PRESIDENCY UNIVERSITY

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PROGRAMME REGULATIONS & CURRICULUM

2021-25

PRESIDENCY SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

BACHELOR OF TECHNOLOGY (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

PRESIDENCY SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Program Regulations and Curriculum

2021-2025

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/2021-25

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

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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 2021-2025 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 2021-2022.

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-P-C" means Lecture-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, 2021-2025;*

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 2021-2025 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 2021-2025 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 Electrical and Electronics Engineering, abbreviated as B.Tech. (Electrical and Electronics Engineering)
4. Bachelor of Technology in Mechanical Engineering, abbreviated as B.Tech. (Mechanical Engineering); and
5. 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 Regulations), 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 Academic 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 able to:

PEO1. Acquire core competence in basic science and civil engineering.

PEO2. Constantly pursue the professional growth with multidisciplinary outlook.

PEO3. Work with high professionalism and ethical standards.

PEO4. 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 12.5 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) shall 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	100%

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 found.** 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 the 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 calculation of the CGPA.

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

The B.Tech. (Civil Engineering) Program Structure (2021-2025) totalling 160 credits. Table 3 summarizes the type of baskets, and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: B.Tech. (Civil Engineering) 2021-2025: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Baskets	Credit Contribution
SCHOOL CORE (SC)	54
PROGRAM CORE (PC)	61
DISCIPLINE ELECTIVE (DE)	30
OPEN ELECTIVE (OE)	15
TOTAL CREDITS	**Min. 160**

The curriculum structure is designed as per the CBCS and incorporating OBE Principles. The students are provided with at most flexibility in selection of the courses of their choice.

The curriculum provides an opportunity to the students to obtain a specific specialization in the basic degree of Bachelor of Technology in Civil Engineering in the following domains:

1] Infrastructure Development
2] Smart Cities

To obtain a specialisation in any one of the above domains. the student must register and earn minimum credits for discipline electives courses from the various baskets as indicated in Table 3.1.

Table 3.1: Minimum Credits from various baskets for each specialization

Specialization	**Discipline Elective Baskets**					
	General	Structural Engineering	Transportation and Geotechnical Engineering	Water Resources and Environmental Engineering	Infrastructure Development	Smart Cities
Infrastructure Development	-	-	-	-	15	-
Smart Cities	-	-	-	-	-	15
General	-	3	3	3	-	-

A student will have to complete a minimum of 15 credits of Discipline Electives from a given specialization basket, to earn a specialization certificate in addition to the base degree to which he/she has taken admission.

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 3.2: List of School Core Courses (SC)					
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**
1	MAT1001	Calculus and Linear Algebra	3	2	4
2	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	3
3	MAT1003	Applied Statistics	1	2	2
4	MAT2003	Numerical Methods for Engineers	1	2	2
5	CSE1001	Problem Solving using JAVA	2	2	3
6	CSE2001	Data Structures and Algorithms	3	2	4
7	CSE1002	Innovation Project - Arduino using C	0	4	2
8	CSE 1003	Innovation Project - Rasberry Pi using Python	0	4	2
9	PIP2001	Capstone Project	-	-	4
10	PIP4001	Internship	-	-	10
11	PIP1001	Apprenticeship	-	-	0
Electrical and Electronics Basket					
Minimum credits to be earned from this basket =					**4**
1	ECE1001	Elements of Electronics Engineering	3	2	4
2	EEE1001	Fundamentals of Electrical and Electronics Engineering	3	2	4
Modern Physics Basket					
Minimum credits to be earned from this basket =					**3**
1	PHY1001	Material Physics	2	2	3
2	PHY1002	Optoelectronics and Advanced Physics	2	2	3
English and Foreign Languages Basket					
Minimum credits to be earned from this basket =					**4**
1	ENG1001	Foundation English	1	2	2
2	ENG1002	Technical English	1	2	2
3	ENG2001	Advanced English	1	2	2
4	FRL1001	Basic Spanish	2	0	2
5	FRL1002	Basic French	2	0	2
6	FRL1003	Basic German	2	0	2
7	FRL2001	Proficiency in French	3	0	3
Kannada Basket					
Minimum credits to be earned from this basket =					**1**
1	KAN1001	Kali Kannada	1	0	1
2	KAN2001	Thili Kannada	1	0	1

Soft Skills Basket (All Courses in this basket are mandatory)					
Minimum credits to be earned from this basket =					**6**
1	PPS1001	Introduction to soft skills	0	2	1
2	PPS1002	Soft Skills for Engineers	0	2	1
3	PPS2001	Reasoning and Employment Skills	0	2	1
4	PPS2002	Being Corporate Ready	0	2	1
5	PPS4002	Introduction to Aptitude	0	2	1
6	PPS3002	Programming skills for employment	0	2	1
Non-Credit Pass/Fail Type Courses					
1	CHE1001	Environmental Studies	-	-	**0**
				Total No. of Credits	**54**

Table 3.3: List of Program Core Courses (PC)

Sl. No.	Course Code	Course Name	L	P	C
1	CIV1003	Elements of Engineering Mechanics	2	0	**2**
2	CIV2046	Construction Technology and Processes	3	0	**3**
3	CIV1004	Basic Construction Practice	0	2	**1**
4	CIV2007_v02	Strength of Materials	3	0	**3**
5	CIV2008_v02	Engineering Geology	1	2	**2**
6	CIV1005_v02	Surveying	3	2	**4**
7	CIV1006	Building Materials and Concrete Technology	2	0	**2**
8	CIV1007	Building Planning and Drawing	0	2	**1**
9	CIV2009_v02	Fluid Mechanics	3	0	**3**
10	CIV2048	Fluid Mechanics Lab	0	2	**1**
11	CIV2010	Hydrology and Irrigation Systems	3	0	**3**
12	CIV2013	Analysis of Determinate Structures	3	0	**3**
13	CIV3002	Analysis of Indeterminate Structures	3	0	**3**
14	CIV3003	Design of RCC Structural Elements	3	0	**3**
15	CIV3047_v02	Fundamentals of Pre-Stressed Concrete Design	2	0	**2**
16	CIV3004_v02	Design of Structural Steel Elements	3	0	**3**
17	CIV2014	Basic Materials Testing Lab	0	2	**1**
18	CIV2015_v02	Geotechnical Engineering	3	0	**3**
19	CIV2049	Geotechnical Engineering Lab	0	2	**1**
20	CIV3027_v02	Foundation Engineering	2	0	**2**
21	CIV2016	Transportation Engineering	3	0	**3**
22	CIV2047	Water Infrastructure Systems	3	0	**3**
23	CIV3035_v02	Waste Water Treatment and Disposal Systems	2	0	**2**
24	CIV2050	Environmental Engineering Lab	0	2	**1**
25	CIV3001_v02	Estimation, Costing and Valuation	2	0	**2**
26	CIV2035_v02	Construction Project Management	2	2	**3**
27	CIV2018	Concrete and Highway Materials Testing Lab	0	2	**1**
				Total Number of Credits	**61**

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 12-16 weeks in an industry / company or academic / research institution during the 8th Semester, subject to the following conditions:

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

18.1.1. 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;

18.1.2. 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 2.6.1.2 above.

18.1.3. 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.

18.1.4. 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 17.2.1). 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 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 17.4.1). 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 3.4: Discipline Elective Courses (DE)										
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites / Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**
General Basket										
1.	CIV3005	Computer Aided Analysis & Detailing Lab	1	4	3	EM	HP	CIV1007, CIV3003, CIV3004		
2.	CIV2012	Building Information Modelling	1	4	3	EM	-	CIV1007		
3.	CIV3024	Remote Sensing and Geographical Information System	2	2	3	EM	-	CIV2008, CIV1005		
4.	CIV3048	Extensive Survey Project (Mandatory)	-	-	3	EM	ES/ HP	CIV1005, CIV2016, CIV1007, CIV2047		
5.	CIV2020	Alternative Building Materials	3	0	3	EM	ES	CIV1006		
6.	CIV2021	Design Concepts of Building Services	3	0	3	EM	HP	CIV1007, CIV3001		
7.	CIV2052	Integration of SDGs in Civil Engineering	3	0	3	EM	ES	CHE1001		
8.	CIV4009	Optimization methods for Civil Engineering	3	0	3	EM	-	MAT1001, MAT1002		
9.	CIV2053	Development and Applications of Special Concretes	3	0	3	EM	-	CIV1006		
10.	CIV2055	Safety in Construction	3	0	3	EM	-	CIV2046		
Structural Engineering Basket										
1.	CIV2019	Advanced Concrete Technology	3	0	3	EM	ES	CIV1006, CIV2018		
2.	CIV3007	Structural Dynamics	3	0	3	EM	-	MAT1002, MAT2001, CIV3002		
3.	CIV3008	Advanced RCC structures	3	0	3	EM	HP	CIV3002, CIV3006, CIV3003		
4.	CIV3009	Design of Industrial structures	3	0	3	EM	HP	CIV3002, CIV3006, CIV3003, CIV3004		
5.	CIV3010	Repair and rehabilitation of structures	3	0	3	EM	ES	CIV3003, CIV3004		
6.	CIV3011	Matrix methods of structural analysis	3	0	3	EM	-	CIV3002		
7.	CIV3012	Masonry structures	3	0	3	EM	ES	CIV1006, CIV3002		

Table 3.4: Discipline Elective Courses (DE)										
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites / Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**
8.	CIV3013	Advanced Design of Steel Structures	3	0	3	EM	ES	CIV3002, CIV3004		
9.	CIV3014	Design of Retaining Structures	3	0	3	EM	ES	CIV3002, CIV3006, CIV3003		
10.	CIV3015	Elements of Earthquake Engineering	3	0	3	EM	-	CIV2008, CIV2015, CIV3003, CIV3004		CIV4004
11.	CIV3016	Bridge Design	3	0	3	EM	ES	CIV3003, CIV3004		
12.	CIV3017	Stability of Structures	3	0	3	EM	-	MAT1002, MAT2001		
13.	CIV3018	Pre-fabricated Structures	3	0	3	EM	ES	CIV3004, CIV3003		
14.	CIV4001	Finite Element Method	3	0	3	EM	-	CIV3002, CIV4001		
15.	CIV4002	Theory of Elasticity	3	0	3	EM	-	CIV2007		
16.	CIV4003	Advanced Prestressed Concrete Design	3	0	3	EM	ES	CIV3003		
17.	CIV4004	Earthquake resistant Design of Structures	3	0	3	EM	HP	CIV3015		
18.	CIV4010	Offshore Structures	3	0	3	EM	-	CIV3002, CIV3003		
19.	CIV3049	Structural Health Monitoring	3	0	3	EM	HP	CIV3003, CIV3004		
20.	CIV3052	Glass in Buildings: Design and Applications	3	0	3	EM	-	CIV3003, CIV3004		
21.	CIV4011	Design of Tall Buildings	3	0	3	EM	HP	CIV3003, CIV3004		
22.	CIV4012	Theory of Plates and Shells	3	0	3	EM	-	MAT1001, MAT1002, CIV2007		
23.	CIV4013	Design of Steel Concrete Composite Structures	3	0	3	EM	-	CIV3008, CIV3013		
Transportation and Geotechnical Engineering Basket										
1.	CIV2022	Railway Engineering and Tunnelling	3	0	3	EM	ES	CIV1005, CIV2016		
2.	CIV2023	Airport Engineering and Harbour	3	0	3	EM	ES	CIV1005, CIV2016		
3.	CIV2024	Pavement Materials & Construction	3	0	3	EM	ES	CIV2016, CIV2018		
4.	CIV2025	Urban Transport Planning	3	0	3	EM	-	CIV2016		
5.	CIV2026	Traffic Engineering	3	0	3	EM	-	CIV2016		
6.	CIV3019	Advanced Surveying	3	0	3	EM	-	CIV1005		
7.	CIV3020	Highway Geometric Design	3	0	3	EM	HP	CIV2016		CIV3022
8.	CIV3021	Pavement Design	3	0	3	EM	ES	CIV2024, CIV3020		CIV3022
9.	CIV3022	Highway Construction and Maintenance	3	0	3	EM	ES/ HP	CIV3020, CIV3021		

Table 3.4: Discipline Elective Courses (DE)										
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites / Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**
10.	CIV3023	Intelligent Transportation Systems	3	0	3	EM	ES	CIV2025		
11.	CIV3025	Environmental Geotechnics	3	0	3	EM	ES	CIV3006		
12.	CIV3026	Advanced Soil Mechanics	3	0	3	EM	-	CIV3006, CIV2015		
13.	CIV3028	Stability of Slopes	3	0	3	EM	-	CIV3006		
14.	CIV3029	Ground Improvement Techniques	3	0	3	EM	ES	CIV3006		
15.	CIV4005	Reinforced Earth Structures	3	0	3	EM	ES	CIV3006		
16.	CIV4006	Advanced Foundation Design	3	0	3	EM	-	CIV3006, CIV3003		
17.	CIV4007	Earth and Earth Retaining Structures	3	0	3	EM	ES	CIV3006, CIV3003		
18.	CIV4008	Earthquake Resistant Design of Foundations	3	0	3	EM	-	CIV3006, CIV3015		
19.	CIV3050	Pavement Management System	3	0	3	EM	-	CIV3021		
20.	CIV3057	Designing of soil structures with Geosynthetics	3	0	3	EM	-	CIV3021		
21.	CIV2054	Road safety and Traffic management	3	0	3	EM	-	CIV2026		
22.	CIV3053	Design of Pile Foundations	3	0	3	EM	-	CIV3026		
23.	CIV2056	Pavement Materials	3	0	3	EM	-			
24.	CIV3058	Unsaturated Soil Mechanics	3	0	3	EM	-	CIV3026		
Water Resources and Environmental Engineering Basket										
1.	CIV2027	Environmental Pollution and Control	3	0	3	EM	ES			
2.	CIV2028	Urban Air Pollution and Control	3	0	3	EM	ES			
3.	CIV2029	Ground Water Hydrology	3	0	3	EM	ES	CIV2009, CIV2008		
4.	CIV2030	Climate Change and Sustainable Development	3	0	3	EM	ES			
5.	CIV2031	Urban Waste Management	3	0	3	EM	ES			
6.	CIV2032	Urban Flooding: Analysis and Control	3	0	3	EM	ES	CIV2010, CIV2009		
7.	CIV2033	Integrated Watershed Management	3	0	3	EM	ES	CIV2010		
8.	CIV2034	Environmental Hydraulics	3	0	3	EM	ES	CIV2009, CIV2011		
9.	CIV3030	Industrial wastewater treatment	3	0	3	EM	ES	CIV2011		
10.	CIV3031	Open Channel Flow	3	0	3	EM	-	CIV2010, CIV2009		
11.	CIV3032	Design of Hydraulic Structures	3	0	3	EM	-	CIV2010, CIV2009		

