Python/IoT						

Text Books

1. Joseph N. Pelton; Indu B. Singh (2018), "Smart Cities of Today and Tomorrow: Better Technology, Infrastructure and Security" publication: Copernicus; 1st ed. 2019 edition.
2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for Municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4).
3. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler- Milanovic; Evert Meijers (2007),"Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science.

References

1. "Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development (http://indiansmartcities.in/downloads/CONCEPT_NOTE-12.2014__REVISED_AND_LATEST_.pdf)
2. Kent E. Calder (2016),"Singapore Smart City, Smart State" Brookings Institution Press publication.

PU e-Library Resource

1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1586504&site=ehost-live

Topics relevant to "ENTREPRENEURIAL SKILLS": Smart city documentation of GOI, Traffic dashboards, System integration, Data processing, Advanced Decision Support for Energy, water, waste, and disaster management for developing Entrepreneurial Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Dr. Jagdish H Godihal/Mr. Ajay H A
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3107	Course Title: Geospatial applications for Engineers Type of Course: Theory &Lab integrated catalogue		L-T-P-C	2	0	2	3
Version No.	1.1						
Course Pre-requisites	No prior knowledge required to know the course and it provides basic awareness of Geospatial techniques to be applied by engineers.						
Anti-requisites	Nil						
Course Description	The primary purpose of this course is to introduce the basic concept of geospatial technologies like remote sensing, GIS and GPS to students. Mainly the course focuses on topics such as Introduction, historical developments, present and future trends in Remote Sensing techniques, Geographic Information System & Global Positioning System and their role in engineering applications. After completing this course, students shall be able to do the operational processes of spatial data acquisition, editing and quality assessment metadata development, geo-database design, spatial query and display and spatial analysis. Students will also be exposed to Google Earth and common open-source GIS tools. The related laboratory offers an opportunity to validate the concepts taught and enhances the ability to visualize the realistic circumstances.						
Course objectives	The objective of the course is to familiarize the learners with the concepts of Geospatial applications for Engineers and attain Entrepreneurial Skills through Experiential Learning techniques.						
Course Out Comes	On successful completion of the course the students shall be able to: 1] Discuss the basic concepts of geospatial technologies. 2] Interpret the operational process of spatial and non-spatial data collection and analysis. 3] Apply the knowledge of geospatial technologies to find the solutions of various engineering and other problems.						
Course Content:							
Module 1	Introduction	Case Study and Assignment	Data Collection, interpretation and analysis.	08 Classes			
Topics: Introduction to Geospatial basics – General description of geospatial, & its components and descriptions of remote sensing, GPS, GIS and Google earth.							
Module 2	Computations of geospatial data	Assignment	Data analysis Spatial quarry using GIS	12 classes			
Topics: Introduction to spatial and non-spatial data. Software and hardware requirement. Map projections. Installation of GIS softwares, General tools used, Primary & Secondary data collection, analysis and spatial query process to produce desired outputs. Digital map preparation.							
Module 3	Drone techniques in Geospatial technologies	Assignment	Data compilation, analysis and case study presentations.	10 classes			
Topics: Drone: Basics, types, data collection, analysis and applications of GIS related to Civil engineering, agriculture domain, petroleum and other general use.							
List of Laboratory Tasks: (06 session required) Experiment No 1:Determination of locations of objects using GPS.							

Level 1:Finding of locations of various objects.
Level 2:Interpretation of location data of different objects in a particular area.

Experiment No. 2:Landuse / land cover change detection study
Level 1: Landuse / land cover pattern of past two decades to find landuse changes using Remote sensing images and GIS.
Level 2: Statistical data analysis using the level 1 data output.

Experiment No. 3: Spatial query and creating map outputs using GIS and Remote Sensing
Level 1: Spatial query using spatial and non-spatial data
Level 2: Making of map outputs using the level 1 data.

Experiment No. 4: Geo-tagging for Efficient, Cost-Effective Project Management
Level 1: Demonstration of Geo-tagging using Google map
Level 2: Collection of location data and geo-tagging of the same.

Targeted Application & Tools that can be used:
The main application area includes infrastructure projects - data collection, analysis and presentation. The information can be used by Government, private companies and other engineers to communicate and work effectively in multidisciplinary Projects.
Professionally used software like GIS (QGIS / ARCINFO) and Image processing softwares (GRASS / ERDAS.) The customized based programs would also be incorporated wherever necessary.

Text Book
T1.V Emayavaramban, K Kannadasan and S Vinothkanna, "Geospatial Technology: Fundamentals & Applications: Fundamentals & Applications, New India Publishing agency, New Delhi, March 2017.

References
R1. Bradley Shellito, "Introduction to Geospatial technologies", WH Freeman, 4th edition, March 2018.
R2. Pavan Kumar, Meenu Rani, Prem Chandra Pandey, HaroonSajjid and Bhagwan Singh Chaudry, "*Applications and Challenges of Geospatial Technology – Potential and future Trends"*, Springerinternational publishing, 1st Edition, 2018 (Ebook).
R3. Lo, C.P. and Yeung, A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice-Hall, Inc., NJ, 2002.

Web links: https://www.omnisci.com/learn/geospatial
https://earth.google.com/web/
https://unctad.org/system/files/official-document/dtlstict2012d3_en.pdf

E-resources:
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=548255&site=ehost-live
https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1947198&site=ehost-live

Topics related to development of "EMPLOYABILITY": Course introduces the basic technologies like remote sensing, GIS and GPS to students. Mainly the course focuses on topics such as preamble, historical developments, present and future trends in Geographic Information System & Global Positioning System and their role in engineering applications for developing Entrepreneurial Skills through Experiential Learning techniques. This is attained through the Lab Experiments as mentioned in the assessment component.

Catalogue prepared by	Dr. Chandankeri G G
Recommended by the Board of Studies on	BoS No. 14 held on 30 July 2022

Date of Approval by the Academic Council	Academic Council Meeting No. 18 held on 03 August 2022

Course Code: CIV3108	Course Title: Environmental Meteorology Type of Course: Open Elective Theory Only Course	L-T-P-C	3	0	0	3
Version No. 1.0						
Course Pre-requisites	Students should aware of surrounding environmental components and current climatic variations in their local environment.					
Anti-requisites	-Nil-					
Course Description	This course introduces the fundamental physical processes in the atmosphere–heat and energy, temperature, pressure, wind, clouds, precipitation, and stability. These concepts provide the basis for understanding weather systems, such as thunderstorms, tornadoes, and hurricanes. These processes are also applied to climatic patterns and the impacts of human activity on weather and climate, such as air pollution and climate change.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Environmental Meteorology and attain Skill Development through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Discuss various elements and controls of weather and climate on earth system. 2] Explain classes and measurement of weather and climatic parameters. 3] Infer meteorological principles of pollutant dispersion and transport in ambient air. 4] Discuss concept of monsoon and seasons and climate change scenario in India.					
Course Content:						
Module 1	Fundamentals of Meteorology	Assignment	Case Study	10 Sessions		
Topics: Motions of the earth and seasons. Earth-Sun relationship. Insolation and its latitudinal and seasonal variation. Difference between weather and climate. Elements of weather and climate, climatic controls, energy balance in atmospheric; elementary ideas about weather systems, climatic classifications; climates in India; monsoons of India.						
Module 2	Weather parameters and measurement	Assignment	Data collection and analysis	10 Sessions		
Topics: Air temperature- warming and cooling of air near ground, measurement of temperature; Humidity- expressions of humidity, measurement of humidity; clouds classification and types; Precipitation- process, types of precipitation, measurement of precipitation-recording, non-recording, radar, satellite. Estimation of precipitation, averaging techniques- thiessen polygon and isohyets. Wind - forces affecting wind, types of wind and measurement of wind.						
Module 3	Pollution meteorology	Assignment	Data collection and analysis	12 Sessions		
Topics: Application of meteorological principles to transport and diffusion of pollutants; Diffusion and turbulence, mixing height; Effect of meteorological factors on air pollution, size and structure of plume, dispersion of air pollutants – Gaussian model, reaction of pollutants in air forming smog, PAN, Acid rain.						
Module 4	Pollution Climatology	Case Study	Data collection and analysis	12 Sessions		
Topics: Preliminary concepts of climate change; seasons in India; Monsoons; El nino and ENSO; Drivers of climate change- greenhouse gases, aerosols – reflective and black carbon, land use changes. Energy balance, feed-back						

processes in climate system, concepts of global warming potential (GWP), radiative forcing. Climate change scenarios of India: impact of climate change on agriculture, forest, water resources, monsoon system of India.	
Targeted Application & Tools that can be used: This Course helps student to assess effects of anthropogenic activities on environmental components and learn to combat environmental issues through apposite measures and management strategies.	
Text Book T1. Arya, S.P. 1999. Air Pollution Meteorology and Dispersion, Oxford University Press, London. T2. Ranganathan, ""Meteorology and Weather", Suhas Printers, Bangalore.	
References R1. Barry, R.G. and R.J. Shorty. Atmosphere, Weather and Climate. R2. K. Siddhartha, 2018, "Climatology", Kitab Mahal. R3. Kelkar RR, 2010, "Climate Change – A holistic view" BS publications, Hyderabad. Web Sources https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=507299&site=ehost-live	
Topics relevant to "SKILL DEVELOPMENT": Types of wind and measurement of wind, Effect of meteorological factors on air pollution, Climate change scenarios of India for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout	
Catalogue prepared by	Dr. Venkatesha Raju K.
Recommended by the Board of Studies on	BOS NO: 12th BOS, held on 7/8/2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16th , Dated 23/10/2021

Course Code: CIV3109	Course Title: Projects/Problem Based Learning (PPBL) Type of Course: Open Elective and Theory only		L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course provides the approach to apply the domain learning in solving real life problems. Project/Problem Based Learning (PPBL) engages students in learning deep and long-lasting, and inspires them for experiential, collaborative, technology enabled learning. It has the potential to promote a greater depth of understanding of concepts, broader knowledge base, improved communication and interpersonal/social skills, enhanced leadership skills, increased creativity, and improved writing skills. PPBL provides the improved design linkages between our natural and engineered systems in optimum use of sustainable material resources, water, energy, infrastructure, and to manufacture products through innovative approach, and outreach.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Projects/Problem Based Learning and attain Entrepreneurial Skills through Problem Solving methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply the knowledge of domain learning to enable solutions to identified challenges at the Local, Regional, National and Global. 2. Analyse the dynamic behavior of the natural systems to employ the BMPs in context to societal needs. 3. Develop the methodology/execute to solve the identified problems.					
Course Content:						
Module 1	Introduction to PPBL	Assignment	Literature Review/ Data Collection	10 Sessions		
Topics: Introduction to PPBL, Characteristics, Principles of PPBL, Identifying the problems, UN 17SDGs, Principles of Sustainable development.						
Module 2	PPBL Salient aspects	Case Study	Mind mapping/ Programming/	12 Sessions		
Topics: PPBL key features, PMLC phases, Project Tools and Techniques, Analysis of case studies						
Module 3	PPBL Execution	Minor projects	Data Collection / Analysis/ Practical solutions	18 Sessions		
Topics: Live Project works based on Socio-Economic, Techno-Economic, Environmental Economics, Sustainable and Technology enabled						
Targeted Application & Tools that can be used: Application areas: Decision Support for Smart Governance to achieve the three dimensions of sustainability, urban/rural disaster management, 17SDGs Professionally used software/Platform: MATLAB/GIS/Python/IoT / Any related software /field work						

Text Books 1.Management of Change Implementation of Problem-Based and Project-Based Learning in Engineering Edited by Erik de Graaff Delft University of Technology, The Netherlands and Anette Kolmos, Aalborg University, Denmark , Published by: Sense Publishers, P.O. Box 21858, 3001 AW Rotterdam, The Netherlands http://www.sensepublishers.com. 2. An Overview of Project-Based Learning Practices Within the Context of 21st Century Skills Cennet Göloğlu Demir, IGI Globle publishers of Timely Knowledge, 2020.	
References Barrett, Terry (2017) A New Model of Problem-based learning: Inspiring Concepts, Practice Strategies and Case Studies from Higher Education. Maynooth: AISHE	
Topics relevant to "ENTREPRENEURIAL SKILLS": Live Project works based on Socio-Economic, Techno-Economic, Environmental Economics, Sustainable and Technology enabled for developing Entrepreneurial Skills through Problem Solving methodologies. This is attained through the Assignment as mentioned in the assessment component.	
Catalogue prepared by	Professor Jagdish H Godihal
Recommended by the Board of Studies on	BoS No. 12 held on 07 August 2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16 held on 23 October 2021

<table>
<tr><td>Course Code: CIV3110</td><td colspan="4">Course Title: Sustainability for Professional Practice
Type of Course: Open Elective and Theory only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">This course has been tailored to cater to students across various disciplines, including schools of engineering and technology, design, law, management, commerce, and humanities. It focuses on the crucial aspect of sustainability and its profound impact on professional practices. The course will delve into two essential methodologies: life cycle assessment (LCA) and Leadership in Energy and Environmental Design (LEED). These methodologies are particularly relevant to the fields of engineering and technology, design, law, management, commerce, and humanities, as they address the growing importance of sustainability, especially within the context of the built environment. Overall, this course is designed to equip students from schools of engineering and technology, design, law, management, commerce, and humanities with the knowledge and skills necessary to embrace sustainable practices in their future careers, contributing to a more sustainable and responsible world.</td></tr>
<tr><td>Course Objectives</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Sustainability for Professional Practice and attain Entrepreneurial Skills through Participative Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="9">On successful completion of the course, the students shall be able to:
1. Recall and describe the key principles and methodologies of sustainability, including LCA and LEED, within the context of the built environment.
2. Explain how life cycle assessment (LCA) and Leadership in Energy and Environmental Design (LEED) contributes to sustainable design practices in the built environment.
3. Apply life cycle assessment (LCA) and Leadership in Energy and Environmental Design (LEED) methodologies to analyze and evaluate the environmental impact of real-world products and built projects, and propose sustainable design solutions for professional practice.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="2">Fundamentals of Sustainability in Professional Practice</td><td>Assignment</td><td colspan="3">Data Collection</td><td colspan="3">10 Sessions</td></tr>
<tr><td colspan="10">Topics: A comprehensive understanding of sustainability and its significance in engineering, design, management, and law professions. Global sustainability landscape and identify its implications on diverse industries. Sustainable Development Goals (SDGs) in shaping professional practices. Role of ethics and corporate social responsibility in driving sustainable initiatives.</td></tr>
<tr><td>Module 2</td><td colspan="2">Sustainability in Professional Projects</td><td>Case Study</td><td colspan="3">Mind mapping/ Programming/</td><td colspan="3">12 Sessions</td></tr>
<tr><td colspan="10">Topics: Integrate sustainable principles into engineering projects, product design, construction processes, management, and law professions. Sustainable management strategies, optimize resources and reduce waste. Sustainable design principles in urban planning, architecture, and product development to create eco-friendly solutions. Legal frameworks and regulations related to sustainability in different industries.</td></tr>
</table>

Module 3	Practical Tools and Techniques for Sustainable Practices	Minor projects	Data Collection / Analysis/ Practical solutions	18 Sessions

Topics: Life cycle assessment (LCA) and environmental impact assessment (EIA) tools for informed decision-making. Integrate renewable energy sources and energy-efficient measures into engineering and design projects for sustainable outcomes. Sustainable supply chain management, Practices to promote ethical and eco-conscious operations. Sustainable practices in legal processes, contract drafting, and dispute resolution for fostering a more sustainable business environment.