Table 3.4: Discipline Elective Courses (DE)										
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites / Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**
12.	CIV3033	Water Resource Management	3	0	3	EM	ES	CIV2010		
13.	CIV3034	Advanced Fluid Mechanics	3	0	3	EM	-	CIV2009		
14.	CIV2051	Soil and water conservation	3	0	3	EM	ES	CHE1001		
15.	CIV3051	Statistics in Hydrology	3	0	3	EM	-	CIV2029		
16.	CIV3054	Environmental management Systems and Audits	3	0	3	EM	-	CHE1001, CIV2027, CIV2030 CIV2031		
Infrastructure Development Basket										
1.	CIV2036	Introduction to Infrastructure System and Planning	3	0	3	EM	ES	CIV1007, CIV2016, CIV3001	-	CIV3037
2.	CIV2037	Urban Planning and Design	3	0	3	EM	ES	CIV1007, CIV3001	-	-
3.	CIV2038	Construction Equipment and Machinery	3	0	3	EM	-	CIV1006	-	-
4.	CIV2039	Construction Quality and Safety	3	0	3	EM	-	CIV1006	-	-
5.	CIV3036	Project Management in Infrastructure Development	3	0	3	EM	HP	-	-	-
6.	CIV3037	Construction Practices and Challenges in Infrastructure Projects	3	0	3	EM	HP	CIV2036	-	-
7.	CIV3038	Construction Economics and Finance	3	0	3	EM	HP	CIV3001	-	-
8.	CIV3039	Applications of Remote Sensing and GIS in Infrastructure Development	3	0	3	EM	-	-	-	-
9.	CIV3040	Environmental Impact Assessment for Infrastructure Projects	3	0	3	EM	-	-	-	-
10.	CIV3055	Infrastructure Projects Financing	3	0	3	EM	-	CIV2036		
11.	CIV3056	Geospatial Analysis in Urban Planning	2	2	3	EM	-	CIV2037		
Smart Cities Basket										
1.	CIV2040	Built Environment Design	3	0	3	EM	ES	-	-	-
2.	CIV2041	Fundamentals of Smart City	3	0	3	EM	-	-	-	-
3.	CIV2042	Urban Mobility	3	0	3	EM	-	CIV2016	-	-
4.	CIV2043	Urban Sanitation and Hygiene	3	0	3	EM	ES	CIV2011	-	-
5.	CIV3006	Smart Materials and Structures	3	0	3	EM	ES	CIV1006, CIV3003	-	-

Table 3.4: Discipline Elective Courses (DE)										
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites / Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**
6.	CIV3041	Smart City Energy Systems and Management	3	0	3	EM	ES	EEE1001	-	-
7.	CIV3042	IoT in Construction	3	0	3	EM	-	EEE1001, CSE1001, CSE1002	-	-
8.	CIV3043	Construction Economics and Financing for Smart Cities	3	0	3	EM	HP	-	-	-
9.	CIV3044	E-Governance	3	0	3	EM	HP	-	-	-
10.	CIV3045	Big Data Analytics for Civil Engineers	1	4	3	EM	ES	CSE1001, CSE1002	-	-

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

Minimum Credits to be earned from this basket = 15 Credits [*Out of 15 Credits, the student has to earn minimum of 6 Credits from Management Basket*]

Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**Credits**	**Type of Skill/ Focus**	**Course Caters to**	**Anti requisites**
Chemistry Basket								
1	CHE1003	Fundamentals of Sensors	3	0	3	S	ES	
2	CHE1004	Smart materials for IOT	3	0	3	S	ES	
3	CHE1005	Computational Chemistry	2	0	2	S	ES	
4	CHE1006	Introduction to Nano technology	3	0	3	S	ES	
5	CHE1007	Biodegradable electronics	2	0	2	S	ES	
6	CHE1008	Energy and Sustainability	2	0	2	S	ES	
7	CHE1009	3D printing with Polymers	2	0	2	S	ES	
8	CHE1010	Bioinformatics and Healthcare IT	2	0	2	S	ES	
9	CHE1011	Chemical and Petrochemical catalysts	3	0	3	S	ES	
10	CHE1012	Introduction to Composite materials	2	0	2	S	ES	
11	CHE1013	Chemistry for Engineers	3	0	3	S	ES	
12	CHE1014	Surface and Coatings technology	3	0	3	S	ES	
13	CHE1015	Waste to Fuels	2	0	2	S	ES	
14	CHE1016	Forensic Science	3	0	3	S	ES	
Civil Engineering Basket								
1	CIV1001	Disaster mitigation and management	3	0	3	S	ES / HP	
2	CIV1002	Environment Science and Disaster Management	3	0	3	F	ES	

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
3	CIV2001	Sustainablility Concepts in Engineering	3	0	3	S	ES	
4	CIV2002	Occupational Health and Safety	3	0	3	S		
5	CIV2003	Sustainable Materials and Green Buildings	3	0	3	EM	ES	
6	CIV2004	Integrated Project Management	3	0	3	EN	HP/GS	
7	CIV2005	Enviornmental Impact Assessment	3	0	3	EN	ES	
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	3	EN	ES	
9	CIV2044	Geospatial Applications for Engineers	2	2	3	EM	ES	
10	CIV2045	Environmental Meteorology	3	0	3	S	ES	
11	CIV3046	Project Problem Based Learning	3	0	3	S	ES	
12	CIV3059	Sustainability for Professional Practice	3	0	3	S	ES	
Commerce Basket								
1	COM2001	Introduction to Human Resource Management	2	0	2	F	HP/GS	
2	COM2002	Finance for Non Finance	2	0	2	S		
3	COM2003	Contemporay Management	2	0	2	F		
4	COM2004	Introduction to Banking	2	0	2	F		
5	COM2005	Introduction to Insurance	2	0	2	F		
6	COM2006	Fundamentals of Management	2	0	2	F		
7	COM2007	Basics of Accounting	3	0	3	F		
Computer Science Basket								
1	CSE2002	Programming in Java	2	2	3	S/EM		
2	CSE2003	Social Network Analytics	3	0	3	S	GS	
3	CSE2004	Python Application Programming	2	2	3	S/ EM		
4	CSE2005	Web design fundamentals	2	2	3	S/ EM/EN		
5	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	0	3	S/ EM/EN		
6	CSE3112	Privacy And Security In Online Social Media	3	0	3	S/ EM/EN		
7	CSE3113	Computational Complexity	3	0	3	S/ EM/EN		
8	CSE3114	Deep Learning for Computer Vision	3	0	3	S/ EM/EN		
9	CSE3115	Learning Analytics Tools	3	0	3	S/ EM/EN		
Design Basket								
1	DES1001	Sketching and Painting	0	2	1	S		
2	DES1002	Innovation and Creativity	2	0	2	F		

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
3	DES1121	Introduction to UX design	1	2	2	S		
4	DES1122	Introduction to Jewellery Making	1	2	2	S		
5	DES1124	Spatial Stories	1	2	2	S		
6	DES1125	Polymer Clay	1	2	2	S		
7	DES2001	Design Thinking	3	0	3	S		
8	DES1003	Servicability of Fashion Products	1	2	2	F	ES	
9	DES1004	Choices in Virtual Fashion	1	2	2	F	ES, GS, HP	
10	DES1005	Fashion Lifestyle and Product Diversity	1	2	2	F	ES, GS, HP	
11	DES1006	Colour in Everyday Life	1	2	2	F	ES	
12	DES2080	Art of Design Language	3	0	3	S		
13	DES2081	Brand Building in Design	3	0	3	S		
14	DES2085	Web Design Techniques	3	0	3	S		
15	DES2089	3D Modeling for Professionals	1	4	3	S		
16	DES2090	Creative Thinking for Professionals	3	0	3	S		
17	DES2091	Idea Formulation	3	0	3	S		
Electrical and Electronics Engineering Basket								
1	EEE1002	IoT based Smart Building Technology	3	0	3	S		
2	EEE1003	Basic Circuit Analysis	3	0	3	S		
3	EEE1004	Fundamentals of Industrial Automation	3	0	3	S		
4	EEE1005	Electric Vehicles & Battery Technology	3	0	3	S		
5	EEE1006	Smart Sensors for Engineering Applications	3	0	3	S		
Electronics and Communication Engineering Basket								
1	ECE1003	Fundamentals of Electronics	3	0	3	F		
2	ECE1004	Microprocessor based systems	3	0	3	F		
3	ECE1005	Journey of Communication Systems	3	0	3	F		
4	ECE3089	Artificial Neural Networks	3	0	3	S		
5	ECE3090	Digital System Design using VERILOG	3	0	3	F/EM		
6	ECE3091	Mathematical Physics	3	0	3	F		
7	ECE3092	Photonic Integrated Circuits	3	0	3	F		
8	ECE3093	Machine learning for Music Information Retrieval	3	0	3	F/EM		

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
9	ECE3094	Video Processing and Computer Vision	3	0	3	F/EM		
10	ECE3095	Blockchain and Cryptocurrency Technologies	3	0	3	S / EM / EN		
11	ECE3096	Natural Language Processing	3	0	3	F/ EM / EN		
12	ECE3097	Smart Electronics in Agriculture	3	0	3	F/EM		
13	ECE3098	Environment Monitoring Systems	3	0	3	F/EM		
14	ECE3099	Modern Wireless Communication with 5G	3	0	3	F/ EM / EN		
15	ECE3100	Underwater Communication	3	0	3	F/ EM / EN		
16	ECE3101	Printed Circuit Board Design	3	0	3	S/F/EM		
17	ECE3102	Consumer Electronics	3	0	3	F/EM		
18	ECE3103	Product Design of Electronic Equipment	3	0	3	S/F/ EM / EN		
19	ECE3104	Vehicle to Vehicle Communication	3	0	3	F/ EM / EN		
20	ECE3105	Wavelets and Filter Banks	3	0	3	F/EM		
21	ECE3106	Introduction to Data Analytics	3	0	3	F/EM		
22	ECE3107	Machine Vision for Robotics	3	0	3	F/EM		
English Basket								
1	ENG1008	Indian Literature	2	0	2		GS/ HP	
2	ENG1009	Reading Advertisement	3	0	3	S		
3	ENG1010	Verbal Aptitude for Placement	2	2	3	S		
4	ENG1011	English for Career Development	3	0	3	S		
5	ENG1012	Gender and Society in India	2	0	2		GS/ HP	
6	ENG1013	Indian English Drama	3	0	3			
7	ENG1014	Logic and Art of Negotiation	2	2	3			
8	ENG1015	Professional Communication Skills for Engineers	1	0	1			
Fitness and Wellness Basket								
1	DSA2001	Spirituality for Health	2	0	2	F	HP	
2	DSA2002	Yoga for Health	2	0	2	S	HP	
3	DSA2003	Stress Management and Well Being	2	0	2	F		

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
Kannada Basket								
1	KAN1003	Kannada Kaipidi	3	0	3	S		
2	KAN2003	Pradharshana Kale	1	2	2	S		
3	KAN2004	Sahithya Vimarshe	2	0	2	S		
4	KAN2005	Anuvadha Kala Sahithya	3	0	3	S		
5	KAN2006	Vichara Manthana	3	0	3	S		
6	KAN2007	Katha Sahithya Sampada	3	0	3	S		
7	KAN2008	Ranga Pradarshana Kala	3	0	3	S		
Foreign Language Basket								
1	FRL1004	Introduction of French Language	2	0	2	S		
2	FRL1005	Fundamentals of French	2	0	2	S		
3	FRL1009	Mandarin Chinese for Beginners	3	0	3	S		
Law Basket								
1	LAW1001	Introduction to Sociology	2	0	2	F	HP	
2	LAW2001	Indian Heritage and Culture	2	0	2	F	HP/GS	
3	LAW2002	Introdcution to Law of Succession	2	0	2	F	HP/GS	
4	LAW2003	Introduction to Company Law	2	0	2	F	HP	
5	LAW2004	Introduction to Contracts	2	0	2	F	HP	
6	LAW2005	Introduction to Copy Rights Law	2	0	2	F	HP	
7	LAW2006	Introduction to Criminal Law	2	0	2	F	HP	
8	LAW2007	Introduction to Insurance Law	2	0	2	F	HP	
9	LAW2008	Introduction to Labour Law	2	0	2	F	HP	
10	LAW2009	Introduction to Law of Marriages	2	0	2	F	HP/GS	
11	LAW2010	Introduction to Patent Law	2	0	2	F	HP	
12	LAW2011	Introduction to Personal Income Tax	2	0	2	F	HP	
13	LAW2012	Introduction to Real Estate Law	2	0	2	F	HP	
14	LAW2013	Introduction to Trademark Law	2	0	2	F	HP	
15	LAW2014	Introdcution to Competition Law	3	0	3	F	HP	
16	LAW2015	Cyber Law	3	0	3	F	HP	
17	LAW2016	Law on Sexual Harrassment	2	0	2	F	HP/GS	
18	LAW2017	Media Laws and Ethics	2	0	2	F	HP/GS	
Mathematics Basket								
1	MAT2008	Mathematical Reasoning	3	0	3	S		