Targeted Applications & Tools that can be used:

1. Life Cycle Assessment (LCA) Project: Choose a common consumer product (e.g., a smartphone, or a beverage container) and conduct a comprehensive LCA.
2. LEED Certification Analysis: Select a building project and evaluate its potential for LEED certification.
3. Sustainable Design Proposal: Formulate a sustainable design proposal for a public space (e.g., a park, plaza, community center).
4. Green Building Simulation: Simulate the energy performance of a building using BIM software.
5. Interdisciplinary Case Study: Form interdisciplinary teams from different schools (engineering, design, law, management, etc.).

Professionally used software/Platform: SimaPro Student Edition, LEED Online, OpenLCA, Green Building Studio

Text Books:

1. "Introduction to Sustainability" by Robert Brinkmann, - Publisher: John Wiley & Sons, Edition: 2nd Edition (2014).
2. "Sustainable Construction: Green Building Design and Delivery" by Charles J. Kibert, Publisher: Wiley-Blackwell, Edition: 4th Edition (2015).
3. "Sustainable Development and Planning VII: Sustainable Development and Green Buildings" edited by C. A. Brebbia, Publisher: WIT Press, Edition: 1st Edition (2015).
4. "Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers" by Dana K. Smith and Michael Tardif, Publisher: John Wiley & Sons, Edition: 1st Edition (2009).
5. "Sustainable Construction" by Charles. K. Alexander and Poonam Sharma, Publisher: CRC Press, Edition: 1st Edition (2018).
6. "LEED Green Associate Study Guide" by Megan Ritchie Saffitz and Holly Williams Leppo, Publisher: John Wiley & Sons, Edition: 2nd Edition (2016)

References:

1. "Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products" by Mary Ann Curran, Publisher: John Wiley & Sons, Edition: 1st Edition (2012).
2. "Handbook on Sustainable Buildings" by Centre of Science and Environment (CSE), Publisher: Centre for Science and Environment (CSE), Edition: 1st Edition (2013).
3. "Green Building Rating System: GRIHA Manual" by Green Rating for Integrated Habitat Assessment (GRIHA), Publisher: GRIHA Council, Edition: Version 3 (2015)

Topics relevant to development of"Entrepreneurship": Role of ethics and corporate social responsibility in driving sustainable initiatives, Sustainable design principles in urban planning, architecture, and product development to create eco-friendly solutions, Life cycle assessment (LCA) and environmental impact assessment (EIA) tools for informed decision-making for developing Entrepreneurial Skills through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Professor Jagdish H Godihal
Recommended by the Board of Studies on	BOS Meeting No: 16th, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: MGT2020	**Course Title: Marketing Fundamentals for Engineers** **Type of Course: Open Elective**	**L-T-P-C**	3	0	0	3

Course Pre-requisites	• Basic communication skills • MS Office
Anti-requisites	**Nil**
Course Description	This course examines the role and importance of marketing activities in the organization. This is a descriptive course which helps students to understand and analyze the marketing activities within the firm. The course develops the critical thinking on management challenge of designing and implementing the best combination of marketing actions to carry out a firm's strategy in its target markets.
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the basic concepts of Marketing and Marketing Mix. CO2: Apply the concepts of Product Mix Strategies in marketing decision making. CO3: Identify the appropriate Pricing and Distribution strategy for a given Marketing situation. CO4: Apply the appropriate Promotional Strategies to communicate effectively to the target customers.
Course objective	The objective of the course is to familiarize the learners with the concepts of **Marketing Fundamentals for Engineers** and attain **Entrepreneurship** through **PARTICIPATIVE LEARNING TECHNIQUES.**
Course Content:	

Module 1	**Introduction to Marketing**			**11 Sessions**
Topics: Concept of Marketing, Needs, Wants and Demand, Nature & Importance of Marketing, Marketing Management Philosophies, Marketing Mix, 4Ps of Marketing, Marketing Environment – Macro and Micro Environment, Factors influencing Consumer Behaviour, Consumer Buying Decision Process, Market Segments, Basis of Segmentation, Targeting Strategies, Concept of Positioning.				
Module 2	**Product**			**11 Sessions**
Topics: Product – Meaning, Levels of Product, Consumer Goods Classification, Product Brand, Benefits of Branding, Brand Equity, Brand Management, Product Mix – Product Line, Length and Depth, Product Line Analysis & Decisions, Product Life Cycle (PLC) – PLC Strategies, Fifth 'P' - Packaging and Labelling.				
Module 3	**Price & Place**			**12 Sessions**
Topics: Pricing – Importance of Pricing, Setting the Price, Pricing Objectives, and Steps in Pricing, Types of Pricing, New Product Pricing – Skimming and Penetration pricing Strategies. Place - Marketing Channels and their roles, Levels, Channel Design decisions, Channel Conflict: Reasons and resolution. Overview of Sales Management, Managing the Sales force, A Primer to Organized Retailing, Introduction to E-Commerce				
Module 4	**Promotion**			**11 Sessions**

Topics: Promotion Mix Elements and Integrated Marketing Communications (IMC), Pros and Cons of Promotional Mix elements, Steps in Promotional Planning, Role of Advertising, Sales Promotion, Events & Experiences, Direct Marketing and Public Relations & Publicity, Digital Marketing & Social Media Marketing

Targeted Application & Tools that can be used: PPT, Videos and board & Chalk Method

Referenc

eText

book

1. Kotler, P., Keller, K.L., Koshy, A., & Jha, M. Marketing Management: A South Asian Perspective. Pearson Education, 2009, 13th ed.
2. Panda, T., Marketing Management Text and Cases, Excel Books, New Delhi, 2007, 2nd ed.

Reference

1. Ramaswamy,V.S., & Namakumari. Marketing Management: Global Perspective Indian Context. Macmillan Publishers India.
2. Etzel, M., Walker, B., Stanton, W., & Pandit, A. Marketing Management. Tata McGraw- Hill.

PU library link

https://presiuniv.knimbus.com/user#/home
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_560
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_128
https://ieeexplore-ieee-org-presiuniv.knimbus.com/document/8478819https://www-emerald-com- presiuniv.knimbus.com/insight/content/doi/10.1108/JCM-04-2014-0937/full/html

E resources:

NPTEL, SWAYAM, MOOC courses, reference link related to the course can be mentioned in this section.

Topics relevant to ENTREPRENEURSHIP : Integrated Marketing Communication for **Entrepreneurship** through **participative learning** techniques. This is attained through assessment component as mentioned in the course handout.

Catalogue prepared by	Dr. Archana Singh
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MGT2021	Course Title: **Finance for Engineers** Type of Course: **Core and Theory Only Course**	L-T- P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	Students are expected to have numerical ability and understanding of basic accounting terms					
Anti-requisites	NIL					
Course Description	Strategic decisions in business on capital projects are decentralized, from corporate to divisions, divisions to operations, from operations to departments. Engineers at various levels within the organization who make a capital proposal are contributing to the strategic success of the organization. This course will assist engineers to contribute strategically to the organization, so that they can contribute to the success of their company and can make a success of their careers. The purpose of this course is to provide engineers with a working knowledge of finance.					
Course Objective	The students develop the context to the techniques, methods and concepts of the economic assessment of engineering decisions. The course develops the skill in understand the basics of decision making of financial management					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Describe the Financial Statements (Knowledge) 2. Evaluate capital projects with the help of different finance tools (Application) 3. To Evaluate the concept of cost of capital 4. To Evaluate the concept of working capital					
Course Content						
Module 1	Introduction to financial management and financial Statements	Experiential Learning	Ability to explain the financial statements		10 Sessions	
Definition and Scope of Finance, Role of finance in Business- Nature & objectives of Financial Statements- Income Statement, Balance Sheet and Cash flow statement						
Module 2	Financial Evaluation of Capital project	Experiential Learning	Evaluate Capital projects		10 Sessions	
Time Value of money-Process of capital budgeting-kinds of capital budgeting decisions- Cash flow for investment analysis- Evaluation Techniques - Pay Back Period, Accounting rate of return, Net Present Value, Internal Rate of Return.						
Module 3	Funding of projects	Participative Learning	Ability to analyze sources of funds		10 Sessions	

Bonds/Debentures, Preference shares and Equity shares. Cost of Capital – Meaning, Significance, Weighted Average Cost of Capital (WACC)					
Module 4	Working Capital Finance for Projects	Participative Learning	Ability to analyze sources of funds for working capital		11 Sessions
Concepts, Kinds of working capital, Sources of Financing Commercial paper, Letter of Credit, Bill Discounting, Factoring Factors determining working capital, Operating Cycle. Working capital policies – Conservative, Moderate, Aggressive. Working Capital Estimation					
Targeted Application & Tools that can be used: Targeted Application: Financial evaluation and Funding of projects Tools: Capital Budgeting tools					
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					
1. Student Group Activity – Analysis and interpretation of Financial Statement of a company – Participative Learning 2. Assignment – Capital Budgeting Techniques 3. Presentation – Sources of funds					
Text Book T1: I M Pandey, Financial Management, Pearson					
Reference books 1. Richard A. Brealey, Stewart C. Myers, Franklin Allen, and Pitabas Mohanty, Principles of Corporate Finance, McGraw-Hill Publishing. 2. F.K. Crundwell, Finance for Engineers, Springer 3. Damodaran Aswath, Corporate Finance: Theory and Practice, John Wiley & Sons 4. Chandra P., "Financial Management: Theory and Practice" McGraw Hill Education.					
Web Links and Case Study Links 1. https://hcommons.org/app/uploads/sites/1000618/2019/04/Mini-Case-1-Capital-Budgeting-Analysis.pdf 2. https://www.hbs.edu/faculty/Pages/item.aspx?num=5668					
Catalogue prepared by	Dr. Yusaf Harun K				
Recommended by the Board of Studies on	4th BOS 11th July, 2024				
Date of Approval by the Academic Council					

Course Code: MGT 2015	Course Title: Engineering Economics	L- T-P- C	3	0	0	3
Course Pre-requisites	Students are expected to meet the core participation requirements for the course outlines. Should possess knowledge on contemporary issues of real world economic environment and be willing to understand the cost benefit analysis and a minimum of numerical orientation.					
Anti-requisites	NIL					
Course Description	The course introduces the student to the discipline of economics and its application in the field of engineering through market and cost structures. The course examines the concept of time value of money and how engineers can apply it for making economic decisions. It also explains how interest rates and different compounding periods influence the value of various capital expenditures. The course also deals with the effect of depreciation, taxes and inflation on capital expenditure decisions.					
Course Outcomes	On completion of the course the students are able to: CO1 Define essential terminology and concepts in engineering economics, encompassing various types of costs, the time value of money, and methods for economic evaluation. CO2 Elucidate how variations in demand and supply influence the equilibrium price and quantity within markets pertaining to engineering products and services. CO3 Employ cost functions to determine total cost, marginal cost, and average cost for engineering projects, while also examining the effects of scale and technological advancements. CO4 Utilize discounted cash flow techniques, including Net Present Value (NPV) and Internal Rate of Return (IRR), to assess investment projects.					
Course Objective:	Course objectives are designed to help students understand the application of economic principles in various aspects of engineering, from project feasibility and financial evaluation to cost management and resource allocation. The course will equip them with both the theoretical knowledge and practical skills needed to make sound economic decisions in the engineering field attain Entrepreneurship through Participative Learning techniques.					
Module 1	Introduction to Engineering Economy and Engg Economic Decisions	Assignment		Assign ment	10 Sessions	
Topics: Introduction, Origins and Principles of engineering economy, engineering economy and design process. Rational decision making and economic decisions, types of strategic engg economic decisions. Circular flow of income, difference between micro and macroeconomics, Production possibility curve.						
Module 2	Theory of Demand and Supply	Assignment	Assignment	10 Sessions		
Topics: Demand-law of demand, demand curve, determinants of demand, exceptions to Law of demand. Elasticity of demand-Price elasticity and income elasticity. Calculation of Price and income elasticity of demand. Supply-law of supply, supply curve and determinants of supply. Elasticity of supply-its type. Equilibrium of demand and supply.						
Module 3	Theory of Production and Cost	Assignment	Assignment	11 Sessions		
Topics: Production function, Factors of Production, Law of Variable Proportion and Returns to Scale, Cost and its classification, short and long run cost curves, cost behavior, cost concepts and decision making, breakeven analysis. Calculation of costs and Break even point.						
Module 4	Time Value of Money and Depreciation	Assignment	Assignment	12 Sessions		

Topics: Cost of money, Interest formulas, Present, Future Values, Internal Return method. Payback period method, rate of return method, Internal rate of return methods.Concept of Depreciation, factors and methods of depreciation
Targeted Application & Tools that can be used: Evaluation of cost effectiveness of individual engineering projects. Economic analysis can be used for problem solving.
Text Book Engineering Economics, R. Pannerselvan. Reference Books: Pindyck, R.S., Rubinfeld, D.L. and Mehta, P.L., Micro Economics, Pearson Education Samuelson, P.A. and Nordhaus, W.D., Economics, McGraw Hill Browning,E.K.and Browning ,J.M, Microeconomic theory and applications, Kalyani Publishers.
References https://presiuniv.knimbus.com/user#/home https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_560 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SPRINGER4_1406 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_128 HBR Digital Articles: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_129 Videos Economics – Link: https://www.youtube.com/watch?v=CR3y2QdbIlY Accenture's Top Strategy for Managing and Retaining to economics - Link: https://www.youtube.com/watch?v=mj7q7H7ioME Enhancing An Effective economics management - Link: https://www.youtube.com/watch?v=d806M_U-XSA Setting out the process of development economics management and succession - Link: https://www.youtube.com/watch?v=heWMVSbsyYc
Topics relevant to development of "ENTREPRENEURSHIP": **Simulation of Market Conditions**: Groups simulate changes in market conditions (e.g., demand shifts, cost increases) and evaluate how these changes affect the financial viability of the project) **Participative Learning Techniques.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Shabeena
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