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
2	MAT2014	Advanced Business Mathematics	3	0	3	S		
3	MAT2041	Functions of Complex Variables	3	0	3	S		
4	MAT2042	Probability and Random Processes	3	0	3	S		
5	MAT2043	Elements of Number Theory	3	0	3	S		
6	MAT2044	Mathematical Modelling and Applications	3	0	3	S		
7	MAT2029	Optimization technique	3	0	3	S		
Mechanical Engineering Basket								
1	MEC1001	Fundamentals of Automobile Engineering	3	0	3	F		
2	MEC1002	Introduction to Matlab and Simulink	3	0	3	S/EM		
3	MEC1003	Engineering Drawing	1	4	3	S		
4	MEC2001	Renewable Energy Systems	3	0	3	F	ES	
5	MEC2002	Operations Research & Management	3	0	3	F		
6	MEC2003	Supply Chain Management	3	0	3	S/ EM/ EN		
7	MEC2004	Six Sigma for Professionals	3	0	3	S/EM		MEC2008
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	3	F		
9	MEC2006	Safety Engineering	3	0	3	S/EM	ES	
10	MEC2007	Additive Manufacturing	3	0	3	F/EM		
11	MEC3069	Engineering Optimisation	3	0	3	S/EM		
12	MEC3070	Electronics Waste Management	3	0	3	F/S	ES	
13	MEC3071	Hybrid Electric Vehicle Design	3	0	3	S/EM	ES	
14	MEC3072	Thermal Management of Electronic Appliances	3	0	3	S/EM		
15	MEC3200	Sustainable Technologies and Practices	3	0	3	S/EM		
16	MEC3201	Industry 4.0	3	0	3	S/EM		
Petroleum Engineering Basket								
1	PET1005	Geology for Engineers	2	0	2	S		
2	PET1006	Overview of Energy Industry	2	0	2	S	ES / HP	
3	PET1007	Introduction to Energy Trading and Future Options	2	0	2	S	ES / HP	
4	PET1008	Sustainable Energy Management	2	0	2	S	ES / HP	
5	PET2026	Introduction to Computational Fluids Dynamics	3	0	3	S	HP	
6	PET2028	Polymer Science and Technology	3	0	3	E	ES / HP	

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
7	PET2031	Overview of Material Science	3	0	3	E	ES / HP	
8	PET2032	Petroleum Economics	3	0	3	E	HP	
Physics Basket								
9	PHY1003	Mechanics and Physics of Materials	3	0	3	F/S		
10	PHY1004	Astronomy	3	0	3	F		
11	PHY1005	Game Physics	2	2	3	F/S		
12	PHY1006	Statistical Mechanics	2	0	2	F		
13	PHY1007	Physics of Nanomaterials	3	0	3	F		
14	PHY1008	Adventures in nanoworld	2	0	2	F		
15	PHY2001	Medical Physics	2	0	2	F	ES	
16	PHY2002	Sensor Physics	1	2	2	F/S		
17	PHY2003	Computational Physics	1	2	2	F		
18	PHY2004	Laser Physics	3	0	3	F	ES	
19	PHY2005	Science and Technology of Energy	3	0	3	F	ES	
20	PHY2009	Essentials of Physics	2	0	2			
Management Basket								
1	MGT1001	Introduction to Psychology	3	0	3	F	HP	
2	MGT1002	Business Intelligence	3	0	3	EN		
3	MGT1003	NGO Management	3	0	3	S		
4	MGT1004	Essentials of Leadership	3	0	3	EM/ EN	GS/ HP	
5	MGT1005	Cross Cultural Communication	3	0	3	S/EM/ EN	HP	
6	MGT2001	Business Analytics	3	0	3	S/ EM/EN		
7	MGT2002	Organizational Behaviour	3	0	3	F	HP	
8	MGT2003	Competitive Intelligence	3	0	3	S		
9	MGT2004	Development of Enterprises	3	0	3	S/EM/EN		
10	MGT2005	Economics and Cost Estimation	3	0	3	S/EM		
11	MGT2006	Decision Making Under Uncertainty	3	0	3	S		
12	MGT2007	Digital Entrepreneurship	3	0	3	S/EM/EN		
13	MGT2008	Econometrics for Managers	3	0	3	S		
14	MGT2009	Management Consulting	3	0	3	S/EM/EN		
15	MGT2010	Managing People and Performance	3	0	3	S/EM/EN	HP/GS	
16	MGT2011	Personal Finance	3	0	3	F		
17	MGT2012	E Business for Management	3	0	3	S/EM		

Sl. No.	Course Code	Course Name	L	P	Credits	Type of Skill/ Focus	Course Caters to	Anti requisites
18	MGT2013	Project Management	3	0	3	EN / EM	GS/HP/ ES	
19	MGT2014	Project Finance	3	0	3	EN / EM	HP	
20	MGT2015	Engineering Economics	3	0	3	S		
21	MGT2016	Business of Entertainment	3	0	3	EM/ EN		
22	MGT2017	Principles of Management	3	0	3	S/EM/ EN		
23	MGT2018	Professional and Business Ethics	3	0	3	S/EM/ EN	HP	
24	MGT2019	Sales Techniques	3	0	3	S/EM/ EN	HP	
25	MGT2020	Marketing for Engineers	3	0	3	S/EM/ EN	HP	
26	MGT2021	Finance for Engineers	3	0	3	S/EM/ EN	HP	
27	MGT2022	Customer Relationship Management	3	0	3	S/EM/ EN	HP	
28	MGT2023	People Management	3	0	3	S/EM/ EN	HP	
Media Studies Basket								
1	BAJ3050	Corporate Filmmaking and Film Business	0	4	2	EM	HP	
2	BAJ3051	Digital Photography	2	2	3	EM	HP	
3	BAJ3055	Introduction to New Anchoring and News Management	0	2	1			
Research URE Basket								
1	URE2001	University Research Experience	-	-	3	S/ EM/ EN		
2	URE2002	University Research Experience	-	-	0	S/ EM/ EN		

Type of Skill
F - Foundation
S - Skill Development
EM - Employability
EN - Entrepreneurship

Course Caters to
GS - Gender Sensitization
ES - Environment and sustainability
HP - Human values and Professional Ethics

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 and the same shall be updated in the PRC.

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

I Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	MAT1001	SC	Calculus and Linear Algebra	3	2	4	5	S[1]	
2	CSE1001	SC	Problem Solving using JAVA	2	2	3	4	S	
3	PHY1001	SC	Material Physics	2	2	3	4	S	
4	ENG1001/ ENG1002	SC	Foundation English/ Technical English	1	2	2	3	S	
5	XXXxxxx	OE	Open Elective - I	3	0	3	3		
6	PPS1001	SC	Introduction to soft skills	0	2	1	2	S	HP[2]
7	CSE1002*	SC	Innovation Project - Arduino using C**	0	4	2	4	S	
8	KAN1001/ KAN2001	SC	Kali Kannada / Thili Kannada	1	0	1	1	S	
TOTAL				**1**	**1**	**19**	**26**		
[1] Skill Development [2] Human Values and									

** Note Students will carry out Innovation Project - Arduino using Embedded 'C' (CSE1002) during either first and second semester and the credits earned will be accounted in the second semester.

II Sem + Summer Term									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	MAT1002	SC	Transform Techniques, Partial Differential Equations and Their Applications	3	0	3	3	S	
2	MAT1003	SC	Applied Statistics	1	2	2	3	S	
3	EEE1001	SC	Fundamentals of Electrical and Electronics Engineering	3	2	4	5	S	
4	CSE2001	SC	Data Structures and Algorithms	3	2	4	5	S	
5	CIV1003	PC	Elements of Engineering Mechanics	2	0	2	2	S	
6	CIV2046	PC	Construction Technology and Processes	3	0	3	3	S	ES[4]
7	CIVXXXX	DE	Discipline Elective - I	3	0	3	3	EM[3]	
8	CSE1002*	SC	Innovation Project - Arduino using 'C'**	0	4	2	4	S	
9	CIV1004	PC	Basic Construction Practice	0	2	1	2	S	
10	XXXxxxx	OE	Open Elective - II	3	0	3	3		
11	ENG1002/ ENG2001	SC	Technical English/ Advanced English	1	2	2	3	S	
12	CHE1001	SC	Environmental Studies	Pass / Fail		0	-	S	ES

13	PPS1002	SC	Soft Skills for Engineers	0	2	1	2	S	
TOTAL				**2**	**1**	**28**	**34**		

[3] Employability Skills [4] Environment

III Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	CIV1006	PC	Building Materials and Concrete Technology	2	0	2	2	S	ES
2	CIV2007_v02	PC	Strength of Materials	3	0	3	3	S	
3	CIV1005_v02	PC	Surveying	3	2	4	5	S	
4	CIV2009_v02	PC	Fluid Mechanics	3	0	3	3	S	
5	CIV2008_v02	PC	Engineering Geology	1	2	2	3	S	
6	CIVXXXX	DE	Discipline Elective - II	3	0	3	3	EM	
7	PPS2001	SC	Reasoning and Employment Skills	0	2	1	2	EM	HP
8	CSE1003	SC	Innovation Project - Rasberry Pi using Python	0	4	2	4	S	
TOTAL				**1**	**1**	**20**	**25**		

IV Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	MAT2003	SC	Numerical Methods for Engineers	1	2	2	3	S	-
2	CIV2013	PC	Analysis of Determinate Structures	3	0	3	3	S	-
3	CIV2015_v02	PC	Geotechnical Engineering	3	0	3	3	S	-
4	CIV2016	PC	Transportation Engineering	3	0	3	3	S	ES
5	CIV2010	PC	Hydrology and Irrigation Systems	3	0	3	3	S	ES
6	CIVXXXX	DE	Discipline Elective - III	3	0	3	3	EM	
7	CIV2014	PC	Basic Materials Testing Lab	0	2	1	2	S	ES/ HP
8	CIV2048	PC	Fluid Mechanics Lab	0	2	1	2	S	-
9	PPS2002	SC	Being Corporate Ready	0	2	1	2	EM	HP /GS[5]
TOTAL				**1**	**8**	**20**	**24**		

[5]Gender Sensitization

V Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	CIV3002	PC	Analysis of Indeterminate Structures	3	0	3	3	S	
2	CIV3003	PC	Design of RCC Structural Elements	3	0	3	3	S	HP
3	CIV3027_v02	PC	Foundation Engineering	2	0	2	2	S	
4	CIV2047	PC	Water Infrastructure Systems	3	0	3	3	S	ES
5	CIVXXXX	DE	Discipline Elective - IV	3	0	3	3	EM	
6	CIVXXXX	DE	Discipline Elective - V	3	0	3	3	EM	
7	MGTXXXX	OE	Open Elective - III (Course from Management Basket)	3	0	3	3	EN[6]	
8	CIV2049	PC	Geotechnical Engineering	0	2	1	2	S	
9	CIV1007	PC	Building Planning and	0	2	1	2	S	HP
10	PPS4002	SC	Introduction to Aptitude	0	2	1	2	S	
TOTAL				**2**	**6**	**23**	**26**		

[6] Entrepreneurship

VI Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	CIV3004_v02	PC	Design of Structural Steel Elements	3	0	3	3	S	HP
2	CIV3001_v02	PC	Estimation, Costing and Valuation	2	0	2	2	S	HP
3	CIV3035_v02	PC	Waste Water Treatment and Disposal Systems	2	0	2	2	S	ES
4	CIV3047_v02	PC	Fundamentals of Pre-Stressed Concrete Design	2	0	2	2	S	HP
5	CIV2035_v02	PC	Construction Project Management	2	2	3	4	S	
6	CIVXXXX	DE	Discipline Elective - VI	3	0	3	3	EM	
7	CIVXXXX	DE	Discipline Elective - VII	-	-	3	2	EM	ES/ HP
8	MGTXXXX	OE	Open Elective - IV (Course from Management Basket)	3	0	3	3	EN	-
9	CIV2050	PC	Environmental Engineering Lab	0	2	1	2	S	ES
10	CIV2018	PC	Concrete and Highway Materials Testing Lab	0	2	1	2	S	HP
11	PPS4005	SC	Aptitude for Employability	0	2	1	2	EM	
TOTAL				**1**	**8**	**24**	**27**		

VII Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	CIVXXXX	DE	Discipline Elective - VIII	3	0	3	3	EM	
2	CIVXXXX	DE	Discipline Elective - IX	3	0	3	3	EM	
3	CIVXXXX	DE	Discipline Elective - X	3	0	3	3	EM	
4	XXXxxxx	OE	Open Elective - V	3	0	3	3		
5	PIP2001	SC	Capstone Project	-	-	4	-	EM	ES/ HP
6	PPS3018	SC	Preparedness for Interview	0	2	1	2	EM	
TOTAL				**1**	**2**	**17**	**14**		

VIII Sem									
S. No.	**COURSE CODE**	**BASKET**	**COURSE NAME**	**CREDIT STRUCTURE**			**CONTACT HOURS**	**TYPE OF SKILL/ FOCUS**	**COURSE INTEGRATES**
				L	**P**	**CREDITS**			
1	PIP4004	SC	Internship	-	-	9	-	EM/ EN	ES/ HP
TOTAL				**-**	**-**	**9**	**-**		

23. Course Catalogues

Each course shall have a course catalogue with the following details:

i) Pre –Requisites of the course
ii) Course Description
iii) Course Outcome
iv) Course Content
iv) Reference Resources.

The Course Catalogues for the Courses offered in each basket are attached below:

<table>
<tr><td>Course Code: CIV1003</td><td colspan="3">Course Title: Elements of Engineering Mechanics
Type of Course: Program Core & Theory Only</td><td>L-P-C</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Version No.</td><td colspan="7">1.1</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">“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.</td></tr>
<tr><td>Course Objective</td><td colspan="7">The objective of the course is to familiarize the learners with the concepts of Elements of Engineering Mechanics and attain <u>Skill Development</u> through <u>Problem Solving</u> methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">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</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td colspan="2">Fundamentals of Engineering Mechanics</td><td>Assignment</td><td colspan="2">Programming Task</td><td colspan="2">7 Sessions</td></tr>
<tr><td colspan="8">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
Assignment: Determination of Resultants using MATLAB</td></tr>
<tr><td>Module 2</td><td colspan="2">Equilibrium of Forces</td><td>Assignment</td><td colspan="2">Data Collection/Excel</td><td colspan="2">7 Sessions</td></tr>
<tr><td colspan="8">Topics:
Equilibrium and Equilibrant, Concept of Free-body diagram. Lami’s theorem – statement and application for various engineering problems.</td></tr>
</table>

Types of beam, supports and reactions (simple, hinged, roller and fixed) and loads acting on beam (vertical point load, uniformly distributed load).
Assignment: Determination of the Reactions at different supports using Excel

Module 3	Friction on Rigid bodies	Assignment	Programming/Data analysis task	**9 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
Assignment: Centroid of an area using numerical integration (Scilab instructions)

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:
https://nptel.ac.in/courses/112/106/112106286/
https://www.youtube.com/watch?v=nGfVTNfNwnk&list=PLOSWwFV98rfKXq2KBphJz95rao7q8PpwT
Engineering Mechanics, R K Bansal, Sanjay Bansal, Lakshmi Publications, 2016
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii
A Textbook of Engineering Mechanics, SS Bhavikatti, New Age International Publishers, 2016
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&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	**12th BOS held on 07/08/2021**
Date of Approval by the Academic Council	**Academic Council Meeting No. 16, Dated 23/10/21**

Course Code: CIV2046	Course Title: Construction Technology and Processes Type of Course: Program Core & Theory Only	L-P-C	3	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 deals with the various aspects of construction. The course provides a brief overview to Construction 4.0 and sustainable construction. The course also covers the various components of a building as well as educate him on various construction machinery. It is a conceptual course which introduces the students 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 **Skill Development** 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 in construction. 4] Identify the need for evolution and the emerging trends in Construction Industry.				
Course Content:					
Module 1	Overview of Construction Technology	Assignment	Market Survey	**20 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, arches and staircases, Types of Doors and windows. Overview of NBC code and its provisions. Formwork and scaffolding, Slip forming, Shoring and under pinning. **Assignment:** Market Survey and Report on types of flooring material, roofing sheets, Doors and Windows available in the market					
Module 2	Basics of Construction Equipment	Assignment	Report on Field Visit	**10 Sessions**	
Topics: Equipment for Earthwork Operation, Equipment for Compaction, Erection Equipment, Forklifts, Cranes and related equipment, Materials handling Equipment – Portable Material Bins – Conveyors – Hauling Equipment. Equipment for Production of aggregate and concreting. Machineries for other construction work. **Assignment:** Field visit to construction site at the university to understand the various construction equipment used at site.					

Module 3	Introduction to Sustainable Construction and Construction 4.0	Assignment	Article Review from E-resource	**15 Sessions**

Topics:

Relevance and importance of sustainability, Building life cycle, Introduction to Green building concepts, Life cycle energy use in buildings, net-zero energy buildings. Life Cycle Assessment (LCA) - Methods and metrics, Indices and measures of sustainability.

Precast Construction, Pre-fabricated Structures, Construction Automation - Robots in Construction, 3D Printing, Digital Transformation in Construction – Building Information Modelling (BIM), Application of AR/VR, AI & ML in construction.

Assignment: Article Review on Sustainable Construction and Construction 4.0 (W3 and W4)

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.

T3. 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-books:

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://puniversity.informaticsglobal.com:2229/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://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1487204&site=ehost-live

Topics relevant to Skill development: Components of building and their functions, Various Construction Equipment used for excavation and concrete production, Introduction to Green building concepts, Life cycle energy use in buildings, net-zero energy buildings and Life Cycle Assessment (LCA) for **Skill Development** 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	**13th BOS held on 30/12/2021**
Date of Approval by	**Academic Council Meeting No. 17, Dated 23/10/21**

the Academic Council	

Course Code: CIV1004	**Course Title: Basic Construction Practice** **Type of Course: 1] Discipline Elective** **2] Laboratory Only**	**L-P-C**	0	2	1
Version No.	1.2				
Course Pre-requisites	NIL				
Anti-requisites	NIL				

Course Description	The course delivers the practical skills which are very important for an aspiring Civil engineer. This course is designed to provide hands –on training to students by exposing them to tasks such as measurement, cement mixing, welding, fitting, carpentry etc. The course will inculcate engineering aptitude, confidence and experience towards technical skills in students. The tasks completed in the lab course will demonstrate how to work towards a common goal while learning self –control, time management and problem solving skills.
Course objectives	The objective of the course is to familiarize the learners with the concepts of **Basic Construction Practice** and attain **Skill Development** through **Experiential Learning techniques**
Course Outcomes	On successful completion of the course the students shall be able to: 1] Demonstrate the trades such as carpentry, assembling, metal sheet filing and welding, plumbing and handling concrete. 2] Practice the construction of wall with the given bond type. 3] Identify faults in preparation of mortar and concrete mix and rectify them 4] Locate slips in the assemblage of the square joint.
Course Content:	**Task 01: Measure the rooms in a building and draw the building plan** Level No 01: Measure the rooms in a building with tape only and draw the building plan. Level No. 02: Measure the rooms in a building approximately without a tape (using mental measurement) and draw the building plan. **Task 02: Setting out the building as per the given building plan** Level 01 : Set out of the building as per the building plan using tape Level 02: Set out the building as per the building plan using tape and cross staff **Task 03: Construct a wall of a given height with a given wall thickness using different types of brick masonry** Level No 01: Construct a wall of height 50 cm and wall thickness of 11/2bricks using English bond or Flemish bond (without mortar) – corner portion – length of side walls – 60cm Level No. 02: Construct a wall of height 50 cm and wall thickness of 2bricks using English bond or Flemish Bond (without mortar) – corner portion – length of side walls – 60cm **Task 04: Prepare a mortar mix based on given specifications** Level No 01: Prepare a cement mortar mix for brickwork Level No. 02: Prepare a cement mortar mix for plastering (1:6 Inner , 1:4 Outer). **Task 05: Prepare a cement concrete mix with a given proportion conforming to IS 10262-2019** Level No 01: Prepare a cement concrete mix and form a cube from the given mould Level No. 02: Prepare a cement concrete mix and form a cylinder from the given mould **Task 06: Bar bending and layout as used in construction sites** Level No 01: Carry out 90deg and 45deg bar bending exercise used in longitudinal reinforcement Level No. 02: Construct stirrups, and meshes through bar bending**.** **Task 07: Preparation of Building Plan for the given area** Level No 01: Prepare a residential building plan and draw in drawing sheet (line sketch) Level No. 02: Prepare a school building plan and draw in drawing sheet (line sketch)

	Task 08: Assemble pipe fittings forming a Plumbing system Level No 01: Use of the fittings such as Elbow, couple, bend etc for GI pipe connections Level No. 02: Fix a cast iron valve (domestic tap) to regulate the flow of water **Task 09: Introduction to Simple Plumbing, sanitary fittings and electrical wiring** Level No 01: Prepare the water supply line and sanitary line for residential building Level No. 02: Prepare the electrical line plan for residential building **Task 10: Weld the given Mild steel pieces** Level No 01: Prepare a double lap joint by arc welding Level No. 02: Prepare a butt joint using shielded metal arc welding process
Targeted Application & Tools that can be used: The applications of experiments in: Civil engineering works, Plumbing etc. The tools used for each experiment in the workshop: (i) Welding – chipping hammer, ground clamp, wire brush, handgloves, face shield etc. (ii) Plumbing – PVC pipes, GI pipes, pipe vice, pipe wrench, screw drivers, hacksaw, valves and taps, hammers etc. (iii) Cement concrete- Cement, sand, aggregate etc.	
Text Book: T1. Hajra Chaudhury S.K, Hajra Chaudhury A.K and Nirjhar Roy S.K , '*Elements of Workshop Technology',* Vol. I 2008 and Vol I. 2010, Media romoters and publishers pvt Ltd, Mumbai. T2. Gowri. P Hariharan and A . Suresh Babu, '*Manufacturing Technology-I*', Pearson education. 2008 T3. Rao P.N, '*Manufacturing Technology',* Vol. I and Vol. II, Tata McGraw Hill House. 2017.	
References: R1. P.Kannaiah, K.L.Narayana ,'*Work shop Manual'* , SciTech Publishers. R2. Jeyapoovan, Saravana Pandian, 4/e Vikas *, 'Engineering Practices Lab Manual',* . R3. GHF Nayler ,'*Dictionary of Mechanical Engineering'*, Jaico Publishing House. **Web References:** https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1487204&site=ehost-live **YouTube link:** https://www.youtube.com/watch?v=ui5JVfXNutg **- Prepare a cement mortar mix for brickwork** https://www.youtube.com/watch?v=RYFSMbtPpqw **– Bar bending process - Stirrups**	
Topics relevant to "SKILL DEVELOPMENT": Measure the rooms in a building and draw the building plan. Prepare a cement concrete mix with a given proportion conforming to IS 10262-2019 for developing **Employability Skills** through **Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**	
Catalogue prepared by	Mrs. Divya Nair/ 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: CIV2007_v02	**Course Title: Strength of Materials** **Type of Course: Program Core & Theory Only**	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Engineering Mechanics Principal of superposition, Moment, Equilibrium of forces, Centroid, and Moment of inertia of simple solid geometry				
Anti-requisites	NIL				
Course Description	**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.**				
Course Objective	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.				
Course Out Comes	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.			
Course Content:				
Module 1	**Stresses and Strains**	Term paper/ Assignment	Simulation/Data Analysis	**15 Sessions**
Topics: Stress in Simple, compound and composite bars, Elastic constants and volumetric strains, Introduction to Principal stress and principal planes.				
Module 2	**Shear Force, Bending Moments, Shear and Bending stresses**	Assignment	Simulation	**9 Sessions**
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.				
Module 3	**Torsion of Shafts**	Assignment	Numerical from E-Reosources	**6 Sessions**
Topics: Theory of torsion - Torsion of circular and hollow circular shafts and shear stresses due to torsion.				
Module 4	**Columns and Struts**	Assignment	Numerical from E-Reosources	**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: 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_v02	**Course Title: Engineering Geology** **Type of Course: Program Core/ Theory & integrated Laboratory**	**L-P-C**	**1**	**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 N0 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 the 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*
Websites: https://www.usgs.gov/science/science-explorer/Geology
https://geology.com/rocks/
E-Resources: Engineering Geology by F G Bell https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=186102&site=ehost-live

Video: https://nptel.ac.in/courses/105/105/105105106/
https://onlinecourses.swayam2.ac.in/aic22_ge16/unit?unit=1&lesson=83
Website: https://nptel.ac.in/courses/105/105/105105106/
https://mg-nitk.vlabs.ac.in/mining-geology/

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, 1957*
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

Course Code: CIV1005_v02	**Course Title: Surveying** **Type of Course: Program Core/ Theory and integrated Laboratory**	**L-P-C**	3	2	4
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. The associated laboratory provides an opportunity to validate the concepts Taught and enhances the ability to visualize the real field performance.				
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 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 field and contours on sheet by site mapping using the concepts of plane table survey and contouring.				
Course Content:					
Module 1	**Chain and Compass surveying**	Assignment	Data Collection		**14 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		**16 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, calculate elevations – 2D by using topo sheets / TIN (Triangular irregular networks), and DEM (Digital elevation model).

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 Drone applications in specific industries, introduction to LIDAR in Remote sensing and applications .

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 leveling and plotting contours by interpolation method.

Experiment No. 6: Measurement of angles and elevation by using Total station.

Level 1: Measure horizontal and vertical angle by using Total station.

Level 2: Conduction of cross section levelling 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.

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, 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.

Web Links: https://www.udemy.com/course/surveying/

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#

E book link R1: https://web.p.ebscohost.com/ehost/detail/detail?vid=4&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 methodologies. This is attained through assessment component mentioned in course handout.**

Catalogue prepared by	Ms. Shwetha 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: CIV1006	**Course Title: Building Materials and Concrete Technology** **Type of Course: Program Core**	**L-P-C**	2	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	**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: CIV1007	**Course Title: Building Planning and Drawing** **Type of Course:1] Program Core** **2] Laboratory only**	**L-P-C**	0	2	1
Version No.	1.1				
Course Pre-requisites	**CIV 1006 – Building Materials and Concrete Technology**				
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 Out Comes	**On successful completion of the course the students shall be able to:** 1. Produce plan, section and elevation drawings for buildings using AutoCAD tools. 2. Sketch structural detailing for basic Structural Components. 3. Prepare layout drawing of utilities like water supply, sanitary and electrical connections.
Course Content:	**Mention the List of Laboratory tasks proposed to be conducted indicating at least 2 different levels of experiment for each of the task [Where ever possible]** **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:

EMPLOYABILITY: 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.

HUMAN VALUES AND PROFESSIONAL ETHICS: Concept of plan, cross section, elevation, and schedule of opening of a single bed residential building, office/commercial buildings- As per by-laws.