<table>
<tr><td>Course Code: MGT2007</td><td colspan="4">Course Title: Digital Entrepreneurship
Type of Course: Open Elective</td><td>L
3</td><td>T
0</td><td>P
0</td><td>C
3</td></tr>
<tr><td>Version No.</td><td colspan="8">2.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Students are expected to know:
Understand why digital technologies are at the forefront of entrepreneurship.
The internet impacts entrepreneurial competition including network effects and platform technologies</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The course aims to strengthen the capabilities of participants to use disruptive digital technologies to design innovative and viable business models, processes, services, products and strategies. This course specifically focused on learning lean startup principles, how to identify potential new venture ideas that boost market growth, state customer value propositions and economic value. The course deals with the competencies needed to become an innovative, opportunity-driven, market-ready and entrepreneurial manager. This course examines successful strategies, business models, frameworks, funding process, barriers and risks for introducing break-through products and services. Topics include business model innovation, strategic leadership, human centered and design-driven innovation, creativity and change management.</td></tr>
<tr><td rowspan="4">Course Outcomes</td><td colspan="8">On successful completion of the course the students shall be able to:</td></tr>
<tr><td>CO1</td><td colspan="5">Explain Outline the rise and development of the concept of digital entrepreneurship</td><td colspan="2">Bloom-1-Remember</td></tr>
<tr><td>CO2</td><td colspan="5">Comprehend Explain various the development of unique digital business models</td><td colspan="2">Bloom-2-Understand</td></tr>
<tr><td>CO3</td><td colspan="5">Apply their knowledge in problem solving and building the understand and interpret the digital business venturing.</td><td colspan="2">Bloom-3- Apply</td></tr>
<tr><td>Course Objective</td><td colspan="8">This course is designed to improve the learner’s skill development by using Experiential Learning Techniques. There are projects works and practical assignments.</td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Digital Entrepreneurship</td><td>Assignment</td><td colspan="3">Case study (Participative Learning</td><td colspan="2">11 Hours</td></tr>
<tr><td colspan="9">Topics: Background of Entrepreneurship, Moving towards Digital business, Digital entrepreneurship(DE), Who is an Entrepreneur, Definition, 5 Ds of Entrepreneurship, Zest 2 Zoom, Zen Thinking, Creativity to Entrepreneurship, Drivers and Enablers of business, Value creation, Gap analysis, Impact of ICT on Business, Cornerstones of Entrepreneurship, Market analysis, Customer and financial analysis, Lifecycle Model of DE, MAP features.</td></tr>
<tr><td>Module 2</td><td colspan="2">Digital Technologies, Value and Design Thinking</td><td>Assignment (Participative Learning)</td><td colspan="3">Case Study</td><td colspan="2">12 Hours</td></tr>
<tr><td colspan="9">Topics: Digital Platform, Emerging Technologies and Entrepreneurial Opportunities, Sustainable Development Goals, Opportunity vs Clarity, Disruptive Technologies, Innovation, Types of innovation, Importance of creativity, 5 steps of Entrepreneurial Innovation Process, Value, domestic vs industrial products, Goal of Business, Value Engineering, Value creation, Design Thinking, Tools and templates, Design Process, Design Principle, Phases of Design, Prerequisites of Financial Support.</td></tr>
</table>

Module 3	Business Model and Business Plan Formulation	Assignment (Participative Learning)	Case Study	12 Hours
Topics: Traits, Competences and Drivers of DE Success, Leadership skills for DE, Characteristics of Digital business, 7 layers of Digital business platforms, DE process, Foundation of Profit, Skills of Digital Enterprise Management Business Model, Who Business model, Market potentiality analysis, Business opportunity, Execution strategy, Constituents of Business model, Revenue management strategy, Business Model Canvass, The 9 Blocks, Critical Success factor, Preparation of Business plan, Business Plan Presentation				
Module 4	Market size, Prospects & Risks of proposed business venture.	Assignment (Participative Learning)	Case Study	10 Hours
Topics: Essential abilities of Entrepreneurship, Key questions of Entrepreneurship, 5 Steps of prospect estimation, Decoding customer pains, market size and prospect, market structure, target fixation, size of target market, Business development strategy matrix, Expected EBITDA, Problem solving.				
Targeted Application & Tools that can be used:				
Students would be encouraged to take up live projects and through experiential learning activities in the classroom.				
Project work/Assignment:				
Assignment 1: quiz. Assignment 2: Preparation of Business Plan & Presentations Assignment 3 : Review of digital/e-resource from PU link given in references section [Mandatory to submit screen shot accessing digital resource, otherwise it will not be evaluated]				
Text Books: Rogers. D., Digital Transformation Playbook – Rethink Your Business for the Digital Age, Columbia Business School Publishing, 2016.				
References: 1.Mayer, M. H., New Venture Creation: An Innovator's Guide to Entrepreneurship, 2nd Edition, Sage Publication, 2013. 2. Kuratko, D. F., & Rao, T. V., Entrepreneurship: A South Asian Perspective, Cengage Learning IndiaPvt. Ltd, Delhi, 2016. 3. Osterwalder, A. and Pigneur, Y., Business Model Generation: A Handbook for Visionaries, Game 4: New Venture Creation- Allen Kathleen R, Cengage Learning, ISBN: 9788131521021, 9788131521021, 6th Edition. 5: Crane, Andrew & Matten Dirk (2010) Business Ethics, Oxford Publications				
Online Resources: Digital Entrepreneurship and Creative Industries in Tourism: A Research Agenda - Publicly Available Content Database - ProQuest Digital Sustainable Entrepreneurship: A Digital Capability Perspective through Digital Innovation Orientation for Social and Environmental Value Creation - Publicly Available Content Database - ProQuest Transition to Digital Entrepreneurship with a Quest of Sustainability: Development of a New Conceptual Framework - Publicly Available Content Database - ProQuest				

Articles: Art 1 : Digital Entrepreneurship and Creative Industries in Tourism: A Research Agenda Art 2: Digital Sustainable Entrepreneurship: A Digital Capability Perspective through Digital Innovation Orientation for Social and Environmental Value Creation Art 3 : Transition to Digital Entrepreneurship with a Quest of Sustainability: Development of a New Conceptual Framework Art 4 : Digital Transformation and Competitive Advantage in the Service Sector: A Moderated-Mediation Model Case Studies: https://www.sciencedirect.com/science/article/abs/pii/S2210670721003978 https://www.elgaronline.com/edcollbook/book/9781802203868/9781802203868.xml https://www.taylorfrancis.com/chapters/edit/10.4324/9780429293207-5/digital-entrepreneurs-sharing-economy-birgit-leick-mehtap-aldogan-eklund-bj%C3%B8rnar-karlsen-kivedal	
Catalogue prepared by	Dr.Geetha C J
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Plan

Course Code:	COM1020
Course Title:	Business Accounting and Financial Analysis
Program:	BBALLB
School:	School of Commerce and Economics
Semester:	VI
Credits:	3
LTPC Structure:	2:1:0:3
Duration of Course	15 Weeks
Contact Hours per week:	3 (2:1:0:3) (45Hours Theory)
Pre-Req Course(s):	Basic Communication and Mathematical Calculation.
Program Outcomes:	**PO1:** Ability to apply the fundamental concept of Humanities, Commerce and Management to legal problems. **PO2:** Ability to develop critical thinking skill. **PO3:** Ability to apply legal theory to factual settings. **PO4:** Ability to conduct client services with necessary usage of technological tools. **PO5:** Recognition of the need for engaging in lifelong learning. **PO6:** Ability to function in multidisciplinary team.
Course Description:	Financial accounting is concerned with understanding the concept of accounting and its importance in preparation with corporate body which help the students to prepare accounts of corporate.
Course Outcomes:	On successful completion of the course the students shall be able to: CO1: Understand the Accounting Concept. CO2: Illustrate Accounting Cycle. CO3: Illustrate the financial statements of corporate body. CO4: Understand the Financial Statement Analysis.

CO PO Mapping:

CO. NO.	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	L	M	L	M	M
CO2	M	M	H	H	M	
CO3	M	M		M	M	L
CO4	M		L	M	M	H

Pedagogy for the Course:	**Procedure adopted in delivery:** Offline and online Lectures, Power Point presentations **Problem-Based Learning:** Cases decided of various financial institutions. **Self-Learning:** Financial statement analysis, Presentations.
Assessment Structure:	Assessment: (Continuous 25%; Mid-Term 25%; End-Term 50%) Class Test : 5% Financial statement analysis and presentation : 20% (1- 10%, 2-10%) Assignment 1 (Marks Weightage: 10%): Module 1 and 2 Assignment 2 (Marks Weightage: 10%): Module 3 and 4 Assignment 3 (Marks Weightage: 5%): Class-Test
Assessment Rubric:	Rubrics for evaluation will be shared and discussed in the class
Module Schedule:	

Week 1	L1-L3		Module I (1- 08 Lectures) Module 2 (09-12 Lectures)
Week 2	L4-L6		
Week 3	L7-L9		
Week 4	L10-L12	A1, T1	
Week 5	L13-L15		Module II (13-20 Lectures) Module 3 (21-24 Lectures)
Week 6	L16-L18		
Week 7	L19-L21		

Week 8	L22-L24	A2	
Week 9	L25-L27		Module III (25-33 Lectures) Module IV (34-37 Lectures)
Week 10	L28-L31		
Week 11	L32-L34		
Week 12	L35-L37	T2	
Week 13	L38-L40		Module IV (37-45 Lectures)
Week 14	L41-L43		
Week 15	L44-L45		

A1	First Assignment
A2	Second Assignment
T1/T2	Class Test ½

Module 1: Business Accounting and Financial Analysis				
#Sessions: 08L				
[REMEMBER]				
Module Takeaway: Understand the Accounting concept				
Target Course Outcome: CO1				
L	**Lecture Sessions (1 Hour)**	**References**	**Outcomes**	**Assessments**
1	Brief introduction of Accounting	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi.	Fundamental of Accounting: Concepts, Principles, standards.	Class-Test-I
2	Meaning and Definition of Book Keeping and Accounting.	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi.	Fundamental of Accounting: Concepts, Principles, standards.	
3	Advantages and Limitations of Accounting.	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi.	Fundamental of Accounting: Concepts, Principles, standards.	
4	Accounting Concepts	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi	Fundamental of Accounting: Concepts, Principles, standards.	
5	Accounting conventions	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi	Fundamental of Accounting: Concepts, Principles, standards.	
6	Accounting standards	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi.	Fundamental of Accounting: Concepts, Principles, standards.	
7	Differences between AS and IFRS	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi.	Fundamental of Accounting: Concepts, Principles, standards.	
8	Importance of Accounting	S.N.Maheswari Introduction to Accounting, Vikas Publishing House, New Delhi.	Fundamental of Accounting: Concepts, Principles, standards.	

Module 2: Accounting Cycle				
#Sessions: 12 L				
[Understand]				
Module Takeaway: Understanding Accounting Cycle				
Target Course Outcome: CO2				
L	**Lecture Sessions (1 Hour)**	**References**	**Outcomes**	**Assessments**
1	Rules of Journalising	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	Particle problems
2	Journal Entries	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
3	Ledger Posting and Balancing	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
4	Trial Balance	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
5	Books of Original Entry(Subsidiary Books)	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
6	Cash Book (Three Column)	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	

7	Cash book contra entries problems	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
8	Purchase Book problems	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
9	Purchase Return Book problems	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
10	Sales Book problems	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
11	Sales return Book problems	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	
12	Journal proper simple problems	M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi.	Understanding Accounting Cycle	

Module 3: Preparation of Final Accounts				
#Sessions: 13 L				
[APPLY]				
Module Takeaway: Final Accounts of Joint Stock Company				
Target Course Outcome: CO3				
L	**Lecture Sessions (1 Hour)**	**References**	**Outcomes**	**Assessments**

1	Preparation of Income statement/ Profit or loss statement format and explanation	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	Class-Test II
2	Problems on Income statement	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
3	Problems on Income statement with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
4	Problems on Income statement with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
5	Preparation of Balance sheet as per companies Act 2013 schedule III	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
6	Discussion of Adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
7	Problems on Balance Sheet	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
8	Problems on Income statement and Balance sheet with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
9	Problems on Income statement and Balance sheet with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
10	Problems on Income statement and Balance sheet with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
11	Problems on Income statement and Balance sheet with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	

12	Problems on Income statement and Balance sheet with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	
13	Problems on Income statement and Balance sheet with adjustments	S.N.Maheswari, Advance Accounting, Vikas Publishing House, NewDelhi.	Final Accounts of Joint Stock Company	

Module 4: Financial Statement Analysis				
#Sessions: 12 L				
(Analyze)				
Module Takeaway: Analysis of Financial Statements				
Target Course Outcome: CO4				
L	**Lecture Sessions (1 Hour)**	**References**	**Outcomes**	**Assessments**
1	Meaning and Importance of Financial Statement Analysis	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	Power point Presentation and Discussion
2	Types and Methods of Financial Statement Analysis	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
3	Comparative Analysis of Income statement	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
4	Comparative Analysis of Balance Sheet	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
5	Common Size Income Statement	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
6	Common Size Balance Sheet	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial	Analysis of Financial Statements	

		Statements Including Project Work, Arya Publication, New Delhi.		
7	Trend analysis problems	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
8	Trend analysis problems	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
9	Trend analysis problems	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
10	Trend analysis problems	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
11	Trend analysis problems	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi.	Analysis of Financial Statements	
12	Trend analysis problems	DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya	Analysis of Financial Statements	

		Publication, New Delhi.		

Tools:	Power point
Resources:	Company official websites and NSE/ BSE
Reference Material:	**Textbooks:** 1. S.N.Maheswari Introduction to Accounting, Vikas Publishing House, NewDelhi. 2. M.C.Shukla, T.S.Grewal and S.C. Gupta – Advanced Accounts, S.Chandand Company Ltd., New Delhi. 3. DK Goel, Rajesh Goel, Shelly Goel-Analysis of Financial Statements Including Project Work, Arya Publication, New Delhi. 4. DK Goel, Rajesh Goel, Shelly Goel -Basic Accounting, Arya Publication, New Delhi.

Assessment	Type	Course Outcome Mapped
Assignment 1	Particle problems	**CO2, CO3**
Assignment 2	Particle problems	**CO3, CO4**
Class Test	Class Test I & II	**CO2, CO4**

Course Code: BBA2088	**Course Title: Management and Behavioral Practices Type of Course: Major Core**	**L- T - P- C**	**3**	0	0	3
Version No.	2.0					
Course Pre-requisites	• General Knowledge in Business world • Knowledge about different management processes					
Anti-requisites	**Nil**					
Course Description	This course provides a conceptual overview and fundamentals leading to functions of management. The students should be able to describe and discuss the elements of effective management, ii) discuss and apply the planning, organizing and control processes, iii) describe various theories related to the development of leadership skills, motivation techniques, team work and effective communication, iv) communicate effectively through both oral and written presentation. It enables the students to inculcate the management qualities like leadership and planning and organizing the activities which are assigned to them as a task. It also paves way to learn the basics of management and its functions in each and every organization from top level to lower-level management					
Course Out Comes	At the end of the course, the student shall be able to: **CO 1**: Describe the fundamentals of management **(Remember)** **CO 2**: Discuss the principles of planning and decision-making (Understanding) **CO 3**: Explain the organizing process (Understanding**)** **CO 4**: Identify the principles of Controlling and Directing (Apply**)**					
Course Objective:						
Module 1	**Introduction to Management**		**Self-learning**	**Remember**		
Definition -Nature-Process and Significance of Management; Henry Fayol's Principles of management; Role of managers; Managerial Skills; Evolution of Management Thought: Classical Management Approaches, Behavioral Management Approaches, Quantitative Management Approach, Modern Management Approaches; Management as a Science or Art - Management as a profession; Differentiate Administration and Management; Functions of Management.						
Module 2	**Planning and Decision Making**		**Participative learning**	**Understanding**		
Planning: Meaning and Nature and Importance of Planning; Types of Plans; Planning process; Management by Objective (MBO); Management by Exception (MBE). **Decision Making**: Meaning, Definition and Nature; Types of decisions; Decision Making Process; Rational Perspectives and Behavioral Aspects of decision making.						