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: CIV2009_v02	**Course Title: Fluid Mechanics** **Type of Course: Program Core** **Theory Only**	**L- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	[1] 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. This course is to introduce the student to the science and practice of Fluid Mechanics. It is intended to develop an understanding of the basic equations governing fluid statics and fluid dynamics. Physical understanding and fundamental approaches are emphasized throughout the course. Students are expected to analyze a variety of fluid flow problems. Thereby widen appreciation of the variety of phenomena covered by fluid mechanics and the techniques available to handle them.				
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 on 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: R.K.Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2018.https://web.p.ebscohost.com/ehost/ebookviewer/ebook/bmxlYmtfXzI4Nzg5MDVfX0FO0?sid=acc21b74-5265-4d1b-8266-a3df1f06d924@redis&vid=2&format=EB&rid=3 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: 21, Dated: 8th July 2023
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023

Course Code: CIV2048	**Course Title: Fluid Mechanics Lab** **Type of Course:1] Program Core** **2] Laboratory only**	**L-P-C**	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

Course Code: CIV2010	**Course Title: Hydrology and Irrigation Systems** **Type of Course: Program Core** **Theory Only**	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	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.				
Anti-requisites	NIL				
Course Description	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.				

Course objectives:	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			
Course Out Comes	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.			
Course Content:				
Module 1	**Introduction to Hydrology and Precipitation**	Assignment	Data Collection/ Analysis	**9 Sessions**
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.				
Module 2	**Losses from Precipitation**	Assignment	Data Collection/ Analysis	**9 Sessions**
Topics: Initial Losses, Evaporation, Evapo-transpiration, Infiltration: Introduction, Process, factors affecting, measurement.				
Module 3	**Runoff and Hydrograph**	Assignment	Simulation/Data Collection	**12 Sessions**
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				
Module 4	**Irrigation**	Case Study	Data Collection/Analysis	**9 Sessions**
Topics: 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: CIV2013	**Course Title: Analysis of Determinate Structures** **Type of Course: Program Core & Theory only**	**L-P-C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Strength of Materials - CIV 2007 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**	Term paper/ 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**	Term paper	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.				
Module 4	**Deflection of beams**	Term paper	Numerical problems and validating the results by using STAAD pro	**10 Sessions**
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 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: CIV3002	**Course Title: Analysis of Indeterminate Structures** **Type of Course: Program Core & Theory only**		**L-P-C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**Strength of Materials** **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/ ETABS.

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:
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: CIV3003	**Course Title: Design of RC Structural Elements** **Type of Course: Program Core** **Theory Only Course**	**L-P-C**	3	0	3
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	Data Analysis Task		**8 Hours**
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 and doubly reinforced beams					
Module 2	Design of RC Sections for Shear, Torsion and Bond	Assignment	Programming Task		**6 Hours**
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			**8 Hours**
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			**8 Hours**
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.				
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 Resourcess:** 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	Dr. Nakul Ramanna Mr. Ramachandra Gollar			
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: CIV3047_v02	**Course Title: Fundamentals of Pre-Stressed Concrete Design** **Type of Course: Program Core** **Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	**CIV3003 - 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 **Waste Water Treatment and Disposal Systems** and attain **Skill Devepoment** 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: CIV3004_v02	**Course Title: Design of Structural Steel Elements** **Type of Course: Program Core & Theory only**	**L- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	CIV2007, CIV2013, CIV 3002, 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: CIV2014	**Course Title: Basic Material Testing Lab** **Type of Course:1] Program Core** **2] Laboratory only**	**L- P- C**	0	2	1
Version No.	1.1				
Course Pre-requisites	**Strength of Materials, 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 Out Comes	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 3. https://sm-nitk.vlabs.ac.in/ **E-Resources** 3. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2719552&site=ehost-live 4. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2196240&site=ehost-live	
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	Academic Council Meeting No. 18 held on 03 August 2022

the Academic Council	

Course Code: CIV2015_v02	**Course Title: Geotechnical Engineering** **Type of Course: Program Core** **Theory only**	**L- P- C**	**3**	**0**	**3**
Version No.	**1.0**				
Course Pre-requisites	**Strength of Materials, 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 Out Comes	**On successful completion of this course the students shall be able to:** 1. Describe soil formation, index properties of soil, clay mineralogy and soil classification. 2. Discuss the permeability, seepage and effective stress concepts. 3. Solve the problems on shear strength, compaction and consolidation parameters.				
Course Content:					
Module 1	**Introduction to geotechnical engineering and basic properties of soil.**	Assignment	Software	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. **Assignment**: Soil Classification Using IS Classification system by Vector Support Machine (Artificial Intelligence)				
Module 2	**Permeability, Effective Stresses and shear strength of soil**	Assignment	Software	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. Assignment: Determination of permeability of soil and shear strength parameters by using Plaxis software 2D/3D				
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: CIV2049	**Course Title: Geotechnical Engineering Laboratory** **Type of Course:1] Program Core** **2] Laboratory only**	**L- P- C**	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. " Course Material(s) "Soil Mechanics Laboratory Manual", Presidency University. 2. Lambe T.W., "Soil Testing for Engineers", Wiley Eastern Ltd., New Delhi.	
References 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 2. 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: CIV3027_v02	**Course Title: Foundation Engineering** **Type of Course: Theory only**	**L-P- C**	2	0	2
Version No.	1.1				

Course Pre-requisites	**The student should have the knowledge of 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 Out Comes	**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] Compute the load carrying capacity of shallow foundation and pile foundation.**			
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 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 for retaining walls**	**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 and pile foundations**	**Assignment**	**Plaxis 2D Software**	**12 Sessions**
Topics: Shallow foundations: Safe bearing capacity and allowable bearing pressure, Terzaghi's bearing capacity equation, 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. **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 Foundation** **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 "Development of Skill": 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 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: CIV2016	**Course Title : Transportation Engineering** **Type of Course: Program Core & Theory only**	**L- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	1]Practical aspects of Surveying 2]Basic Mathematical abilities 3]Construction materials				
Anti-requisites	NIL				

Course Description	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.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Transportation Engineering and attain <u>Skill Development</u> through <u>Problem Solving methodologies</u>.**			
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Recognize the importance of transportation, surveys involved in highway planning and the characterization of materials used in highway construction 2. Compute highway geometric parameters 3. Discuss the elements of airport planning and railway engineering.			
Course Content:				
Module 1	Introduction to Transportation Engineering and Highway Materials	Assignment	Programming	**10 Sessions**
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				
Module 2	Highway Geometric Design	Case Study	Data Collection	**15 Sessions**
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.				
Module 3	Railway Engineering and Airport Planning	Assignment	Data Collection	**10 Sessions**
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.				
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: 12th BOS, held on 7/8/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 16th, Dated 23/10/2022

Course Code: CIV2047	**Course Title:** Water Infrastructure Systems **Type of Course:** Program Core & Theory only	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	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.				

<table>
<tr><td>Course Outcomes</td><td colspan="4">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</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Water demand and Water quality</td><td>Assignment</td><td>Data collection and analysis</td><td>09 Sessions</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td>Module 2</td><td>Water treatment</td><td>Assignment</td><td>Java program for water quality analysis</td><td>16 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Collection, Conveyance and water distribution</td><td>Assignment</td><td>Case study</td><td>10 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Catalogue prepared by</td><td colspan="4">Mr. Bhavan Kumar,
Mr. Santhosh M B,
Dr. Jagdish Godihal</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td colspan="4">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

Course Code: CIV3035_v02	**Course Title:** Waste Water Treatment and Disposal Systems **Type of Course:** Program core & Theory only	**L-P-C**	2	0	2
Version No.	1.1				
Course Pre-requisites	Fluid Mechanics - Properties of fluids, Flow through pipes, Water infrastructure systems.				
Anti-requisites	NIL				
Course Description	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.				
Course Objective	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.				
Course Outcomes	On successful completion of this course the students shall be able to: 1) Interpret the relevant treatment units/process for treatment of domestic sewage 2) Relate the process/principles in sizing and locating the sewage treatment plant 3) Analyze the appropriate disposal methods for sewage effluent/sludge				
Course Content:					

Module 1	Estimating the Sewage Discharge and Waste water characterization	Waste water auditing and characterization	Data collection and analysis	13 Sessions
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				
Module 2	treatment of sewage	Presentation	Site visit and observation	15 Sessions
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.				
Module 3	Disposing of Sewage Effluents	Sewage effluents characterization	Sample collection and analysis	12 Sessions
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.				
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				
Text Books 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: 21, Dated: 8th July 2023			
Date of Approval by the Academic Council	Academic Council Meeting No: 21, dated on 28th August 2023			

Course Code: CIV2050	**Course Title:** Environmental Engineering Lab **Type of Course:1] Program Core** **2] Laboratory only**	**L- P- C**	0	2	1
Version No.	1.2				
Course Pre-requisites	**Water infrastructure systems**				
Anti-requisites	NIL				
Course Description	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.				
Course Objective	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.				
Course Out Comes	**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.				
Course Content:	**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.

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.

Professional Software: SPSS, Aquachem

Text Books

3. Metcalf & Eddy, *Wastewater Engineering Treatment and Reuse (4th edition) (2004), mcgraw-hill publication, 1988.*
4. 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: CIV3001_v02	**Course Title: Estimation, Costing and Valuation** **Type of Course: Program Core**	**L- P- C**	2	0	2
Version No.	1.0				
Course Pre-requisites	**Computer Aided Building Drawing Lab**				
Anti-requisites	**NIL**				
Course Description	This subject covers the various aspects of estimating of quantities of items of works involved in buildings, water supply and sanitary works, road works and irrigation works. 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 valuation of various building works.				
Course Content:					
Module 1	**Introduction to estimation**	**Assignment**	**Collection of data/Excel**	**06 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					
Module 2	**Method of building estimate**	**Assignment**	**Collection of data/Excel**	**08 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.					
Module 3	**Valuation of buildings**	**Assignment**	**Collection of data/Excel**	**06 Sessions**	

Topics:
Introduction to Valuation- Purpose of valuation, 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: 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: CIV2035_v02</td><td colspan="4">Course Title: Construction Project Management
Type of Course: Program Core Theory & Integrated Laboratory</td><td>L- P- C</td><td>2</td><td>2</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">[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.
The associated laboratory provides an opportunity to validate the planning and scheduling concepts Taught and enhances the ability to visualize the real system performance.</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 <u>Skill Development</u> through <u>Experiential Learning</u> 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.
4) Prepare schedule of projects in MS Project/ Primavera software and perform various operations to optimize the schedule.</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="2">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="2">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, earn value analysis.</td></tr>
</table>

Module 3	Risk Management	Assignment	Data Collection and Analysis	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

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. 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 "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 handout**	
Catalogue prepared by	**Ms. Sowmyashree 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: CIV2018	**Course Title: Concrete and Highway Materials Testing Lab** **Type of Course: 1] Program Core 2] Laboratory Only**	**L- P- C**	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: CIV3005	**Course Title: Computer Aided Analysis & Detailing Lab** **Type of Course: 1] Discipline Elective** **2] Theory Integrated**	**L-P-C**	1	4	3
Version No.	2.1				
Course Pre-requisites	**CIV3003 – Design of RCC Structural Elements** **CIV3004 – 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.				

<table>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Computer Aided Analysis & Detailing Lab and attain <u>Employability Skills</u> through <u>Experiential Learning</u> techniques</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">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</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1:</td><td>Design Concepts and overview of Detailing of RC Structures</td><td>Quiz</td><td>Quiz on aspects of SP-34 and features of steel detailing</td><td>8 classes</td></tr>
<tr><td colspan="5">Topics: Design concepts of portal frame as per BIS codal provisions. Design concept of isolated and combined foundation. Introduction and overview of SP-34. Aspects of detailing for beams, columns, foundations and beam column junction. Introduction to sleeves in beams and detailing around sleeves as per SP:34.</td></tr>
<tr><td>Module 2:</td><td>Overview of Steel connection detailing</td><td>Quiz</td><td>Quiz on connection details</td><td>5 classes</td></tr>
<tr><td colspan="5">Topics: Design concept of connections. Introduction and overview of detailing of Beam to beam connection, Beam to Column connection, Column bases and Gusseted bases as per IS:800.</td></tr>
<tr><td>List of Laboratory Tasks: (30 sessions required):</td><td colspan="4">Task 01: To model and analyze a given beam/frame with different loading conditions
Level No 01: To model and analyze a 2D beam/ frame with different loading conditions and varying column heights using STAAD. Pro
Level No. 02: To model and analyze a 3D beam/ frame with different loading conditions and same column heights using STAAD. Pro
Task 02: Design and detailing of RC Portal Frames
Level No 01: To design a 2D RC portal frame using STAAD. Pro and Reinforcement Detailing of Beam and Column including Beam-column junction.
Level No. 02: Preparation of Bar Bending Schedule (BBS) for a 2D RC portal frame after design and detailing
Task 03: Analysis, Design and Detailing of Isolated Footing
Level No 01: To analyze, design and carry out reinforcement detailing for an isolated footing with uniform thickness excluding self- weight with the help of STAAD Advanced Foundation
Level No. 02: To analyze, design and carry out reinforcement detailing for an isolated footing with sloped thickness including self –weight with and without pedestal with the help of STAAD Advanced Foundation
Task 04: Analysis, Design and Detailing of Combined Footing
Level No 01: To analyze, design and detail the reinforcement for a rectangular combined footing using STAAD Advanced Foundation
Level No. 02: To analyze and design a trapezoidal combined footing using STAAD Advanced Foundation</td></tr>
</table>

	Task 05: Connections – Beam to beam and Beam to Column **Level No 01:** To detail Beam to beam and Beam to Column by bolted and welded connections for given data **Level No. 02:** To design and detail Beam to Column by bolted and welded connections for given data **Task 06: Column bases and Gusseted bases** **Level No 01:** To detail Column bases and Gusseted bases with bolted and welded connections. **Level No. 02:** To design and detail Column bases with bolted and welded connections. **Task 07: Modelling, Analysis and Design of Multistorey building frame** **Level No 01:** To model, analyze and design a typical multistorey building frame using ETABS software **Level No. 02:** To verify the design results by carry out manual design for typical beams and columns after grouping of beams and columns based on force and moment output
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. 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	
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.**	
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: CIV2012	**Course Title: Building Information Modeling** **Type of Course:1] Discipline Elective** **2] Laboratory only**	**L-P-C**	1	4	3
Version No.	1.1				
Course Pre-requisites	**CIV 1007 - 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] Create projects using Revit Architectural Template and work with Family and massing tools. 2] Demonstrate competency using REVIT to create and document small building projects with custom curtain walls.				
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: (30 sessions required):	**Task 01: Introduction to BIM and Autodesk REVIT, Basic Drawing and Editing Tools** **Task 02: Views, View Controls and Properties** **Task 03: Dimensions and Constraints** **Task 04: Categories, Families, Types, and Instances** **Task 05: Levels, Perspective and Sheet Creation** **Task 06: Section Views** **Task 07: Material and Additional Settings** **Task 08: Compound and Custom Walls** **Task 09: Creating and Modifying Footprint Roofs** **Task 10: Editing Wall Profiles** **Task 11: Floor and Foundation** **Task 12: Staircase** **Task 13: Ramp** Level No. 02: Implementation of REVIT tools on different types of buildings and Massing Tools
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: CIV3024	**Course Title: Remote Sensing and Geographical Information System** **Type of Course: Discipline Elective and Theory Only**	**L-P-C**	**3**	**0**	**3**
Version No.	1.0				
Course Pre-requisites	[1] Engineering Geology [2] 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: CIV2020	**Course Title: Alternative building materials Type of Course: Discipline Elective & Theory only**	**L-P-C**	3	0	3
Version No.	1.1				

Course Pre-requisites	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

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

PU e-Library Resources

1. https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=86b92190-5f6a-46f6-ac3c-4a3f4251b842%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
2. https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=be513583-17f0-4e62-856d-6c642745f86f%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#
3. https://web.s.ebscohost.com/ehost/detail/detail?vid=0&sid=b42f607d-6496-4482-8156-517a967fdd00%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#

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: CIV2021	**Course Title: Design concepts of Building Services** **Type of Course: Program Core & Theory only**	**L-P-C**	3	0	3
Version No.	1.1				
Course Pre-requisites	CIV1007 - Building Planning and Drawing, CIV3001 - Estimation, Costing and Valuation				
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: CIV2052	**Course Title: Integration of SDGs in Civil Engineering** **Type of Course: Open Elective and Theory only**	**L-P- C**	3	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: CIV4009	**Course Title: Optimization Methods for Civil Engineering** **Type of Course: Discipline Elective** **Theory Only Course**	**L-P-C**	3	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: CIV2053	**Course Title: Development and Applications of Special Concrete** **Type of Course: Discipline Elective and Theory only**	**L-P- C**	3	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 Out Comes	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: CIV2055	**Course Title: Safety in Construction** **Type of Course: Elective & Theory Only**	**L-P- C**	3	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: CIV2019	**Course Title: Advanced Concrete Technology** **Type of Course: Discipline Elective** **Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**Building Materials and Concrete Technology, 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 Hrs**
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 Hrs**
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 Hrs**
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	**9 Hrs**

			performance concrete and Self compacting concrete as per IS 10262:2019 for a given set of input data.	

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

Course Code: CIV3007	**Course Title: Structural Dynamics** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	[1] Engineering Mathematics [2] Analysis of Determinate structures [3] 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.				
Anti-requisites	NIL				
Course Description	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.				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Structural Dynamics** and attain **Employability Skills** through **Problem Solving** methodologies.				

Course Outcomes	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.			
Course Content:				
Module 1	**Introduction to Structural dynamics and free vibration of SDOF systems**	Assignment	Numerical models of SDOF systems	**8** Sessions
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.				
Module 2	**Forced vibration of SDOF systems**	Assignment	Model a response spectrum for systems under various loadings	**10** Sessions
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.				
Module 3	**Vibration of MDOF systems**	Assignment	Numerical models of MDOF systems	**6** Sessions
Topics: Free vibration of MDOF (Multi Degree Freedom System), Natural frequencies, Normal modes, Orthogonality of normal modes, Eigen Values. Free vibrations, Natural frequencies.				
Module 4	**Shear modeling of buildings**	Assignment	Program the equations for obtaining shear building responses	**10** Sessions
Topics: Forced vibrations, Shear buildings modelled as MDOF systems, Motion of shear buildings, Model Superposition Method, Response to shear buildings, Base motion, Harmonic fixed 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: 1. Mario Paz,"Structural Dynamics", CBS publishers. 2. M. Mukhopadhaya,"Structural Dynamics: Vibrations & Systems", Anne Books Pvt. Ltd.				
References 1. Clough & Penzien, "Structural Dynamics", Tata Mc Graw Hill. 2. 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: CIV3008	**Course Title: Advanced RCC Structures** **Type of Course: Discipline Elective & Theory only**	**L-P-C**	3	0	3
Version No.	1.2				
Course Pre-requisites	**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 Out Comes	**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. **Assignment:** Solve the design problem manually and compare the results using STAAD Pro software. Also prepare a report by including the result sheet, SFD, BMD and deflections using the software.				
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. **Assignment:** Analysis and design of flat slab using MATLAB coding /ETABS.				
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. **Assignment:** Design a Rectangular Combined footing manually and compare the results using STAAD Pro software.				
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 **Assignment:** Design a Rectangular Water tank manually and compare the results using STAAD.Pro. software.				
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.				
Project work/Assignment:				
Project Assignment: Analyze and Design a G+2 framed building for the given loading conditions using : 1] STAAD Pro and 2] ETABS and compare the results **Assignment 1:** Solve the design problem manually and compare the results using STAAD Pro software. Also prepare a report by including the result sheet, SFD, BMD and deflections using the software **Assignment 2:** Analysis and design of flat slab using MATLAB coding /ETABS				

Assignment 3: Design a Combined footing and Water tanks manually and compare the results using STAAD Pro 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 of flat slab using MATLAB coding/ETABS
•Design concept of rectangular and trapezoidal combined footings.
•Design concept of water tanks

Topics relevant to development of "HUMAN VALUES AND PROFESSIONAL ETHICS SKILLS":
•Solve the design problem manually and compare the results using STAAD Pro software

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: CIV3004	**Course Title:** D**esign of Industrial Structures** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	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 D**esign 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

Course Code: CIV3010	**Course Title: Repair and Rehabilitation of Structures** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Building Materials & Concrete Technology, Design of RCC Structures				
Anti-requisites	NIL				
Course Objectives	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.**				
Course Description	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.				
Course Outcomes	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.				
Course Content:					
Module 1	**Deterioration causes**	Assignments	Article review		**10 Sessions**
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.					
Module 2	**Inspection and NDT**	Assignments	Case study on application of NDT and Data analysis		**12 Sessions**
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.					
Module 3	**Repair Materials**	Assignment	Market Survey		**10 Sessions**
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.

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

Topics related to Environment and sustainability

Selection of repair materials for concrete, Strength and durability aspects

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**

Course Code: CIV3011	**Course Title: Matrix methods of Structural analysis** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Basic knowledge of Arithmetic, Fundamentals of Matrices and Determinants and Basics of Structural analysis.				
Anti-requisites	NIL				
Course Description	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.				

Course Objectives	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.			
Course Outcomes	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.			
Course Content:				
Module 1	**Introduction to Matrix Method of Structural analysis**	Assignments	Theory based questions	**6** Sessions
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.				
Module 2	**Element Flexibility Method**	Assignments	Analysis by flexibility method and use of STAAD Pro/ETABS	**10** Sessions
Topics: Force transformation matrix, global flexibility matrix, analysis of continuous beams, rigid frames and trusses.				
Module 3	**Element Stiffness Method**	Assignment	Analysis by stiffness method and use of STAAD Pro/ETABS	**10** Sessions
Topics: Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, rigid frames and trusses.				
Module 4	**Direct Stiffness Method**	Assignment	Analysis by direct stiffness method and use of STAAD Pro/ETABS	**8** Sessions
Topics: Local and global coordinates systems, principle of contra gradience, global stiffness matrices of beam and truss elements, analysis of continuous beams and trusses.				
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 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 related to Employability Skill: 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 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: CIV3012	Course Title: Masonry Structures Type of Course: Discipline Elective Theory	L- P- C	3	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:

i) Reference Book(s)

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.

(ii) 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
Recommended by the Board of Studies on	14th BOS held on 30/07/2022
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Course Code: CIV3013	**Course Title: Advanced Design of Steel Structures** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	CIV3002 - Analysis of Indeterminate structures CIV3004 - Design of Steel Structures				
Anti-requisites	NIL				
Course Description	The objective of this course is to understand the plastic behavior of structures a the principles of plastic analysis of Structures as well as to expose students to desi of steel trusses and gantry girder. The main objective of this course is to provi civil engineering students with the knowledge of plastic analysis and behavior as w				

	as design of steel structures. This course is a second level course on steel structur It deals with the plastic behavior of structures, plastic analysis, and development plastic hinges. It also deals with the design of steel trusses and gantry girders as p limit state of design following the Indian codal provisions. The basic knowledge structural analysis and design of steel structures is essential to easily understa this course. This Course helps to design steel trusses for supporting the roof industrial structures, railway stations and to design gantry girders used in factor and manufacturing industries to lift and move heavy machinery/equipment.
Course Objective	The objective of the course is to familiarize the learners with the concepts **Advanced Design of Steel Structures** and attain **Employability Skills** throu **Problem Solving** methodologies.
Course Outcomes	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 st elements. 3) Demonstrate the design concept of Cold formed Steel sections. 4) Choose appropriate steel sections for different components of a steel roof tru
Course Content:	

Module 1	Laterally Unrestrained Beams	Assignment	Numerical problems from E-resources	**10 session**
Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approa Lateral buckling strength of Cantilever beams, continuous beams, Mono- symmetric and non- uniform bea – Design Examples. Concepts of Shear Center, Warping, Uniform and Non-Uniform torsion				
Module 2	Plastic Analysis and Fire Resistance of Structural Steel	Assignment	Case study on fire protection measures in various steel structures	**10 sessio**
Introduction to plastic behaviour of Structural steel, Plastic theory, Plastic hinge concept, Plastic collap load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis, conditions of plas analysis, Plastic analysis of Beams. Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting St temperature, Protected and unprotected members, Methods of fire protection, Fire resistance Ratin Numerical Examples.				
Module 3	Design of Cold formed steel sections	Assignment	Numerical problems from E-Resources	**08 sessio**
Techniques of manufacture and properties of Cold formed steel sections, Advantages, Typical profil Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801 & 811 co provisions for Design of Cold Form sections. Numerical examples on beam design and column design.				
Module 4	Design of Steel Roof Truss	Assignment	Numerical problems from E-Resources	**08 session**
Introduction and Types of Roof Trusses, Selection of type of trusses, Types of member sections and select of sections, Loads on roof trusses and load combinations, Deflection of Trusses, Design procedure for a R 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 desi following the Indian codal provisions and design of steel trusses for supporting the roof of industr 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 Pr 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=ehos live**
Topics relevant to "Employment Skill": Selection of members for roof truss, cold formed steel desi using software **for developing Employability Skills through Problem Solving methodologies. This 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: CIV3014	**Course Title: Design of Retaining Structures** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	[1] Foundation Engineering [2] Design of RCC structures 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 tanks 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: CIV3015	**Course Title: Elements of Earthquake Engineering** **Type of Course: Discipline Elective** **Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**CIV2008 - Engineering Geology, CIV2015 - Geotechnical Engineering, CIV3003 - 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.				

<table>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Dynamics for Earthquake Analysis</td><td>Assignment</td><td>Computation of Mode Shapes for a 4-storey RC Building</td><td>15 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 2</td><td>Engineering Seismology</td><td>Case Study</td><td>Case Study of any relevant past earthquake with presentation.</td><td>12 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Code Based Seismic Analysis Methods</td><td>Programming Assignment</td><td>Write a program to calculate base shear distribution for regular buildings using static and dynamic method.</td><td>10 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used: Applied in structural engineering consultancies to provide earthquake resistant design of structures.
Tools: ETABS, Staad Pro.</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td colspan="5">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 <u>Employability Skills through Problem Solving methodologies.</u> This is attained through assessment component mentioned in course handout.</td></tr>
<tr><td>Catalogue prepared by</td><td colspan="4">Ms. Anju Mathew</td></tr>
</table>

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: CIV3016	**Course Title: Bridge Design** **Type of Course: Discipline Elective** **Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**1] Structural Analysis, 2] 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 Out Comes	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 depth requirement for RC slab	**9 Classes**
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: CIV3017	**Course Title: Stability of Structures**	**L- P- C**	3	0	3

	Type of Course: Discipline Elective & Theory only				
Version No.	1.0				
Course Pre-requisites	[1] Differential Equations [2] Analysis of Indeterminate structures [3] 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: CIV3018	**Course Title: Pre-fabricated Structures** **Type of Course: Discipline Elective** **Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**1] Building Construction, 2] Strength of Materials, 3] 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: CIV4001	**Course Title: FINITE ELEMENT METHOD** **Type of Course:** **Program Core (Discipline Elective) & Theory Only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**1] Strength of Materials, 2] 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 Out Comes	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: CIV4002	**Course Title: Theory of Elasticity** **Type of Course: Program Core & Theory Only**	**L- P- C**	3	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 NO: 14th BOS, held on 30/7/2022			
Date of Approval by	Academic Council Meeting No. 18.3, Dated 2/8/2022			

the Academic Council	

Course Code: CIV 4003	**Course Title:** Advanced Prestressed Concrete Design **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	CIV 3003 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:** https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=NAP_1_4412				
Topics relevant to "EMPLOYABILITY SKILLS": Stress distribution in end block and anchorage zone stresses. Design of tension and compression members. Design of slabs and grid floors. Design of statically indeterminate beams, slabs, grid floors, precast elements and composite beams using relevant software **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: CIV4004	**Course Title: Earthquake Resistant Design of Structures** **Type of Course:1] Discipline Elective** **2] Theory Only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**CIV3015 - 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 Out Comes	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 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 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 4010	**Course Title: Offshore structures** **Type of Course: Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	CIV 2013, CIV 3002, CIV 3003				
Anti-requisites	NIL				
Course Description	The objective of the course is to develop the knowledge in analysis and design of various offshore structures conforming to codal provisions. The course also inclu the topics to get exposed to special features of offshore structures like geome forces encountered, structural modeling for design purpose together with th design. The course covers wave theories, wind forces and other forces acting offshore structures. Students also get familiarize with design of platforms, helipa jacket tower and mooring cables and pipelines including the Corrosion and Fati Failure behavior. Students are expected to obtain basic knowledge about the des and failure mode of offshore structures after finished this course.				