Module 3	**Organizing**		Case Study	**Understanding**
Organizing: Definition, Nature and purpose; Principles of Organization; Types of Organization; Organizational Structure and Design; Line, Staff and functional authority; Conflict between Line and Staff; Overcoming the Line-Staff Conflict; Departmentation; Span of control; Authority, Responsibility and Accountability; Delegation Vs Decentralization; Centralization Vs. Decentralization				
Module 4	**Directing & controlling**		**Experiential Learning**	**Apply**
Directing: Nature of Directing function; Principles; Importance of Effective Direction; Leadership and change; Effective Communication skills for directing. **Controlling:** Concept- Nature and Importance; Essentials of Control; Behavioral Implications of Control; Techniques of Managerial control.				
Targeted Application & Tools that can be used: NPTEL Videos used to enhance the students understanding. **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course:** Assess the cases with respect to principles of management and prepare a write up of 1000-1500 words.				
DELIVERY PROCEDURE (PEDAGOGY): **Self-learning:** Management as a Science or Art - Management as a profession **Experiential Learning**: Case Studies on Planning and Controlling **Participative learning**: Group discussion and presentation on Planning and Decision Making				
Web Based Resources: W1: https://www.youtube.com/watch?v=CmC8UaCNQFc W2: https://byjus.com/commerce/henri-fayol-14-principles-of-management/ W3: https://www.simplilearn.com/principles-of-management-by-henri-fayol-article W4: https://www.youtube.com/watch?v=U4wuKKwV-eg W5: https://www.youtube.com/watch?v=dEVulKf1wYs **PU E-Book Resources Links:** https://presiuniv.knimbus.com/user#/home 1. Lichtenthaler, U. (2016), "Six principles for shared management: a framework for the integrated economy", *Journal of Business Strategy*, Vol. 37 No. 4, pp. 3-11. https://doi.org/10.1108/JBS-03-2015-0029 Link: https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/JBS-03-2015-0029/full/html 2. Kristiansen, A. and Schweizer, R. (2021), "Practice coordination by principles: a contemporary MNC approach to coordinating global practices", *Critical Perspectives on International Business*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/cpoib-04-2020-0027. Link: https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/cpoib-04-2020-0027/full/html				

NPTEL Videos:

1. https://www.digimat.in/nptel/courses/video/110107150/L01.html
2. http://digimat.in/nptel/courses/video/110105146/L01.html

Case Study Links:

1. https://www.citehr.com/296129-case-studies-principles-management-business-management.html
2. Chrome extension://efaidnbmnnnibpcajpcglclefindmkaj/http://punainternationalschool.com/assets/upload/ck-images/XII%20BST%20Case%20Studies-ch-2.pdf
3. https://studyresearch.in/2018/03/11/case-studies-principles-of-management/
4. https://cbsencertsolutions.com/case-study-chapter-2-principles-of-management/

Topics relevant to development of "**EMPLOYABILITY SKILLS**": Henry Fayol's Principles of management; Role of managers; Managerial Skills ; Evolution of Management Thought: Classical Management Approaches, Behavioral Management Approaches, Quantitative Management Approach, Modern Management Approaches ; Management as a Science or Art

Topics relevant to development of "**HUMAN VALUES AND ETHICS**": Importance of Effective Direction; Motivating people at work; motivational theories; Leadership and change; Effective Communication skills for directing ; Barriers of communication.

Textbook

T1: Stoner, Freeman, Gilbert Jr. (2014). Management (6th edition), New Delhi: Prentice Hall India.

T2.) Koontz, H. and Wihrich H, Management, Mc Graw Hill.

T3.) Stephen P. Robbins, Timothy A. Judge, "Organizational Behavior" Pearson Education, 18th Edition (2019)

T4.) Laurie J. Mullins, "Management and Organizational Behavior" Pearson Education, 11th Edition (2016)

T5.) Kris Cole, Cengage Learning, "Leadership and Management: Theory and Practice" 7th Edition (2018)

References

R1: Koontz, H. and Wihrich H, Management, Mc Graw Hill.

R2: Stoner, J etc., Management, Pearson Education.

R3: Sharma, Principles of Management, Kalyani Publishers, Hyderaba**d**

R4: Dinkar Pagare, Business Management

R5: Gupta C.B., Business Management

R6: Harold Koontz, Cyril O Donnel, Heinz Weihrich, Management

R7: James A.B. Stoner & Charles Wankel, Management

R8: Prasad L.M., Principles of Management

R9: Daft, R. L. (2009). Principles of Management (1st edition), Cengage Learning.

R10: Gupta, R.S., Sharma, B.D., & Bhalla. N.S. (2011). Principles & Practices of Management (11th edition). New Delhi: Kalyani Publishers.

R11:Stephen P. Robbins, Timothy A. Judge and Neharika Vohra (2018), 18th Ed. *Organizational Behaviour.* Pearson Education Asia	
Catalogue prepared by	Dr. Suhashini A
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: ECE3802	Course Title: Artificial Neural Networks Type of Course: Open Elective	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	NA					
Anti-requisites						
Course Description	The purpose of this course is to introduce the students to Machine learning and decision systems. The course is both conceptual and analytical and develops critical design skills by introducing the concept of "Thinking by machines". We talk of gathering and processing of knowledge, and classifiers and controllers based on approximate reasoning. It is intended at introducing basic concepts to Non ECE and CSE students.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Artificial Neural Networks and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques					
Course Outcomes	On successful completion of this course the students shall be able to: i. Distinguish Learning paradigms and Learning Algorithms for a simple neural network. ii. Explain the implementation of linearly separable/ Non- linearly separable problems with SLP/ MLP. iii. Illustrate the implementation of non-linearly separable problems with MLP. iv. Explain various real time problems and their solutions using ANN.					
Course Content:						
Module 1	Introduction To Artificial Neural Networks	Assignments	Assignments	09 SESSIONS		
Topics: Module: 1: Natural and artificial neuron, Models Of A Neuron, simple real world learning problem like a two year baby learning sweet milk versus fire. Neural Networks- Associated Graphs And Feedback, Network Architectures And Knowledge Representation, 4 Rules of Knowledge. Learning Processes, Learning Algorithms and learning Paradigms. ANNs						
Module 2	Single layer perceptron for linearly separable problems	Quizzes and assignments	Quizzes and assignments	10 SESSIONS		
Topics: Single Layer Feed forward N/W, Multilayer Feed Forward N/W, Rosenblatt's Perceptron, Error correction algorithm, Hebbian learning algorithm and Perceptron convergence algorithm. Introduction to Digital Logic gates. Implementation of learning with different algorithms for linearly separable digital logic gates. Derivation of perceptron convergence theorem and Introduction to LMS algorithm. Concept and Domain of MLP for non-linearly separable problems where SLP is unsuitable (no derivations).						
Module 3	Multilayer perceptron	Quizzes and assignments	Quizzes and assignments	10 SESSIONS		

Topics: The back propagation algorithm, Forward path for function computation, back ward path for error computation and synaptic adjustments, X-OR Problem and why it cannot be implemented with SLP, Heuristics for making back propagation perform better.

Module 4	Applications of ANN	Quiz	Quizzes and assignments	11 SESSIONS

Topics: Applications: Implementing Artificial Neural Network training process in MATLAB and Python, Introduction to CNN, Implementation of classification task on MATLAB, Implementation of image recognition using CNN on python, Demonstration of real time projects based on image classification on Teachables

List of Laboratory Tasks:
NA

Targeted Application & Tools that can be used :
JOBS- AI & ML ENGINEERS IN SOFTWARE INDUSTRY, Data Scientist, Machine Learning Engineer, Research Scientist, Business Intelligence Developer, AI Data Analyst, Big data engineering, Robotics Scientist, AI engineer
TOOLS – PYTHON, MATLAB, JAVA.

Project work/Assignment:

1. Sample Project works - Iris Flowers Classification Project, MNIST Digit Classification Machine Learning Project, Stock Price Prediction using Machine Learning, Wine Quality Test Project, Music Genre Classification Machine Learning Project, Handwritten Character Recognition

2. Sample Assignments –
   i. You went to an agriculture farm which cultivates vegetables. Identify any three problems which can be solved by machine learning and mention the steps of database preparation and training the models.
   ii. Implement the perceptron model of a two-input XOR gate in MATLAB/ Python and verify the structure using the truth table.
   iii. Please visit the college library or e-resource and find the below Journal and submit the report for the following paper (Attach the title of the journal and the paper)
   iv. A single layer n/n is given with two input values [x1 x2]=[0.05 0.10]; and initial weights as w1=0.15 w2= 0.20 w3= 0.25 w4= 0.30 w5=0.40 w6=0.45 w7=0.50 w8=0.55; bias value as b1=0.35 b2=0.60; target value T1=0.01, T2=0.99. Show the steps for both forward and backward pass at the output layer.

3. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .

Text Book(s):

1. Simon Haykin, "*Neural Networks and Learning Machines*", Pearson.

Reference Book(s)

1. C. Bishop, "Neural Networks for Pattern Recognition", Oxford University Press.
2. K. Mehrotra, C. Mohan, and S. Ranka, "*Elements of Artificial Neural Networks*", MIT Press
3. Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition) by Eric Matthes

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Introduction to ANN (NPTEL) - https://nptel.ac.in/courses/117/105/117105084/
2. Artificial Intelligence Courses (Udemy) - https://www.udemy.com/topic/artificial-intelligence/
3. Supervised Machine Learning: Regression and Classification by Dr. Andrew Ng (Coursera) - https://www.coursera.org/learn/machine-learning

E-content:

1. Ciregan, D., Meier, U., & Schmidhuber, J. (2012, June). Multi-column deep neural networks for image classification. In 2012 IEEE conference on computer vision and pattern recognition (pp. 3642-3649). IEEE. - https://ieeexplore.ieee.org/abstract/document/6248110
2. W. Lin and G. Chen, "Large Memory Capacity in Chaotic Artificial Neural Networks: A View of the Anti-Integrable Limit," in *IEEE Transactions on Neural Networks*, vol. 20, no. 8, pp. 1340-1351, Aug. 2009, doi: 10.1109/TNN.2009.2024148. - https://ieeexplore.ieee.org/document/5166455
3. K. B. Lee and H. S. Shin, "An Application of a Deep Learning Algorithm for Automatic Detection of Unexpected Accidents Under Bad CCTV Monitoring Conditions in Tunnels," *2019 International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML)*, 2019, pp. 7-11, doi: 10.1109/Deep-ML.2019.00010. https://ieeexplore.ieee.org/document/8876906
4. D. Goularas and S. Kamis, "Evaluation of Deep Learning Techniques in Sentiment Analysis from Twitter Data," *2019 International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML)*, 2019, pp. 12-17, doi: 10.1109/Deep-ML.2019.00011. https://ieeexplore.ieee.org/document/8876896

Topics relevant to "ENTREPRENEURIAL SKILLS": Applications of ANN for developing Entrepreneurial Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Ms Anupama S, Mr. Arvind Kumar
Recommended by the Board of Studies on	15th BOS held on 28/07/2022
Date of Approval by the Academic Council	Meeting No. 18th , Dated 03/08/2022

<table>
<tr><td>Course Code: ECE1003</td><td colspan="3">Course Title: Fundamentals of Electronics
Type of Course: Open Elective</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">2.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">Nil</td></tr>
<tr><td>Course Description</td><td colspan="8">The purpose of this course is to introduce the students to Electronics and Communication Systems. The course is conceptual and is an introductory level course. It is primarily intended at Non-Electronics background students and introduces the basic concepts of semiconductor devices and electronics engineering.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Fundamentals of Electronics and attain SKILL DEVELOPMENT through PARTICPATIVE LEARNING.</td></tr>
<tr><td>Course Outcomes</td><td colspan="8">On successful completion of this course the students shall be able to:
1. Describe the significance of electronic devices, specifically diodes
2. Explain the operating principles of BJT and its applications.
3. Summarize the concepts of number system, Boolean laws and logic gates.
4. Explain the basic concepts of Microprocessors and Communication systems.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td>Basic Electronic Components and applications</td><td colspan="2">Quizzes and assignments</td><td colspan="2">Memory Recall based Quizzes and assignments</td><td colspan="2">10SESSIONS</td></tr>
<tr><td colspan="9">Topics: Classification of materials into Resistors, Conductors, Insulators, Ohm’s law, Kirchhoff’s laws. Semiconductor materials: Intrinsic and extrinsic. Bands and Bonds. The p-n junction diode, Characteristics and Parameters, Diode ideal approximation (only one approximation) DC load line, Half-wave rectifier, Two-diode Full-wave rectifier, Bridge Rectifier(only operation, no derivations)Rectifier with capacitor Filter operation(only qualitative waveforms, no derivations), Zener and Avalanche breakdown.</td></tr>
<tr><td>Module 2</td><td>Bipolar Junction Transistors</td><td colspan="2">Quizzes and assignments</td><td colspan="2">Memory Recall based Quizzes</td><td colspan="2">10 SESSIONS</td></tr>
<tr><td colspan="9">Topics:
BJT Construction, BJT operation, BJT Symbol, Voltages and Currents, Common Base, Common Emitter and Common Collector configurations. Alpha, Beta, Gamma and current conversions. CE Characteristics in active, saturation and cut-off. DC Load line concept. Concept of biasing and feedback for stabilization(only operation, no derivations)</td></tr>
<tr><td>Module 3</td><td>Digital Electronics</td><td colspan="2">Quizzes and assignments</td><td colspan="2">Programming and Simulation Task</td><td colspan="2">11 SESSIONS</td></tr>
<tr><td colspan="9">Topics:</td></tr>
</table>

Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, and Binary to decimal, Hexadecimal to and from Binary, Complement of Binary Numbers(no subtractions)

Boolean Algebra Theorems, De Morgan's theorems. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NOR Gate, SOP AND-OR implementation, NAND-NAND Implementation.

Module 4	Introduction to Microprocessor and communication systems	Quizzes and assignments	Memory Recall Quizzes and assignments	9 SESSIONS

INTEL 8085 MICROPROCESSOR: Basic Architecture and features of 8085 Microprocessor. Flags.
COMMUNICATION SYSTEM: Block diagram of communication system, Modulation: Definition of Modulation, Need of Modulation, Types of Modulation: Amplitude Modulation and Frequency Modulation (Waveforms only).

Textbook(s):

T1: John Hiley, Keith Brown and Ian McKenzie Smith, *"Hughes Electrical and Electronic Technology",* Pearson, 12th Edition

References

R1: D.P. Kothari, I. J. Nagrath, *"Basic Electronics",* McGraw Hill Education, 1st Edition

R2:Rajendra Prasad, *"Fundamentals of Electronics Engineering",* Cengane Learning, 3rd Edition

Class Notes (CN) and Video Lectures

1. Video lectures on "BASIC ELECTRONICS" by Prof. Dr. Chitralekha Mahanta, Department of Electronics and communication Engineering, IIT Guwahati": https://nptel.ac.in/courses/117/103/117103063/

2. Lecture Series on " Useful Laws in Basic Electronics" by Prof. T.S.Natarajan, Department of physics, IIT Madras: https://www.youtube.com/watch?v=vfVVF58FtCc

3. Lecture Series on "Introduction to Bipolar Junction Transistors BJT " by All About Electronics Youtube Channel:

https://www.youtube.com/watch?v=-VwPSDQmdjM&list=PLwjK_iyK4LLDoFG8FeiKAr3IStRkPSxqq

4. Lecture Series on " PN Junction Diode " by All About Electronics Youtube Channel:

https://www.youtube.com/watch?v=USrY0JspDEg

5. Lecture Series on "Introduction to Digital Electronics" by All About Electronics Youtube Channel:

https://www.youtube.com/watch?v=DBTna2ydmC0&list=PLwjK_iyK4LLBC_so3odA64E2MLgIRKafl

6. Lecture Series on "Introduction to Microprocessors" by Bharat Acharya Education :https://www.youtube.com/watch?v=0M74z5jEAyA

7. Lecture Notes on : "Electronic Devices", Bipolar Junction Transistors, 2nd Chapter, by Shree Krishna Khadka (PDF) Bipolar Junction Transistor (researchgate.net): https://www.researchgate.net/publication/323384291_Bipolar_Junction_Transistor

E-content:

1. Ali HabebAseeri ,Fouzeyah Rajab Ali, "Bipolar Junction Transistor as a Switch", IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 13, Issue 1 Ver. I (Jan. – Feb. 2018), PP 52-57. [PDF] Bipolar Junction Transistor as a Switch | Semantic Scholar

2. Osama S. HAMAD, Othman SIDEK, MahfoozurREHMAN,Kamarulazizi IBRAHIM, Magdy H. MOURAD, "FABRICATION PROCESS OF SILICON-ON-INSULATOR AND LATER BIPOLAR TRANSISTORS", Journal of Annals of Faculty of Engineering Hunedoara-Journal of Engineering; TOME-VII,2009, ISSN 1584-2665. Osama S. Hamad's research works | Universiti Sains Malaysia, George Town (USM) and other places (researchgate.net)

3. Amos, S. W. Principles of transistor circuits: Introduction to the design of amplifiers, receivers, and digital circuits. (6th ed.). London: Butterworths, 1981: Principles of Transistor Circuits: Introduction to the Design of Amplifiers ... - S W Amos, Mike James - Google Books

4. DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMurase, "An encoding technique for design and optimization of combinational logic circuit"2010, 13th International Conference on Computer and Information Technology (ICCIT). An encoding technique for design and optimization of combinational logic circuit | Semantic Scholar , An encoding technique for design and optimization of combinational logic circuit | Request PDF (researchgate.net)

5. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029.Applying Incompletely Specified Boolean Functions for Patch Circuit Generation | IEEE Conference Publication | IEEE Xplore

6. https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT": Rectifiers, BJT operation, Boolean Algebra, Number Systems, Microprocessor, Block diagram of communication system, Modulation for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Safinaz S
Recommended by the Board of Studies on	BOS Meeting NO: 15th, Dated BOS 28/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18th, Dated 03/08/2022

Course Code: EEE 3100	**Course Title: IOT Based Smart Building Technology** **Type of Course: Open Elective & Theory only**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**Nil**					
Course Description	This Course intends to provide a basic understanding of IoT based building technology as all modern buildings will have a heavy focus on automation and efficient usage of energy through IOT. The course uses the fundamentals of mathematics and software tools and enhances the process of learning. The course is both conceptual and analytical in nature and imparts the basic skills of developing the IoT based systems through assignments and mini projects. Gaining knowledge in this field gives an experience to build innovative projects that enhances and improves the chances of a great career in IOT.					
Course Objective	The objective of the course is to familiarize the learners with the concepts IOT Based Smart Building Technology and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Summarize about IOT Concepts and Applications. 2. Explain about communication over internet. 3. Experiment with Arduino architecture and its Programming. 4. Develop distinct models using PIR Sensors. 5. Interpret the knowledge about integration of cloud platform.					
Course Content:						
Module 1	Introduction to IoT	Assignment	Quiz	**6 Sessions**		
Topics: IOT an Introduction – Scope of IOT - Basics of Networking - Communication in Smart Buildings - Impact Of IOT On Smart Buildings - Energy and Cost Efficiency						
Module 2	Communication Over Internet	Assignment	Data Collection	**6 Sessions**		
Topics: How Internet works – understanding the Design of a Communication Network – Wireless Communication Devices – Concept of ESP 8266 and its powering up.						
Module 3	Arduino and its Interfacing	Assignment	Case study	**7 Sessions**		
Topics: An Introduction to Arduino and its architecture – Arduino UNO connection and Detection – Programming in Arduino - ESP 8266 AT Commands – Interfacing with Arduino – Debugging Techniques.						
Module 4	Sensing in IOT	Assignment	Simulation/Data Collection	**7 Sessions**		
Topics: Sensors and Data Acquisition – PIR Sensors – Interfacing Arduino with Sensors – Sensor Calibration – Reading data from PIR Sensor.						
Module 5	Control and design of smart buildings using PIR for electrical loads	Simple model based on Case Study	Simulation/Data Collection	**7 Sessions**		
Topics: Relay and Electrical loads – interfacing relay drivers to Arduino – Programming logic – Thinkspeak API - Smart Building using PIR - Design the Arduino Sketch – Testing the model.						
Targeted Application & Tools that can be used:						

Application: To assess and analyze various parameters involved in a smart building using IOT. Professionally Used Software: Arduino, Python Programming.

Text Book

1. Internet of Things: Principles and Paradigms by Raj kumar Buyya and Amir vahid
2. Foundational elements of an IOT by Joe Biron &Jonathan Follett.
3. Exploring Arduino: Tools and Techniques for Engineering Wizardry 1st Edition by Jeremy Blum

References

1. Gao, Xinghua, et al. "Internet of Things Enabled Data Acquisition Framework for Smart Building Applications." *Journal of Construction Engineering and Management* 147.2 (2021): 04020169.
2. Sivagami, P., et al. "Smart Home Automation System Methodologies-A Review." *2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV)*. IEEE, 2021.
3. Zahra, Syed Rameem, and Mohammad Ahsan Chishti. "Smart Cities Pilot Projects: An IoT Perspective." *Smart Cities: A Data Analytics Perspective*. Springer, Cham, 2021. 231-255.
4. Hu, Ming. "Smart Building and Current Technologies." *Smart Technologies and Design For Healthy Built Environments*. Springer, Cham, 2021. 75-91.
5. Deng, Der-Jiunn, and Abderrahim Benslimane. "Innovation and Application of Internet of Things for Smart Cities." *Mobile Networks and Applications*: 1-2.

Online Learning Resources

1. https://www.i-scoop.eu/internet-of-things-iot/facility-management-iot-smart-buildings/
2. Case study: https://www.hindawi.com/journals/js/2018/1757409/
3. Seminar:https://puniversity.informaticsglobal.com
4. Ebook:https://puniversity.informaticsglobal.com

Topics relevant to the "SKILL DEVELOPMENT": Sensors and Data Acquisition – PIR Sensors – Interfacing Arduino with Sensors – Sensor Calibration – Reading data from PIR Sensor for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in the course handout.

Catalogue prepared by	**Dr. Nageswara Rao Atyam**
Recommended by the Board of Studies on	BoS No: 12th. BoS held on 27/7/21
Date of Approval by the Academic Council	16th Academic Council Meeting held on 23/10/21

<table>
<tr><td>Course Code:
EEE3101</td><td colspan="4">Course Title: Basic Circuit Analysis
Type of Course: Open Elective
Theory only</td><td>L-T- P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">This Course intends to provide a basic understanding of electrical circuits which are used in several applications like computer hardware, Automotive electronics, mobile communications and so on and its analysis using NI lab view. The course is both conceptual and analytical in nature and imparts the basic skills of developing the Simulink models, Programming and hardware interfacing through assignments and mini projects.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Basic Circuit Analysis and attain Skill Development through Problem Solving methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="9">On successful completion of this course the students shall be able to:
1. Explain Kirchhoff’s Voltage Law and Kirchhoff’s Current Law
2. Summarize Superposition theorem and Thevenin’s theorem for DC excitation.
3. Intrepret the behaviour of RL and RC circuits for DC and AC excitation.
4. Explain the concept of virtual Instrumentation using NI lab view
5. Demonstrate the Superposition theorem and Thevenin’s theorem for DC excitation</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="2">Basic concepts of circuits and AC fundamentals</td><td>Assignment</td><td colspan="3">Data sheet collection of resistors and inductors and validation of parameters values using NI lab view</td><td colspan="2">08 Sessions</td></tr>
<tr><td colspan="10">Topics:
Concept of Potential difference. Current and network elements, Ohm’s law, Kirchhoff’s laws, ideal and practical voltage and current sources, series and Parallel circuits , AC fundamentals</td></tr>
<tr><td>Module 2</td><td colspan="2">Mesh and Nodal analysis using NI lab View</td><td>Hands on Task & programming</td><td colspan="3">Lab-VIEW program with data acquisition and to measure resistance of a thermistor with change in the temperature</td><td colspan="2">08 Sessions</td></tr>
<tr><td colspan="10">Topics:
Basic Mesh and Nodal analysis for DC excitation only</td></tr>
<tr><td>Module 3</td><td colspan="2">Introduction to basic</td><td>Assignment</td><td colspan="3">Development of Simulink model and</td><td colspan="2">10 Sessions</td></tr>
</table>

	circuit theorems		Analysis using MATLAB & NI lab View	
Topics: Super position theorem, Maximum power Transfer theorem and Thevenin's theorem for DC excitation, Validation of Theorems with dependent sources, numerical on theorems.				
Module 4	Analysis of series RL and RC circuits with AC excitation using NI lab View	Assignment	Simulation using NI lab view and Analysis	**10 Sessions**
Topics: Analysis of series RL and RC circuits with AC excitation, voltage and current waveforms, Concept of leading, lagging and power factor.				
Targeted Application & Tools that can be used: The knowledge of basic circuit analysis is required in the fields of circuit design, computer hardware, Automotive electronics, mobile communications, power systems and power converter circuit analysis. Furthermore, the concepts of NI lab view will be helpful in data acquisition and analysis in several applications like process industries, Electric Vehicles, boiler operation and petrochemical industries. **Professionally Used Software:** NI Lab view /MATLAB				
Textbooks 1. Ravish.R.Singh, "Electrical Networks", Mcgraw Hill company,2009, 2nd Edition. 2. D.P. Kothari and Nagrath " Theory and Problems in electrical Engineering", PHI edition 2011				
References 1. V. N. Mittal and Arvind Mittal;, " Basic Electrical Engineering" McGraw Hill, 2nd Edition 2. Vincent DelToro, " Electrical engineering Fundamentals", PHI second edition 2011 **Online resources** 1. https://www.youtube.com/results?search_query=Lecture+on+KVL 2. https://www.tutorialspoint.com/network_theory/index.htm 3. https://nptel.ac.in/courses/108/105/108105159/ 4. https://puniversity.informaticsglobal.com				
Topics relevant to "SKILL DEVELOPMENT": Analysis of series RL and RC circuits with AC excitation, voltage and current waveforms, Concept of leading, lagging and power factor for **Skill Development** through **Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.				
Catalogue prepared by	Mr Bishakh Paul			
Recommended by the Board of Studies on	BoS No: 12th, held on 27/07/2021			
Date of Approval by the Academic Council	16th Academic Council meeting held on 23/10/2021			

Course Code: **EEE3102**	**Course Title: Fundamentals of Industrial Automation** **Type of Course: Open Elective & Theory only**		**L- T-P-C**	3	0	0	3
Version No.	1.0						
Course Pre-requisites	**NIL**						
Anti-requisites	**NIL**						
Course Description	This course deals with the PLC hardware/software and their importance in automation. SCADA deals with the communication protocols and real time control of power systems using EMS. The course is both conceptual and analytical in nature. It develops programming and simulation skills.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Industrial Automation and attain **Skill Development** through **Participative Learning** techniques.						
Course Outcomes	**On successful completion of this course the students shall be able to:** **1)** Explain about the architecture of PLCs 2)Apply PLC codes for automation applications requiring special functions. 3) Explain about the SCADA and communication technologies . 4)Apply SCADA for various utilities.						
Course Content:							
Module 1	Introduction to Programmable Logic Controllers:	Assignment	List all the PLC applications in industries like Siemens, ABB, Schneider Electric	**8 Sessions**			
Topics: Advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.							
Module 2	PLC Programming Methodologies:	Quiz	Programming	**7 Sessions**			
Topics: Ladder diagram, STL, functional block diagram, SFC, Instruction List. Creating ladder diagram from process control descriptions, Introduction to IEC61131 international standard for PLC.							
Module 3	Introduction to SCADA	Assignment	Simulation	**7 Sessions**			
Topics: Data acquisition system, Evolution of SCADA, Communication Technologies, Monitoring and Supervisory Functions.							
Module 4	Distributed Control Systems:	Case study	Simulation	**11 Sessions**			
DCS detail engineering, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc. Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC support, Security and Access Control etc. Performance Criteria for DCS and other automation tools.							
Targeted Application is **Siemens, ABB, Power-grid, Yokogawa Electric** **Tools that can be used: NI Lab-VIEW**							

Text Books

1. W.Boldon, 'Programmable logic controllers', 5th Edition, Elsevier India Pvt. Ltd., New Delhi, 2011.
2. Stuart A.Boyer, "SCADA: 'Supervisory control and Data Acquisition', 4th Edition, ISA, 2010.

References

1. Robert Radvanovsky, Jacob Brodsky, "Handbook of SCADA/Control Systems Security", 2nd edition, CRC press, 2016.
2. G. K. McMillan, Douglas Considine, "Process/Industrial Instruments Hand book", 5th edition, McGraw Hill, New York, 2009.

Online learning resources

1.Seminar https://electrical-engineering-portal.com/resources/plc-programming-training

2. Case Study: https://puniversity.informaticsglobal.com

3. Ebook**:**https://electrical-engineering-portal.com/download-center/books-and-guides/electrical-engineering/plc-book

Topics relevant to the "SKILL DEVELOPMENT": Data acquisition system, Evolution of SCADA, Communication Technologies, Monitoring and Supervisory Functions for **Skill Development** through **Participative Learning techniques**. This is attained through assessment component mentioned in the course handout.

Catalogue prepared by	Mr. Bishakh Paul
Recommended by the Board of Studies on	BoS No: 12th BoS held on 27/7/21
Date of Approval by the Academic Council	Academic Council Meeting No.16, Dated 23/10/21

Course Code: EEE3103	Course Title: Electric Vehicles & Battery Technology Open Elective and Theory Only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The Course is designed with an objective of giving an overview of Electric Vehicles and battery technology. The Course discusses the history, configurations of Electric vehicles and the electrical characteristics of batteries. The Course is conceptual and analytical in nature and needs fair knowledge of mathematical computation. The course develops the critical thinking and analytical skills.					
Course objective	The objective of the course is to familiarize the learners with the concepts of Electric Vehicles & Battery Technology and attain **Entrepreneurial Skills** through **Problem Solving** methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the working of Electric Vehicles and recent trends 2. Explain the working of Hybrid Electric Vehicles and recent trends 3. Summarize about the battery characteristic & parameters. 4. Summarize the importance of battery management system.					
Course Content:						

Module 1	Electric Vehicles	Assignment	Computation and Data Analysis
Topics: History of Electric vehicles, Configuration of Electric Vehicles, Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption.			
Module 2	Hybrid Electric Vehicles	Case Study	Data collection and Analysis
Topics: Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.			
Module 3	Energy storage for EV and HEV	Assignment	Any energy storage device
Topics: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells.			
Module 4	Battery Management Systems (BMS	Assignment	Case study
Topics: Introduction to Battery Management Systems (BMS), important terminology used to describe battery cells, Architecture of BMS, Classification of BMS, principles of operation of standard electrochemical battery cells.			