Course Objectives	The objective of the course is to familiarize the learners with the concepts **Offshore structures** and attain **Employability Skills** through **Problem Solv** methodologies.			
Course Outcomes	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			
Course Content:				
Module 1	Wave Theories	Assignment	Case study	**10 class**
Topics: Conservation mass and momentum, Euler equation, Bernoullis Equation, Potential flow, Classificatior waves, small amplitude or Linear Airy's theory, dispersion relationship, water particle kinematics, w energy.				
Module 2	Forces on Offshore Structures	Assignment	Numerical problems and validate by software	**12 class**
Wind forces, wind forces on vertical, inclined cylinders, structures – current forces and use of Morri equation, Different type of offshore structures, fixed jacket platform.				
Module 3	Design of Offshore Structures	Assignment	Numerical problems and validate by software	**12 class**
Static method of analysis - foundation analysis and dynamics of offshore structures, Design of platfor helipads, jacket tower and mooring cables and pipelines – Corrosion and Fatigue Failure.				
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				
Text Books: 1.Chakrabarti, S.K., "Hydrodynamics of Offshore Structures", Computational mechanics, Publications, 19 2.Reddy DV and Arockiasamy M., "Offshore Structures", Vol.1, Krieger Publication Company, Malabar, Flor 1991				
References 1 . Thamas H Dawson, "Offshore Structural Engineering", Prentice Hall Inc. Englewood, Cliffs, N.J. 1983 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=eho live**				
Topics relevant to "EMPLOYABILITY SKILLS": Wind forces, wind forces on vertical, inclined cylind structures – current forces and use of Morrison equation . Static method of analysis - foundation analysis dynamics of offshore structures, Design of platforms, helipads, jacket tower and mooring cables and pipeli **for developing Employability Skills through Problem Solving methodologies. This is attain 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: CIV3049	**Course Title: Structural Health Monitoring** **Type of Course: Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	CIV 3013, CIV 3002, CIV 3003				
Anti-requisites	NIL				
Course Description	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.				
Course Objectives	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**.				
Course Outcomes	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				
Course Content:					
Module 1	Structural Health Monitoring	Assignment	Case study		**10 classes**
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				
Module 2	Static and Dynamic Field Testing	Assignment	Numerical problems and validate by software	**10 classes**
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				
Module 3	Introduction to Repairs and Rehabilitations of Structures	Assignment	Numerical problems and validate by software	**10 classes**
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				
Targeted Application & Tools that can be used: Application area is understanding of static and dynamic field testing of structures.				
Text Books: 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

<table>
<tr><td>Course Code: CIV3052</td><td colspan="4">Course Title: Glass in Buildings: Design and Applications

Type of Course: Discipline Elective and Theory only</td><td>L- P- C</td><td>3</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">Design of RC Structural elements</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">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.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Glass in Buildings: Design and Applications and attain <u>Employability Skills</u> through <u>Problem Solving</u> 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) 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.</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Glass manufacturing process</td><td colspan="2">Assignment</td><td colspan="2">Case Study</td><td colspan="2">11 Sessions</td></tr>
<tr><td colspan="9">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.</td></tr>
</table>

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.

Assignment: Discuss the different techniques used in Production planning and control in Glass industries.

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.

Assignment: Identify the different types of Glass facades and Development and Trends of Glass Innovation Under Global Climate Change

Module 3	Useful Daylighting in Buildings	Case Study	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

Assignment: Describe the potential of Glass in Biophilic Design in Daylighting in buildings

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: CIV4011	**Course Title: Design of Tall Buildings**	**L- P- C**	3	0	3

	Type of Course: Discipline Elective **Theory Only Course**				
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 stafford 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: CIV4012	**Course Title: Theory of Plates and Shells** **Type of Course: Discipline Elective** **Theory Only Course**	**L- P- C**	3	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 Out Comes	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 . 4https://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: CIV4013	**Course Title: Design of Steel Concrete Composite Structures** **Type of Course: Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	CIV 1066, CIV 3003,CIV3004				
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 & Tunneling** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**Surveying, 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 signaling 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 & Tunneling** and attain **Employability Skills** through **Participative Learning techniques**.				

<table>
<tr><td>Course Outcomes</td><td colspan="4">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.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to Railway Engineering</td><td>Assignment</td><td>Data collection</td><td>10 Sessions</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td>Module 2</td><td>Geometric Design of Railway</td><td>Assignment</td><td>Software Application</td><td>8 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Components of Rail Transport</td><td>Assignment</td><td>Software Application</td><td>9 Sessions</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td>Module 4</td><td>Introduction to Tunnel Engineering</td><td>Case Study</td><td>Data Collection</td><td>11 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Professionally Used Software: Open Rail Designer</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">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: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1468148&site=ehost-live</td></tr>
</table>

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/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- P- C**	3	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				
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				
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.**				
Catalogue prepared by	**Mrs. 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: CIV2024	**Course Title : Pavement Materials and Construction** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	1] Transportation Engineering 2] Concrete and Highway Materials Testing Laboratory Basic insights into various types of pavement materials and their characterization.				
Anti-requisites	NIL				
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 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 Out Comes	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 behavior 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				
References **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.
4. A T Papagiannakis and E A Masad, *"Pavement Design and Materials"*, John Wiley & Sons, 2008.
5. 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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Transportation Engineering				
Anti-requisites	NIL				
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 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 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 1. Jothi Kristey and Lal, "*Introduction to Transportation Engineering"*, PHI, New Delhi, 2002. 2. Wilson AG, "*Urban and Regional Models in Geography and Planning*", John Wiley and Sons, London, 1974. 3. Hutchinson B.G, "*Introduction to Urban System Planning*", Tata McGraw Hill. E Resources Presidency University: 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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	1] Transportation Engineering 2] Highway Engineering Basic insights into traffic stream characteristics				

Anti-requisites	NIL			
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 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 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

1. Kadiyali L R, "*Traffic* Engineering *and Transport Planning*", Khanna Publishers, 2017.
2. Khanna, S.K and Justo, C.E.G., "*Highway Engineering*", Nem Chand and Bros. Roorkee (U.P), 1998.
3. Mc. Shane, William R., Roess, Roger P. and Prassas Elena S., "*Traffic Engineering*", Pearson, 2019.

References

1. Jothi Kristey and Lal, "*Introduction to Transportation Engineering"*, PHI, New Delhi, 2002.
2. AASHTO, *"A Policy on Geometric Design of Highway and Streets"*, 2004.
3. R. J. Salter and N. B. Hounsel, *"Highway Traffic Analysis and Design*", Macmillan Press Ltd, 1996.
4. Chandra, Satish, S. Gangopadhyay, S. Velmurugan, and Kayitha Ravinder. "Indian highway capacity manual (Indo-HCM)." (2017).
5. 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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	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*				

Website: https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1227289&site=ehost-live	
Topics related to development of "Employability ": Concepts of geodetic Surveying, aerial Photogrammetry and Total station **for developing <u>Employability Skills through Problem Solving methodologies.</u> 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- P- C**	3	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. 2. Web link: 3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2665206&site=ehost-live
Topics relevant to "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 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: CIV3021	**Course Title : Pavement Design** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	1] 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	**6 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	**7 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	**8 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	**9 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:

3. *https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=121367&site=ehost-live*
4. 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 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: CIV3022	**Course Title: Highway Construction and Maintenance** **Type of Course: Discipline Elective & Theory only**	**L- P- C**	3	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 6. Khanna, S.K and Justo, C.E.G., "*Highway Engineering*", Nem Chand and Bros. Roorkee (U.P), 1998. 7. Dar-Hao Chen and Cindy Estakhri, *"Material, Design, Construction, Maintenance, and Testing of Pavement"*, Geotechnical Special Publications, American Society of Civil Engineers, 2009. 8. 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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	1] 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	Case study	Data Collection		**5 classes**

	Transportation Systems (ITS)			
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

Course Code: CIV3025	**Course Title: Environmental Geotechnics** **Type of Course: Discipline elective Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**Geotechnical Engineering, Environmental Engineering**				
Anti-requisites	**NIL**				
Course Description	**This course addresses the problems of industrial world and impact on health and welfare in relation to pollution of ground.**				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Environmental Geotechnics** and attain **Employability Skills** through **Participative Learning** techniques.				
Course Outcomes	**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)** D**iscuss the transport phenomena concepts and contaminated ground water and seepage.**				
Course Content:					
Module 1	**Introduction to Environmental geotechnics**	**Assignment**	**Collection of data of Hazardous wastes and analysis.**	**10 Sessions**	
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.**					
Module 2	**Geo environmental Hazards**	**Assignment**	**Collection of data of natural and manmade hazards and analysis.**	**6 Sessions**	
Topics: **Geo environmental Hazards: Natural and manmade, Mitigate measures and soil pollutant interaction.**					

Module 3	**Waste disposal and Remediation**	**Assignment**	**Design a Municipal Landfill and Reuse of Industrial wastes**	**16 Sessions**
Topics: **Waste disposal facilities: Landfills, Transport phenomena, contaminated ground water and seepage, Stabilization/ Solidification, Waste Remediation, Recycle and Reuse of Industrial Waste.**				
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				
Text Book: **T1. D.S.Hari and R.R.Krishna — Geoenvironmental Engineering, Site remediation, waste containment and emerging waste management technologies, Wiley, 2005.**				
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.** **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: CIV 3026	**Course Title: Advanced Soil Mechanics** **Type of Course: Discipline elective Theory only**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**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. Assignment: Data Collection of various soil and analysis using excel.					
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.** Assignment: Data Collection of various soil and determination of consolidation parameters using excel.					
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.** **Assignment: Data Collection of various soil and analysis of secondary consolidation parameters using excel.**				
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.** **Assignment: Data Collection of various soil and analysis of shear strength using excel.**				
Targeted Application & Tools that can be used: **This course is 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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	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 behavior 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**	**L- P- C**	3	0	3

	Type of Course: Discipline elective				
Version No.	1.1				
Course Pre-requisites	**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. **Assignment: Collection of data and analysis of damages to the structures founded on problematic soils using Excel.**					
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. **Assignment: Collection of Data and Determination of maximum dry density and optimum moisture content using excel**					
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. **Assignment: Performance analysis of prefabricated vertical drains using Plaxis 2D software**				
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. **Assignment: Study of behavior of Reinforced slopes using Plaxis 2D**				
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

Course Code: CIV4005	**Course Title: Reinforced Earth Structures Type of Course: Discipline elective Theory only**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	**Foundation Engineering**				
Anti-requisites	**NIL**				
Course Description	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.				
Course Objective	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**.				

<table>
<tr><td>Course Outcomes</td><td colspan="4">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="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to reinforced soil structures</td><td>Assignment</td><td>Collection of data of Historical background of reinforced earth structures and analysis.</td><td>10 Sessions</td></tr>
<tr><td colspan="5">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>Types of Geosynthetic materials and their testing</td><td>Assignment</td><td>Collection of data of applications of various types of geosynthetics and analysis.</td><td>6 Sessions</td></tr>
<tr><td colspan="5">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>Application of Geotextiles</td><td>Assignment</td><td>Performance analysis of geotextile reinforced retaining structures with Plaxis 2D software</td><td>7 Sessions</td></tr>
<tr><td colspan="5">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>Design applications of reinforced soil structures</td><td>Assignment</td><td>Study of behavior of Reinforced slopes using Plaxis 2D</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Design applications of reinforced soil structures: Bearing capacity Improvement, Reinforced Earth Walls.</td></tr>
<tr><td colspan="5">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>
<tr><td colspan="5">Text Book:
1. Koerner, R.H. Designing with geosynthetics, Prentice Hall Inc, 5TH Edition, 2005.</td></tr>
<tr><td colspan="5">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/</td></tr>
</table>

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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**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.** **Assignment: Collection of data of soil using Excel.**				
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.** **Assignment: Design of pile foundations using Plaxis 2D.– mat foundation**				
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.** **Assignment: Data collection on Case studies of caissons using Excel.**				
Module 4	**Machine Foundations**	**Case study**	**Collection of Data/ Excel**	**09 Sessions**
Topics: **Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation'** **Assignment: Collection of Data on Case study on Braced cuts using Excel.**				
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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**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. **Assignment: Collection of data of Backfill using Excel**				
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. **Assignment: Design of Rigid retaining structures by Python**				
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.** **Assignment: Data collection on Case studies on failure of Flexible retaining structures.**				
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. **Assignment: Data collection on Case study on Cofferdams using Excel.**				
Targeted Application & Tools that can be used: **This course is 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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**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.
Assignment: Collection of data of dynamic properties of soil using excel.