Targeted Application & Tools that can be used:

Application: Automotive industry.

Software tools: Matlab-Simulink

Text Book

1. Mehrdad Ehsani, YiminGao, sebastien E. Gay and Ali Emadi, —Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design‖, CRC Press, 2009.
2. Iqbal Husain, —Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011.

References

1. James Larminie and John Loury, —Electric Vehicle Technology-Explained‖, John Wiley & Sons Ltd., 2003.

2.C.C. Chan and K.T. Chanu Modern Electric Vehicle Technology, OXFORD University, 2011

3.Sheldon S. Williamson,- Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer,2013

4. Chris Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

Online resources:

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/courses/108/106/108106170/
3. Text book of Electric and Hybrid Vehicles : Power Sources, Models, Sustainability, Infrastructure and the Market, Gianfranco Pistoia, 1st ed. Amsterdam : Elsevier. 2010 https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=0&sid=52da4e6e-8813-45d5-87f9-73b9f493f358%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=342445&db=nl ebk
4. Seminar https://puniversity.informaticsglobal.com:2069/search/searchresult.jsp?newsearch=true&q ueryText=electric%20vehicles
5. Case Study: Data collection/Quiz based on the basics of batteries and the characteristics of energy storage devices used in EVs.

Topics relevant to "ENTREPRENEURIAL SKILLS": Vehicle fundamentals, total tractive effort and design of drive train for different vehicle architectures for developing **Entrepreneurial Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Topics relevant to "ENVIRONMENT AND SUSTAINABILITY": Types of Batteries, Materials of battery used, Fuel cell.

Catalogue prepared by	Mr. K Sreekanth Reddy
Recommended by the Board of Studies on	BoS No:14th BoS held on 22/2/2022
Date of Approval by the Academic Council	18th Academic Council meeting held on 03/8/2022

Course Code: EEE3104	**Course Title: Smart Sensors for Engineering Applications** **Type of Course: Open Elective &Theory Only**		**L-T- P-C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	Nil						
Anti-requisites	Nil						
Course Description	The course highlights the basics of sensors & transducers and on the integration of electronics and sensors to create a smart transducer or a system on a chip with multiple integrated devices. It also provides inputs in the selection of appropriate sensor based on requirement and application. The course is being analytical one it requires basic mathematical and computing knowledge.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of smart sensor for engineering **Entrepreneurial Skills** through **Participative Learning** techniques.						
Course Out Comes	On successful completion of the course the students shall be able to: 1) Explain the need of transducers, their classification and principle 2) Explain the principle of various types of sensors 3) Describe the fundamentals and general architecture of smart sensors. 4) Summarize the applications area of smart sensors.						
Course content:							
Module 1	Introduction to sensors & Transducers	Assignment	Quiz	**12 sessions**			
Introduction, Classification of transducers, Basic Principle, Different types of transducers: Resistive transducers, capacitive transducers, piezoelectric transducers, Temperature transducers							
Module 2	Sensor fundamentals	Assignment	Case study	**12 sessions**			
Sensor types and classification, Sensors parameters, Selection of sensors, Light sensing, technology, Proximity sensors: Inductive and capacitive, Pneumatic sensors, Motion sensors, Miscellaneous sensors							
Module 3	Components & Architecture of Smart Sensors	Mini project	Developing a measurement system /Programming task	**12 sessions**			
Smart Sensors, Components of Smart Sensors, General Architecture of Smart Sensors, Evolution of Smart Sensors, Advantages, Telemetry							
Module 4	Application area of Smart Sensors	Mini project continued	Developing a measurement system /Programming task	**9 sessions**			
Home Automation, Industrial, Medical, Robotics, Automobile, Aircrafts							

Targeted Application & Tools that can be used:
Application: Various types of Industries, Robotics, Automation of machines
List of Open Source Software/learning website: NPTEL, Matlab-Simulink, LabVIEW (NI),

Text Books

1. Sensor Systems: Fundamentals and Applications, Clarence W. De Silva, CRC press, 1st edition, 2016.
2. Understanding Smart Sensors- Randy Frank, 2nd Edition. Artech House Publications, 2013.
3. Lecture notes(L1) /PPT

References

1. A Course In Electrical And Electronic Measurements And Instrumentation, A. K. Sawhney, Dhanpat Rai publications, 4th edition
2. Smart sensor systems, Gerard C.M. Meijer, Willey Publications,2008, First Edition
3. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart
   Systems: Technology and modeling, Willey Publications,2012
4. Measurement and Instrumentation: Theory and Applicationc By Alan S Morris, Reza Langari, Academic press, Elsevier, 2015.
5. Data Acquisition and Signal Processing for Smart Sensors by Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadim Deynega, John Wiley & Sons Ltd

Online resources:

1. https://nptel.ac.in/courses/108/108/108108147/
2. https://nptel.ac.in/courses/112/108/112108092/
3. https://www.coursera.org/lecture/smart-device-mobile-emerging-technologies/2-4-sensors-0EIl
   https://puniversity.informaticsglobal.com

Topics relevant to the "SKILL DEVELOPMENT": Study of various types of smart sensors & transducers used for practical applications for **Skill Development** through **Participative Learning techniques**. This is attained through the assessment component mentioned in the course handout.

Catalogue prepared by	Ms. Ragasudha C P
Recommended by the Board of Studies on	BoS No: 14th BoS held on 22/02/22
Date of Approval by the Academic Council	18th Academic council Meeting held on 03/08/2022

Course Code: MEC3250	Course Title: Engineering Drawing Type of Course: Open Elective & lab based	L-T-P-C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course is designed with the objective of giving an overview of engineering drawing with the help of software tools. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings with computerized drafting tools. Computerized drafting provides accurate and easily modifiable graphic entities, easy data storage, easy retrieval facility and it enhances creativity. It will expose students to the concept of engineering drawing and teach them to draw different views of planes and solids in different orientations. The course will teach students to use AutoCAD to produce engineering drawings. They will learn to create drawing layouts, dimensioning, the theory of projection, orthographic projection of points, lines, planes and solids, isometric projection and be introduced to the development of surfaces.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Engineering Drawing" and attain ENTREPRENEURIAL SKILL through Experiential learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: (1) Demonstrate competency using AutoCAD graphics software as per BIS conventions and standards. (2) Comprehend the theory of projection for drawing projections of Points, Lines and Planes under different conditions. (3) Prepare multiview orthographic projections of Solids by visualizing them in different positions. (4) Prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions.					
Course Content						
Module 1	Introduction to Drawing	Assignment	Standard technical drawing		02 Sessions	
Topics: Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Line conventions, dimensioning, Selection of drawing sheet size and scale.						
Module 2	Orthographic projections of Points, Straight Lines and Plane Surfaces	Assignment	Projection methods Analysis		20 Sessions	

Topics:

Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points in all 4 quadrants.

Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only.

Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	15 Sessions

Topics:

Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron in different positions (Problems resting on HP only and First angle projection).

Module 4	Isometric Projections of Solids (Using isometric scale only)	Assignment	Spatial Visualization	8 Sessions

Topics:

Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects.

Targeted Application & Tools that can be used:

Application Area is in understanding and interpreting an object in various positions and converting it into a technical drawing which can be universally accepted.

Professionally Used Software: AutoCAD

Text Book:

1.N. D. Bhatt, "Engineering Drawing: Plane and Solid Geometry," Charotar Publishing House Pvt. Ltd.

References:

1. K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.

2. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.

3. D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill.

4. Engineering Graphics Manual provided by Instructor incharge.

Webresources :

Knimbus - Your Library. Anywhere, Anytime.

Topics relevant to "ENTREPRENEURIAL SKILLS ": Projection in First and third angle, Orthographic Projection for developing ENTREPRENEURIAL SKILLS through Experiential

Learning techniques. This is attained through the assessment component mentioned in the course handout.	
Catalogue prepared by	Mr. Yeshwanth D
Recommended by the Board of Studies on	BOS NO: 12th BoS held on 06/08/2021
Date of Approval by the Academic Council	16th Meeting of the Academic Council held on 23rd October, 2021

Course Code: MEC3251	Course Title: Supply Chain Management Type of Course: Open Elective & Theory only	L-T- P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to understand components of supply chain management, operational challenges in managing global supply chains and to develop the basic abilities in modelling supply chain. The course is both conceptual and analytical in nature. The course develops the analytical, critical thinking, and decision making skills. The course also enhances the problem solving abilities through assignments.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of " Supply Chain Management" and attain ENTREPRENEURIAL SKILL through Participative learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: (1) Summarize the drivers and their role in the performance of Supply Chain. 2) Construct Supply Chain Network according to the requirement of any particular type of product. 3] Solve forecasting and inventory related issues in Supply Chain in practice. 4] Estimate transportation requirements of global product in real life.					

	5] Interpret the impact of future technologies in Supply Chain Management.			
Course Content:				
Module 1	Introduction to SCM	Assignment	Data Collection and Analysis	10 Sessions
Topics: Understanding Supply Chain – Objectives, Importance and Decision phases in Supply Chain, Process and Cycle view, Examples of Supply Chain., Supply Chain Drivers – Various drivers, Framework for structuring drivers, Supply Chain Performance – Achieving strategic fit.				
Module 2	Designing the Supply chain Network	Case Study	Simulation and data analysis task	10 Sessions
Topics: Designing distribution network – The Role of Distribution in the Supply Chain, Factors Influencing Distribution Network Design. Network Design In The Supply Chain - The Role of Network Design in the Supply Chain, Framework for Network Design Decisions and Making Network Design Decisions in Practice. Designing Global Supply Chain Networks.				
Module 3	Planning and Coordinating Demand and Supply	Assignment	Data Collection and Analysis	10 Sessions
Topics: Demand forecasting, Aggregate Planning in Supply Chain, Coordination in Supply Chain. Managing economies of scale in a supply chain: Cycle inventory, Managing Uncertainty In A Supply Chain: Safety Inventory, Determining The Optimal Level of Product Availability.				
Module 4	Designing and Planning Transportation Networks	Case Study	Data collection and Programming	08 Sessions
Topics: Transportation In a Supply Chain - The Role of Transportation in a Supply Chain, Modes of Transportation and Their Performance, The Role of IT in Transportation. The Role of Sourcing in a Supply Chain, Third- and Fourth-Party Logistics Providers, Supplier Selection—Auctions and Negotiations.				

Module 5	Future Technologies in Supply Chain	Assignment	Simulation and Analysis	07 Sessions

Topics: Information Technology In a Supply Chain, The Supply Chain IT Framework. The Future Technologies in the Supply Chain – AI, Additive Manufacturing, Driverless Vehicles, IoT, Block Chain Technologies, Wearable Devices.

Targeted Application & Tools that can be used:

Application Area include almost all manufacturing organizations (Automotive – Hyundai, KIA, Ford etc.,) Processing industries (Petroleum – Reliance, Shell, HP etc.,), service industries like Banking, Hospital, etc. and E-commerce platforms like Amazon, Flipkart etc.

Professionally Used Software: SAP SCM, E2Open, Oracle SCM

Text Book

1. Chopra, S., & Meindl, P., "Supply Chain Management: Strategy, Planning, and Operation.". Pearson Bostan, Fifth Edition, 2013.

References

1. Hugos, M., "Essentials of Supply Chain Management", John Wiley & Sons, Inc., Third Edition, 2011.

2. Christopher. M., "Logistics & Supply Chain Management ", Prentice Hall., New Delhi, Fourth Edition, 2011.

Website: https://www.ascm.org

Supply Chain Management - New Perspectives by Sanda Renko , IntechOpen, 2011

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=INTECH_1_2610

Supply Chain Management - Applications and Simulations, Md. Mamun Habib IntechOpen, 2011.

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=INTECH_1_2609

Topics relevant to "ENTREPRENEURIAL SKILLS":The Future Technologies in the Supply Chain – AI, Additive Manufacturing, Driverless Vehicles, IoT, Block Chain Technologies for developing ENTREPRENEURIAL SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. R. Jothi Basu

Recommended by the Board of Studies on	BOS NO: 15th BOS held on 29/7/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022.

Course Code: MEC3252	Course Title: Six Sigma for Professionals Type of Course: Open Elective & Theory only	L- T-P-C	3	0	0	3
Version No.	2					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Six Sigma is a methodology of implementing a highly successful project, or producing a high-quality product or service, using techniques and principles that ensure excellence. The Six Sigma methodology incorporates many years of studying best practices in business and its goal is ultimately the creation of a nearly error-free business environment. This course will give a complete overview of the Six Sigma process and prepare to be a Six Sigma team member.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of " Six Sigma for Professionals" and attain ENTREPRENEURIAL SKILL through Participative learning techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: 1] Define the problem statement through customer analysis in terms of time, budget, and resource requirements. 2] Summarize a detailed process map by gathering baseline data. 3] Complete a root cause verification analysis by the help of inferential statistics and hypothesis testing. 4] Devise a preliminary implementation plan, update standard work procedures and write an action plan.			
Course Content:				
Module 1	Define Phase	Assignment	Data Collection	12 Sessions
Topics: Define Phase: The Basics of Six Sigma, The Fundamentals of Six Sigma, Selecting Six Sigma Projects.				
Module 2	Measure Phase	Case Study	Data Analysis	10 Sessions
Topics: Measure Phase: Process Definition, Six Sigma Statistics, Measurement System Analysis, Process Capability.				
Module 3	Analyze Phase	Assignment	Data Analysis	12 Sessions
Topics: Analyze Phase: Patterns of Variation, Inferential Statistics, Hypothesis Testing, Hypothesis Testing with Normal Data, Hypothesis Testing with Non-Normal Data.				
Module 4	Improve & Control Phase	Case Study	Data Analysis	11 Sessions
Topics: Improve and Control Phase: Simple Linear Regression, Multiple Regression Analysis, Statistical Process Control (SPC), Six Sigma Control Plans.				
Targeted Application & Tools that can be used:				

Application Area: Employ Six Sigma skills to lead a successful process improvement project to deliver meaningful results to the organization. Professionally Used Software: MINITAB/STATISTICA	
Textbook: 1. John Morgan, "Lean Six Sigma for Dummies ", A Wiley Brand, 3rd Edition 2015.	
References: 1. Michael George, David Rowlands, Mark Price, John Maxey, "The Lean Six Sigma Pocket Toolbook", The McGraw Hill Companies. 2. The council for six sigma certification, "SIX SIGMA, A Complete Step by Step Guide". W1:https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3610	
Topics relevant to "ENTREPRENEURIAL SKILLS": Improve and Control Phase: Simple Linear Regression, Multiple Regression Analysis, Statistical Process Control (SPC), Six Sigma Control Plans for developing ENTREPRENEURIAL SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	
Catalogue prepared by	Prof. Shashi Kiran G
Recommended by the Board of Studies on	BOS NO: 15TH BOS HELD ON 29/07/2022
Date of Approval by the Academic Council	Academic Council Meeting No.18,Dated 03/08/2022

Course Code: MEC3253	Course Title: Fundamentals of Aerospace Engineering Type of Course: Open Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to give an overview of the fundamentals of aerospace engineering. It will give an overview of the aircraft industry, discuss the different components of and different types of aircrafts, go into the mechanical, electrical, electronic and auxiliary					

	systems in aircrafts, discuss aircraft engines, pressurization, cover the basic principles of flight and space flight, and discuss various aircraft maneuvers.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of " Fundamentals of Aerospace Engineering" and attain ENTREPRENEURIAL SKILL through Problem solving methodologies.			
Course Outcomes	On successful completion of the course the students shall be able to: CO 1: Solve problems based on the concepts of flowing gases and the standard atmosphere CO 2: Apply the principles of basic aerodynamics to airfoils CO 3: Determine the thrust and power requirements for level, unaccelerated flight of an aircraft CO 4: Explain the criteria for longitudinal static stability for an airplane CO 5: Apply the basics of space vehicle trajectories to simple missions CO 6: Determine some propulsive characteristics of aircraft and rocket engines			
Course Content:				
Module 1	Introduction	Assignment	Data Analysis task	10 Sessions
Topics: Introduction, early developments, Sir George Cayley, Otto Lilienthal, Wilbur and Orville Wright. fundamental physical quantities of flowing gas, the source of all aerodynamic forces, equation of state for a perfect gas, anatomy of the airplane and a space vehicle, definition of altitude, the hydrostatic equation, geopotential and geometric altitudes, definition of the standard atmosphere, pressure, temperature and density altitudes.				
Module 2	Basic Aerodynamics	Assignment	Programming task and simulation	15 Sessions
Topics: The continuity equation, incompressible and compressible flow, momentum equation, elementary thermodynamics, isentropic flow, energy equation, speed of sound, low-speed subsonic wind tunnels, introduction to airfoils, airfoil nomenclature, lift, drag and moment coefficients, airfoil data, infinite versus finite wings, pressure coefficient, obtaining lift coefficient from the pressure coefficient.				
Module 3	Airplane Performance, Stability and Control	Assignment	Data Collection and Analysis	10 Sessions
Topics: The drag polar, equations of motion, thrust and power requirements for level, unaccelerated flight, thrust available and maximum velocity, power available and maximum velocity, definitions of stability and control, moments on the airplane, absolute angle of attack, criteria for longitudinal static stability.				

Module 4	Propulsion	Assignment	Data Collection and Analysis	10 Sessions

Topics:
Introduction, propeller, reciprocating engine, jet propulsion, turbojet engine, turbofan engine, ramjet engine, rocket engine, rocket propellants, rocket equation, rocket staging and propellant requirements for spacecraft trajectory maneuvers.

Targeted Application & Tools that can be used:

Application Area is Indian Space Research Organization (ISRO), Hindustan Aeronautics Limited (HAL), DRDO, General Electric(GE), Bombardier and many others

Professionally Used Software: XFLR, Aeolus.

Textbooks

T1 A. C. Kermode, Flight Without Formulae, Pearson Education, 10th Edition

T2 A. C. Kermode, Mechanics of Flight, Pearson Education, 5th Edition

References

R1 Shevell, Fundamentals of Flight, Pearson Education, 2nd Edition

R2 Dave Anderson, Introduction to Flight

R3 I. Moir, A. Seabridge, Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley

Web Resources:

Knimbus - Your Library. Anywhere, Anytime.

Topics relevant to "ENTREPRENEURIAL SKILLS": Aerodynamic forces Equation, propellers equation for developing ENTREPRENEURIAL SKILLS through Problem-Solving methodologies. This is attained through the assessment component mentioned in the course handout.

Catalogue prepared by	Mr. Yeshwanth D
Recommended by the Board of Studies on	12th BoS held on 06/08/2021
Date of Approval by the Academic Council	16th Meeting of the Academic Council held on 23rd October, 2021

Course Code: MEC3254	Course Title: Safety Engineering Type of Course: Open Elective/ Theory Only Course	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The Course is designed with an objective of giving an overview of study of Industrial Safety followed in industries such as various safety terms used, Fire Safety, Mechanical Safety, Electrical Safety, Chemical Safety followed by case studies to understand the industrial safety in detail.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of " Safety Engineering" and attain ENTREPRENEURIAL SKILL through Participative learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: Understand the basic safety terms and international standards. Identify the hazards and risk analysis around the work environment and industries. Use the safe measures while performing work in and around the work area of the available laboratories. Able to recognize the sign boards and its application Recognize the types of fires extinguishers and to demonstrate the portable extinguishers used for different classes of fires. Report the case studies by sharing experience of the employees working in housekeeping, laboratories etc. Recognize the chemical and electrical hazards for its prevention and control.					
Course Content:						
Module 1	Introduction to Safety	Case Study	Data Collection	10 sessions		
Topics: Terms used: accident, safety, hazard, safe, safety devices, safety guard, security, precaution, caution, appliance, slip, trip, fall. Ladders and scaffolding. Unsafe acts, reason for accidents, MSDS (material safety data sheet), OSHA, WHO. Lockout and tag out procedures. Safe material handling and storage. Case studies: Student should identify the unsafe acts near their surroundings like housekeeping, lab as well as industrial layouts, road safety, campus layout, safety signs.						
Module 2	Fire Safety	Term paper	Data Collection	10 sessions		

Topics: Introduction, Class A, B, C, D and E fire. Fire triangle, Fire extinguishers, Fire hazard and analysis, prevention of fire. Fire protection and loss prevention, steps after occurrence of fire. Notice-first aid for burns, Portable fire extinguishers. Fire detection, fire alarm and firefighting systems. Safety sign boards, instruction on portable fire extinguishers. Case studies: demonstration of fire extinguishers, visit to local firefighting stations. Visit to fire accident sites to analyze the cause of fire and its prevention for future.

Module 3	Mechanical Safety	Case Study	Data Collection	10 sessions

Topics: PPE, safety guards, safety while working with machine tools like lathe, drill press, power and band saws, grinding machines, safety during welding, forging and pressing. Safety while handling material, compressed gas cylinders, corrosive substance, waste drum and containers.

Case studies: Visit to machine shop, workshops, foundry lab and local industries to record the practical observation and report the same with relevant figures and comments.

Module 4	Electrical Safety	Assignment	Data Collection	08 sessions

Topics: Introduction to electrical safety, Indian standards on electrical safety, Electric hazards, effect of electric current on human body, causes of electrical accidents, prevention of electric accidents, PPE used. Electric shock. Primary and secondary electric shocks, AC and DC current shocks. Safety precautions against shocks. Safety precautions in small and residential building installations. Safety procedures in electric plant.

Module 5	Chemical Safety	Case Study	Data Collection	07 sessions

Topics: Introduction to Chemical safety, Labeling of chemicals, acid hoods. Handling of acids, eye ashers and showers. Safety thinking, accident investigation, safety policy of the company, safety, loss prevention and control, check list for LPG installations, safety precautions using CNG, fire prevention and safety audit, confined space entry, risk assessment.

Case studies: To visit chemical laboratory of the college and other chemical industries like LPG, CNG facilities and report.

Targeted Application & Tools that can be used:

Job profiles like Safety Engineer etc

Text Book

1. L M deshmukh, "Industrial Safety & Management". McGraw Hill Education (India) Private Limited, ISBN-13:978-0-07-061768-1.

2. S Rao, R K Jain & Sauja, "Electrical Safety, fire safety & safety management", Khanna Publishers, ISBN:978-81-7409-306-6.

References 3. A M Sarma, "Industrial Health & Safety Management", Himalaya Publishing House. 4. K S N Raju, "Chemical Process Industrial Safety", McGraw Hill Education (India) Private Limited, ISBN-13:978-93-329-0278-7 Web Links https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=960146&site=ehost-live https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=NAP_1_1600
Topics relevant to "ENTREPRENEURIAL SKILLS": Safety practices and handling of fire extinguisher, for mechanical, safety precautions using CNG, fire prevention and safety audit and Safety precautions against shocks for developing ENTREPRENEURIAL SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Mr. Basavaraj Devakki
Recommended by the Board of Studies on	11th BoS held on 05/09/2020
Date of Approval by the Academic Council	14th Meeting of the Academic Council held on 24/12/2020

Course Code: MEC3255	Course Title: Additive Manufacturing Type of Course: Open Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Students will be able to Understand the fundamentals of various Additive Manufacturing Technologies for application to various industrial needs. Able to convert part file into STL format. Able to understand the method of manufacturing of liquid based, powder based and solid based techniques. Understand the manufacturing procedure of a prototype using FDM technique.					

<table>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of “Additive Manufacturing ” and attain EMPLOYABILITY SKILL through Participative learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
1] Understand the fundamentals of Manufacturing Processes.
2] Understand the classifications of Manufacturing Process and methodologies of manufacturing for industrial applications.
3] Understand the fundamentals of Additive Manufacturing and its importance in Industrial Applications.
4] Understand the classifications of Additive Manufacturing and methodology of manufacturing the products using various technologies and study their applications, advantages and limitations.
5] Understand the methodology to manufacture the products using FDM technologies and study their applications, advantages and case studies.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to Manufacturing Technology</td><td>Assign ment</td><td>Identify the Major manufacturing Technologies and report the manufacturing capabilities</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction to Manufacturing Technology: Introduction, Prototyping fundamentals, Historical development, Advantages of MT, Commonly used terms, process chain, modelling, Classification of Manufacturing process, Applications to various fields.</td></tr>
<tr><td>Module 2</td><td>Manufacturing Processes</td><td>Assign ment</td><td>Literature review</td><td>12 Sessions</td></tr>
<tr><td colspan="5">Topics:
Manufacturing Processes: Working methodologies of different Manufacturing processes like Casting Process, Machining process, Joining process, Forming process, Machine tools, Cutting tools, Material Specifications, applications, advantages and limitations.</td></tr>
<tr><td>Module 3</td><td>Introduction to Additive Manufacturing (AM)</td><td>Assign ment</td><td>Identify the Major manufactures in India for 3D printing and report the manufacturing capabilities</td><td>12 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction to Additive Manufacturing: Introduction, Prototyping fundamentals, Historical development, Advantages of AMT, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats</td></tr>
</table>

Module 4	AM processes and Software	Assign ment	Decision Tree	11 Sessions

Topics:

AM Processes: Classifications of Additive Manufacturing, Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, Cura Software, Slicing, DFAM ,applications, advantages and limitations.

Targeted Application & Tools that can be used:

Application Area is rapid prototyping, product design and development industries

Professionally Used Software: 3D Modeling software.

Text Book;

Jing Zhang; Yeon-Gil Jung, "Additive manufacturing: materials, processes, quantifications and applications", Cambridge, Massachusetts: Elsevier, 2018.

Salvatore Brischetto, Paolo Maggiore and Carlo Giovanni Ferro (Eds.), "Additive Manufacturing Technologies and Applications" MDPI -2017

References

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific, 2003.

2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

3. Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006

4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001

Web Resources:

https://presiuniv.knimbus.com/user#/searchresult?searchId=elements%20of%20Mechanical%20Engineering&_t=1659588753433

Topics relevant to "EMPLOYABILITY SKILLS":3d modelling, Application of AM for developing EMPLOYABILITY SKILLS through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.

Catalogue prepared by	Priyanka S Umarji
Recommended by the Board of Studies on	BOS NO: 15th BOS held on 27/8/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 18, Dated 03/08/2022

Course Code: MEC3256	Course Title: Sustainable Technologies and Practices Type of Course: Open Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This open elective course aims to provide students with a comprehensive understanding of sustainability principles and their applications in the fields of computer science, mechanical engineering, and electronics. The course explores the challenges and opportunities associated with sustainability, equipping students with the knowledge and skills to develop and implement sustainable technologies and practices in their respective engineering disciplines. Through a combination of theoretical learning, case studies, and hands-on projects, students will gain a multidisciplinary perspective on sustainability and its relevance to the rapidly evolving technological landscape.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of " "Sustainable Technologies and Practices" and attain ENTREPRENEURIAL SKILL through Participative learning techniques					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Introduce students to the fundamental concepts and principles of sustainability and their significance in engineering disciplines. 2. Familiarize students with the latest sustainable technologies and practices in science and engineering. 3. Enable students to analyse the environmental, social, and economic impacts of engineering projects and propose sustainable alternatives. 4. Cultivate critical thinking and problem-solving skills to address sustainability challenges in engineering through project-based learning.					
Course Content:						
Module 1	Introduction to Sustainability	Assignment				10 sessions
Topics: Definition of sustainability and its relevance to engineering, Global environmental challenges and the role of technology in addressing these, Ethical considerations and the social dimension						

of sustainability, Life cycle assessment (LCA) methodologies, Carbon footprint analysis and reduction strategies				
Module 2	Sustainable Computing	Case Study	Simulation and data analysis task	10 sessions
Topics: Green computing and energy-efficient algorithms, Data center optimization and energy management				
Module 3	Sustainable Mechanical Engineering	Assignment	Simulation and data analysis task	10 sessions
Topics: Renewable energy systems and their integration, Energy-efficient design principles, Sustainable manufacturing processes				
Module 4	Sustainable Electronics engineering	Assignment	Simulation	08 sessions
Topics: Energy-efficient electronic devices and components, Energy harvesting and power management, Responsible electronic waste management				
Module 5	Sustainable Project Management	Assignment	Simulation/Data Analysis	07 sessions
Topics: Sustainability assessment frameworks and tools, Sustainability project planning and decision making				
Targeted Application & Tools that can be used: Contemporary issues: One contemporary issue in this course is the growing concern over e-waste management and the need for responsible disposal and recycling of electronic devices. Another issue is the increasing demand for energy-efficient computing systems and the development of green computing strategies to reduce the environmental impact of data centers and algorithms. Professionally Used Software: SimaPro, GaBi, EnergyPlus				
Textbooks: 1. R L Rag, L D Ramesh. "Introduction to Sustainable Engineering", PHI publication. 2. David T Allen, David R Shonnard. "Sustainable Engineering- Concepts, Design and Case Studies, Pearson 3. Munier, Nolberto. Introduction to sustainability. Amsterdam, The Netherlands: Springer, 2005.				
References 1. Portney, Kent E. Sustainability. MIT Press, 2015.				

<table>
<tr><td colspan="2">2. Green IT Strategies and Applications Using Environmental Intelligence By Bhuvan Unhelkar

1st Edition, Pub. Location Boca Raton, CRC Pres.

3. Kim, Jae H., and Myung J. Lee, eds. Green IT: technologies and applications. Vol. 26. No. 11. Berlin: Springer, 2011.

4. Graedel, Thomas E., and Braden R. Allenby. "Industrial ecology and sustainable engineering." (No Title) (2010).

5. Bakshi, Bhavik R. Sustainable engineering: principles and practice. Cambridge University Press, 2019.</td></tr>
<tr><td colspan="2">Topics relevant to “ENTREPRENEURIAL SKILLS”:Data center optimization, Energy-efficient electronic devices and components, Green computing and energy-efficient algorithms for developing ENTREPRENEURIAL SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout</td></tr>
<tr><td>Catalogue prepared by</td><td>Dr. Devendra Singh Dandotiya,

Dr. Udaya Ravi M</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>17th BOS, 08/07/2023</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td>6/9/2023</td></tr>
</table>

Course Code: MEC3257	Course Title: Industry 4.0 Type of Course: Open Elective & Theory only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course provides students with an introduction to Industry 4.0, its building blocks, its applications and advantages compared to conventional production techniques. Learners get a deep insight into how intelligent processes, big data, and artificial intelligence can be used to build up the production of the future. Also enabling design principles that support companies in identifying and implementing various Industry 4.0 scenarios and the key technologies for smart factories. The course also discusses the Impact of Industry 4.0 on Society: Impact on Business, Government, People etc & also future framework of Industry 4.0.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of "Industry 4.0" and attain ENTREPRENEURIAL SKILL through Participative learning techniques			
Course Outcomes	On successful completion of this course the students shall be able to: (1) Understand the basic concepts of Industry 4.0 and scope for Indian Industry (2) Demonstrate conceptual framework and road map of Industry 4.0 (3) Apply Industry 4.0 for various fields of application (4) Understand the Impact to Industry 4.0 for various fields of application			
Course Content:				
Module 1	Introduction to Industry 4.0	Assignment	Case Study	12 Sessions
Topics: Introduction, History, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality , How is India preparing for Industry 4.0				
Module 2	Conceptual Framework for Industry 4.0	Case Study	Simulation and data analysis task	10 Sessions
Topics: Introduction, Main Concepts and Components of Industry 4.0, The Basic Characteristics of Industry 4.0, General framework, The Industry 4.0 Model Framework				
Module 3	Applications of Industry 4.0	Assignment	Data Collection and Analysis	10 Sessions
Topics: Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation Logistics .				
Module 4	Impact of Industry 4.0	Assignment	Case Study	13 Sessions
Topics:				

Impact of Industry 4.0 on Society: Impact on Business, Government, People. Education 4.0 – Curriculum 4.0 – Faculty 4.0 – Skills required for Future - Framework for aligning Education with Industry 4.0 – Framework for achieving next ten years vision – Challenges
Targeted Application & Tools that can be used: Application Area are wearables (Samsung, Apple), health (GE Healthcare), traffic monitoring (Waze, google maps), fleet management, smart grid and energy saving (PowerGrid), agriculture, hospitality etc. Professionally Used Software: Kinoma, Arduino, Device Hive, Riot etc.
References 1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation". 2. Bartodziej, Christoph Jan,"The Concept Industry 4.0". 3. Klaus Schwab,"The Fourth Industrial Revolution". 4. Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises". E Resource https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueue_id=DOAB_1_2964
Topics relevant to "ENTREPRENEURIAL SKILLS":Industry 4.0 technologies, Big Data, Artificial Intelligence (AI), Industrial Internet of Things (IoT), Cyber Security , Cloud and Augmented Reality for developing ENTREPRENEURIAL SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Dr. Ramachandra C G
Recommended by the Board of Studies on	17th BOS, dated 08/07/2023
Date of Approval by the Academic Council	6/9/2023

Course Code: **PET3302**	**Course Title:** **Energy Sustainability Practices** **Type of Course:** **1] Open Elective Course** **2] Theory Only**			**L-T-P-C**	3	0	0	3
Version No.:	1.0							
Course Pre-requisites:	NIL							
Anti-requisites:	NIL							
Course Description:	This course offers an in-depth exploration of both renewable and non-renewable energy sources, focusing on the technologies, environmental impacts, and policies that drive sustainable energy practices. Students will engage with theoretical concepts and practical applications, equipping them with the knowledge and skills needed to contribute effectively to the field of energy sustainability.							
Course Objective:	The objective of the course is to familiarize the learners with the concepts Energy Sustainability Practices and attain **Skill Development** through **Participative Learning** techniques.							
Course Outcomes:	Upon successful completion of the course the students shall be able to: CO1: Explain key concepts of energy sustainability, CO2: Explain the role of emerging renewable technologies in sustainable energy systems, CO3: Summarise the principles and technologies of carbon capture and storage, CO4: Illustrate the role of smart grids and energy storage in energy sustainability.							
Course Content:								
Module 1:	Fundamentals of Energy Sustainability	Assignment / Quiz	Analytical Skills Development	09 Periods				
Topics: Overview of Energy Sustainability, Global Energy Landscape and Challenges, Environmental Impact of Energy Production and Consumption, Energy Policy and Regulation for Sustainability, Introduction to Life Cycle Assessment (LCA).								
Module 2:	Renewable Energy Sources and Technologies	Assignment / Quiz	Analytical Skills Development	11 Periods				
Topics: Solar Energy: Photovoltaics and Solar Thermal Systems, Wind Energy: Onshore and Offshore Technologies, Hydropower: Large-scale and Small-scale Systems, Biomass and Bioenergy, Emerging Renewable Technologies: Geothermal, Ocean Energy, and Hydrogen.								
Module 3:	Non-Renewable Energy Sources and their Impacts	Poster Presentation	Verbal Communication Skill Development	09 Periods				
Topics: Fossil Fuels: Coal, Oil, and Natural Gas, Nuclear Energy: Fission and Fusion Technologies, Environmental and Health Impacts of Non-Renewable Energy, Carbon Capture and Storage (CCS), Transition Strategies from Non-Renewable to Renewable Energy.								
Module 4:	Energy Efficiency and Sustainable Practices	e-Resource Review	Literature Survey and Report Submission	11 Periods				
Topics: Principles of Energy Efficiency, Energy-Efficient Technologies for Buildings, Industrial Energy Efficiency Practices, Sustainable Transportation Solutions, Smart Grids and Energy Storage.								
Targeted Applications and Tools that can be used:								

Applications: Energy Management, Policy, and Technology Development and related fields.
Tools: EIA Open Data, MATLAB Simulink.

Text Books:

T1. "Sustainable Policies and Practices in Energy, Environment and Health Research: Addressing Cross-cutting Issues", Diogo Guedes Vidal, Maria Alzira Pimenta Dinis, Ricardo Cunha Dias, Walter Leal Filho, Springer International Publishing, 2021.
T2. "Renewable Energy and Green Technology: Principles and Practices", Amit Kumar, Hukum Singh, Narendra Kumar, CRC Press, 2021.
T3. "Sustainability and Energy Management: Innovative and Responsible Business Practices for Sustainable Energy Strategies of Enterprises in Relation with CSR", Gregor Weber, Springer Fachmedien Wiesbaden, 2017.
T4: "An Introduction to Sustainable Transportation: Policy, Planning, and Implementation", Preston L. Schiller, and Jeffrey R. Kenworthy, Routledge, 1st Edition, 2010.

Reference Books:

R1. "Introduction to Renewable Energy", Vaughn C. Nelson, and Kenneth L. Starcher, CRC Press, 2nd Edition, 2016.
R2. "Transport, Climate Change and the City", Robin Hickman, and David Banister, Routledge, 1st Edition, 2014.
R3. "Sustainable Energy: Choosing Among Options" by Elisabeth M. Drake, Jefferson W. Tester, Michael J. Driscoll, Michael W. Golay, and William A. Peters, MIT Press, 2nd Edition, 2012.
R4. "The Quest: Energy, Security, and the Remaking of the Modern World", Daniel Yergin, Penguin Publication, Revised and Updated Version, 2012.
R5. "Renewable Energy: Power for a Sustainable Future", Godfrey Boyle, Oxford University Press, 3rd Edition, 2012.

e-resources:

1. Link for PU e-resources: https://presiuniv.knimbus.com/user#/home
2. Project Drawdown: https://drawdown.org/
3. UN Sustainable Development Goals (SDGs): https://sdgs.un.org/
4. GreenBiz: https://www.greenbiz.com/
5. Global Footprint Network: https://www.wri.org/
6. Environmental Protection Agency (EPA) on Sustainability: https://www.epa.gov/sustainability
7. Courses on Coursera Online Platform: https://www.coursera.org/en-IN

TED Talks on Sustainability: https://www.ted.com/topics/sustainability

Skill Sets: Topics relevant to **"SKILL DEVELOPMENT"**: Carbon Capture and Storage (CCS), Transition Strategies from Non-Renewable to Renewable Energy, Energy-Efficient Technologies for Buildings, Industrial Energy Efficiency Practices, Sustainable Transportation Solutions, Smart Grids and Energy Storage for **Skill Development** through **Participative Learning** techniques**.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by:	Mr. Bhairab Jyoti Gogoi, Dr. Abhinav Kumar, and Dr. Suman Paul
Recommended by the Board of Studies on:	18th Meeting of the Board of Studies held on 4th July, 2024
Date of Approval by the Academic Council:	24th Meeting of the Academic Council held on 3rd August, 2024

<table>
<tr><td>Course Code:
PET3301</td><td colspan="4">Course Title: Energy Industry Dynamics

Type of Course: 1] Open Elective Course
2] Theory Only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.:</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites:</td><td colspan="9">NIL</td></tr>
<tr><td>Anti-requisites:</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description:</td><td colspan="9">This course provides a comprehensive understanding of the complex and evolving energy sector, focusing on the interplay between market forces, technological advancements, policy frameworks, and environmental considerations. Students will have a thorough understanding of the dynamics within the energy industry, enabling them to analyze market trends, evaluate policy impacts, and contribute to the development and implementation of innovative energy solutions.</td></tr>
<tr><td>Course Objective:</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Energy Industry Dynamics and attain Skill Development through Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="9">Upon successful completion of the course the students shall be able to:
CO1: Classify the various sources of energy and their characteristics,
CO2: Demonstrate energy efficiency technologies in practical scenarios,
CO3: Identify the processes involved in energy trading and risk management,
CO4: Select policy and regulatory changes needed for sustainable energy development.</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1:</td><td colspan="3">Introduction to the Energy Industry</td><td>Assignment / Quiz</td><td colspan="3">Analytical Skills Development</td><td>09 Periods</td></tr>
<tr><td colspan="10">Topics:
Overview of Energy Sources - Renewables and Non-renewables, History and Evolution of the Energy Industry, Sectors in Energy Industry, Energy Demand and Supply Dynamics, Energy Policy and Regulation, Environmental Impact of Energy Production and Consumption.</td></tr>
<tr><td>Module 2:</td><td colspan="3">Energy Production and Technologies</td><td>Assignment / Quiz</td><td colspan="3">Analytical Skills Development</td><td>11 Periods</td></tr>
<tr><td colspan="10">Topics:
Exploration and Production of Fossil Fuels, Renewable Energy Technologies - Solar, Wind, Hydro, and Biomass, Nuclear Energy Production, Advances in Energy Storage and Grid Management, Energy Efficiency Technologies.</td></tr>
<tr><td>Module 3:</td><td colspan="3">Energy Markets and Economics</td><td>Poster Presentation</td><td colspan="3">Verbal Communication Skill Development</td><td>09 Periods</td></tr>
<tr><td colspan="10">Topics:
Structure and Dynamics of Energy Markets, Pricing Mechanisms and Market Regulation, Energy Trading and Risk Management, Economics of Energy Production and Consumption, Case Studies of National and Regional Energy Markets.</td></tr>
<tr><td>Module 4:</td><td colspan="3">Future Trends and Innovations in the Energy Industry</td><td>e-Resource Review</td><td colspan="3">Literature Survey and Report Submission</td><td>11 Periods</td></tr>
<tr><td colspan="10">Topics:
Transition to Sustainable Energy Systems, Technological Innovations in Energy, Policy and Regulatory Changes for Sustainable Energy, Impact of Digitalization and Smart Grids, Energy Industry's Role in Climate Change Mitigation.</td></tr>
</table>

Targeted Applications and Tools that can be used:

Applications: Energy Management, Policy, and Technology Development and related fields.

Tools: EIA Open Data, MATLAB Simulink.

Text Books:

T1. "Energy Market and Energy Transition: Dynamics and Prospects", Dayong Zhang, Farhad Taghizadeh-Hesary, Phoumin Han, Qiang Ji, Xunpeng (Roc) Shi, Frontiers Media SA, 2021.

T2. "Innovation Dynamics and Policy in the Energy Sector: Building Global Energy Markets, Institutions, Public Policy, Technology and Culture on the Texan Innovation Example", Milton L. Holloway, Elsevier Science, 2021.

T3. "Dynamics of Energy, Environment and Economy: A Sustainability Perspective", Hassan Qudrat-Ullah, Muhammad Asif, Springer International Publishing, 2020.

T4. "Fundamentals of Oil & Gas Industry for Beginners", Samir Dalvi, Notion Press; 1st Edition, 2015.

Reference Books:

R1. "Renewable Energy in India: Economics and Market Dynamics", Pramod Deo, Sushanta Kumar Chatterjee, Shrikant Modak, Sage PublicationsIndia Pvt Limited, 2021.

R2. "Handbook of Energy Economics and Policy - Fundamentals and Applications for Engineers and Energy Planners", Alessandro Rubino, Alessandro Sapio, and Massimo La Scala, Elsevier, 2021.

R3. "Energy Economics: Concepts, Issues, Markets, and Governance", Subhes C. Bhattacharyya, Springer, 2019.

R4. "Energy Economics: Markets, History and Policy", Roy L. Nersesian, Routledge; 1st Edition, 2016.

R5. "The Quest: Energy, Security, and the Remaking of the Modern World", Daniel Yergin, Penguin Publication, Revised and Updated Version, 2012.

R6. "Renewable Energy: Power for a Sustainable Future", Godfrey Boyle, Oxford University Press, 2012.

e-resources:

1. Link for PU e-resources: https://presiuniv.knimbus.com/user#/home
2. The Oil and Gas Industry in Net Zero Transitions: https://www.youtube.com/watch?v=NcGyZfIPtOw
3. Energy Information Administration https://www.eia.gov/energyexplained/
4. Energy Information Administration (EIA) Reports: https://www.eia.gov/
5. International Energy Agency (IEA) Reports: https://www.iea.org/
6. Renewable Energy World Reports: https://www.renewableenergyworld.com/
7. The U.S. Department of Energy (DOE) Reports: https://www.energy.gov/
8. Energy Central Reports: https://energycentral.com/

World Energy Council Reports: https://www.worldenergy.org/

Skill Sets: Topics relevant to **"SKILL DEVELOPMENT"**: Advances in Energy Storage and Grid Management, Energy Efficiency Technologies, Pricing Mechanisms and Market Regulation, Energy Trading and Risk Management, Economics of Energy Production and Consumption, Technological Innovations in Energy, Policy and Regulatory Changes for Sustainable Energy, Impact of Digitalization and Smart Grids for **Skill Development** through **Participative Learning** techniques**.** This is attained through assessment component mentioned in course handout.

Catalogue prepared by:	Mr. Bhairab Jyoti Gogoi, Dr. Abhinav Kumar, and Dr. Suman Paul
Recommended by the Board of Studies on:	18th Meeting of the Board of Studies held on 4th July, 2024
Date of Approval by the Academic Council:	24th Meeting of the Academic Council held on 3rd August, 2024