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.
Assignment: Design of shallow foundation by PLAXIS 2D

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.

Assignment: Data collection on Case studies on behavior of deep foundations using Excel.

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.
Assignment: Case study on Structural design of foundation

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: CIV 3050	**Course Title: Pavement Management System** **Type of Course: Discipline Elective Theory only**	**L- P- C**	**3**	**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 **Assignment:** Data collection of existing Pavement management system and interpretation				
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 **Assignment:** Overlay Design using PAVER software.				
Module 3	Implementation of Pavement Management System	Assignment	Data analysis/Softwares	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. **Assignment:** Design of pavement maintenance system using PAVER software.				
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: 5. https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=710371&site=ehost-live 6. *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 softwares 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 Meeting No. 18 held on 03 August 2022			

Academic Council	

Course Code: CIV3057	**Course Title: Designing of soil structures with Geosynthetics** **Type of Course: Discipline Elective Theory only**	**L- P- C**	**3**	**0**	**3**
Version No.	1.0				
Course Pre-requisites	**Geotechnical Engineering and 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. **Assignment:** Data collection of historical background on the use of Geosynthetics and interpretation on excel.					
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.					

Assignment: Interpretation of results of geosynthtics testing using Excel.				
Module 3	**Strength Analysis of Reinforced Soils**	Assignment	Data analysis/Softwares	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.

Assignment: Determination of shear strength of geosynthetic reinforced soil using Plaxis 2D/3D software.

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**	**L-P-C**	3	0	3

	Type of Course: Discipline Elective & Theory Only				
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. **Assignment:** analysis of accident data using MATLAB					
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. **Assignment:** Road safety audit data collection and interpretation using Excel					
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 softwa**re – 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- P- C**	**3**	**0**	**3**
Version No.	1.0				

Course Pre-requisites	**Geotechnical Engineering and 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. **Assignment:** Data collection of constructed pile foundation and interpretation on excel.				
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. **Assignment:** Interpretation of pile group efficiency using Excel.				
Module 3	Behavior of laterally loaded vertical and batter piles	Assignment	Data analysis/Softwares	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. **Assignment:** Determination of load carrying capacity using **DeepFND** software.				
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 multistory structures. Professionally Used Software: DeepFND				
Project work/Assignment:				
Project Assignment: Design a pile foundation using DeepFND.				

Assignment 1] Collect the design of constructed pile foundation of BMRCL and understand the design. **Assignment 2]** Modelling of a pile foundation using DeepFND software.
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-P-C**	3	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 behavior 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 behavior 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. **Assignment:** Determination of flakiness and elongation index of aggregates using MATLAB				
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. **Assignment:** Mix design of bituminous mixture using Excel				
Module 3	Concrete Mix Design and Alternative	Assignment	Programming/Data analysis task	**10 Sessions**

	Pavement Materials:			

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.

Assignment: Mix design of pavement quality concrete

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- P- C**	**3**	**0**	**3**
Version No.	1.0				
Course Pre-requisites	**Geotechnical Engineering and 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 include 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	Datacollection/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. **Assignment**: Soil Classification Using Artificial Intelligence				
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. **Assignment**: Estimation of sate variable by data collection using Excel.				
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. **Assignment:** Determination of shear strength of unsaturated soil using Plaxis 2D/3D software.				
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 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: CIV2027	**Course Title: Environmental Pollution and Control** **Type of Course: Discipline Elective/ Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**Environmental Science**				
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 Out Comes	**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			

Course Code: CIV2028	**Course Title: URBAN AIR POLLUTION AND CONTROL** **Type of Course: Discipline Elective & Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Environmental studies				
Anti-requisites	**Nil**				
Course Description	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.				
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.				
Course Out Comes	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				
Course Content:					
Module 1	Introduction	Case Study	Data Collection		**15 sessions**
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.					
Module 2	Meteorology	Assignment/ Case Study	Programming task and Data collection.		**10 sessions**

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.				
Module 3	Control of air pollution-Particulates and Gaseous	Assignment	Data Collection	**10 sessions**
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.				
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.				
Text Book *1) M N Rao, "Air pollution and control", McGraw Hill Publication-2017*				
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*				
Topics relevant to Employability Skill: Entrepreneurship and Air quality Monitoring				

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- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	Knowledge of 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- P- C**	3	0	3
Version No.	1.1				

Course Pre-requisites	Environmental Science			
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 Out Comes	**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, tunneling 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- P- C**	3	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 Hours**
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 Session**
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 Session**
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 Session**
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 Session**
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- P- C**	3	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)				
Project work/Assignment:				
Assignment 1: Case study and discussion on Drainage systems of smart cities **Assignment 2: Flood mitigation and forecasting 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 **Topics related to "Environment and Sustainability":** LID practices to Urban drainage systems	
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

Course Code: CIV2033	**Course Title: Integrated watershed management** **Type of Course: Discipline Elective/ Theory Only Course**	**L- P-C**	3	0	0
Version No.	1.1				
Course Pre-requisites	Basic concepts of hydrology and hydrogeology, Water resource management.				
Anti-requisites	Nil				
Course Description	The course is interdisciplinary in nature, the technical concepts of hydrology, hydrogeology are inter twined with integrated approach in resource management concepts for efficient management of water sources for a sustainable development.				
Course Objective	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**.				
Course Out Comes	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				
Course Content:					
Module 1	**Integrated watershed**	case study	Data Collection/Data Analysis		**10 Sessions**

	resource management			
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.				
Module 2	**Conjunctive use of water**	Assignment 1, Case study	Data Interpretation / Analysis	**12 Sessions**
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.				
Module 3	**Rainwater harvesting systems and Roof catchment system**	Assignment 2, Case study.	Interpretation	**08 Sessions**
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				
Targeted Application & Tools that can be used: IOT Applications in smart water management.				

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

References

1. 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:** Theory only Discipline Elective Course	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	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: 1. 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: 2. 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**	**L- P- C**	3	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- P- C**	3	0	3
Version No.	1.2				
Course Pre-requisites	Knowledge of 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**		**L- P- C**	2	1	0
Version No.	1.2				
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] Analyze 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.

Web Resources: https://web.s.ebscohost.com/ehost/detail/detail?vid=6&sid=d8dfd86b-34dc-495f-8ec0-5a90d217ea9f%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=582625&db=e000xww

https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=539252&site=ehost-live

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": River water training, Energy dissipaters **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 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: CIV3033	**Course Title:** Water Resources Management **Type of Course: Discipline Elective**	**L- P- C**	3	0	3

	Theory only course				
Version No.	1.2				
Course Pre-requisites	Knowledge of Hydrology and Water Resources engineering Irrigation Engineering				
Anti-requisites	NIL				
Course Description	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.				
Course Objective	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**.				
Course Out Comes	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.				
Course Content:					
Module 1	Water resources Planning	Case study	Data Collection/ Data Analysis	15 Sessions	
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					
Module 2	Integrated Water Resources Management	Assignment	Data Collection/ Data Analysis	10 Sessions	
Topics: Integrated Water Resources Management: Definition of IWRM, Principles, Implementation of IWRM, Legislative and Organizational Framework, Types and Forms of Private Sector Involvement.					
Module 3	Water Management	Case Study/Quiz	Data Collection/ Data Analysis	15 Sessions	
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.
Targeted Application & Tools that can be used: Application Area is Integrated watershed management, Watershed modelling Professionally Used Software: HEC-HMS, WEAP, MIKE
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 modeling 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- P- C**	3	0	0
Version No.	1.2				
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 Out Comes	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**	Assignment1	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**	Assignment2	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	Assignment3	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 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: CIV2051	**Course Title: Soil and water conservation** **Type of Course: Discipline Elective & Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Environmental studies, 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 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				
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				
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				
Catalogue prepared by	Mr. Bhavan Kumar			
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: CIV3051	**Course Title: Statistics in Hydrology** **Type of Course:** Discipline Elective Theory Only Course	**L- P- C**	3	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: CIV2036	**Course Title: Introduction to Infrastructure System and Planning** **Type of Course: Discipline Elective & Theory only**	**L-P-C**	3	0	3
Version No.	1.2				
Course Pre-requisites	**Building Planning and Drawing, Transportation Engineering**				
Anti-requisites	**NIL**				
Course Description	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.				
Course Objective	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.**				
Course Outcomes	**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.				
Course Content:					
Module 1	Introduction to Infrastructure	Case Studies	Data collection/ Software	**12 Sessions**	
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)

Module 2	Infrastructure Planning	Case Study	Primavera and MS projects, MS excel	**10 Sessions**

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.

Module 3	Concepts of Infrastructure Planning	Assignments	MS excel, MSP, ERP software	**10 Sessions**

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

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.

Textbooks:
T1. A. S. Goodman and M. Hastak, *Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill, New York, 2006.*
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-P-C**	3	0	3
Version No.	1.2				
Course Pre-requisites	**Building Planning and Drawing and Estimation , Costing and Valuation**				
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

Course Code: CIV2038	**Course Title: Construction Equipment and Machinery** **Type of Course: Discipline Elective** **Theory only**	**L-P-C**	3	0	3
Version No.	1.2				
Course Pre-requisites	Building Materials and Concrete Technology				
Anti-requisites	NIL				
Course Description	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.				
Course Objective	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**.				
Course Outcomes	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				
Course Content:					
Module 1	Basics of Construction Equipment	Assignment	Case study	**06 Sessions**	
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.					
Module 2	Construction Equipment & Machinery	Case Study	Data Collection	**10 Sessions**	
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					
Module 3	Principles of construction	Case Study	Data Collection	**09 Sessions**	
Topics: Formworks, Centering and Shuttering of sheet piles, moving the forms, Joints in concrete, Plastering and Pointing, Shoring and Scaffolding, underpinning, submerged structures					

Module 4	Structure Prefabrication	Assignment	Data Collection	**09 Sessions**

Topics:
Prefabricated panels and structures, Transporting and Erection of structures, Fire resistance in construction, Damp proofing, Termite proofing, Sound insulations, Ventilation

Targeted Application & Tools that can be used:
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**	**L-P-C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**CIV1006- 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

Course Code: CIV3036	**Course Title:** Project Management in Infrastructure Development **Type of Course:** Discipline elective & Theory only	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Basic knowledge of different civil engineering structures and Basic Engineering mathematics.				
Anti-requisites	**NIL**				
Course Description	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.				
Course Objective	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.				
Course Outcomes	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.				

<table>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to Infrastructure</td><td>Assignment</td><td>Data collection and Analysis task</td><td>09 Hours</td></tr>
<tr><td colspan="5">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>Project Management in Infrastructure</td><td>Assignment</td><td>Simulation in MS project</td><td>13 Hours</td></tr>
<tr><td colspan="5">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>Life cycle Analysis</td><td>Assignment</td><td>Data collect</td><td>10 Hours</td></tr>
<tr><td colspan="5">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="5">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="5">Textbooks:
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="5">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.
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</td></tr>
<tr><td colspan="5">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 colspan="4">Mr. Ahamed Sharif/ Ms. Sowmyashree T</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td colspan="4">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

Course Code: CIV3037	**Course Title: Construction Practices and Challenges in Infrastructure Projects** **Type of Course: Discipline Elective and Theory Only**	**L-P-C**	3	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-P-C**	3	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-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Engineering Geology (CIV 2008), Surveying CIV 3024				
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-P-C**	3	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-P-C**	3	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	Academic Council Meeting No. 18 held on 03 August 2022			

the Academic Council	

Course Code: CIV3056	**Course Title: Geospatial Analysis in Urban Planning** **Type of Course: Discipline Elective and Theory Only**	**L-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	**[1] Engineering Geology (CIV 2008)** **[2[Surveying CIV 1005**				
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. Interpretation of Multispectral Imagery and High-resolution data.				
Module 3	Urban population growth and transport trends analysis	Assignment	Data Collection and Analysis	**06** Sessions
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.				
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.				
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.				
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

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)

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.**

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: CIV2040	**Course Title: Built Environment Design** **Type of Course: Discipline Elective** **Theory Only Course**	**L-P-C**	3	0	3
Version No.	1.2				
Course Pre-requisites	Nil				
Anti-requisites	Nil				
Course Description	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.				
Course Objectives	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**.				
Course Out Comes	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)				
Course Content:					
Module 1	**Introduction**	Assignment 1	Report		**10 Sessions**
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.					
Module 2	**Built up environment, Cultural disaster and risk**	Term Paper			**14 Sessions**
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;					
Module 3	**Planning for culture, Social change in India**	Assignment 2	Report		**16 Sessions**
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.					
Targeted Application & Tools that can be used: Application in sustainable buildings and Green Buildings					
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

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

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**	**L- P- C**	3	0	3

	Type of Course: Discipline elective & Theory only				
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:					

<table>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td>Catalogue prepared by</td><td>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: CIV 2042	**Course Title: Urban Mobility** **Type of Course: Discipline Elective** **Theory Only**	**L-P-C**	3	0	3
Version No.	1.2				
Course Pre-requisites	[1] CIV2016 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 3. Mashrur A. Chowdhury and Adell Sadek,"*Fundamentals of Intelligent Transportation Systems Planning*", , Artech House, Inc., 2003. 4. Sussman, Joseph, NY, "*Perspectives on Intelligent Transportation Systems (ITS)"*: Springer, 2010.				
References 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	
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.**	
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: CIV2043	**Course Title:** Urban sanitation and Hygiene **Type of Course:** Discipline Elective Theory Only Course	**L-P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	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.				
Course Objective	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.				

Course Outcomes	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			
Course Content:				
Module 1	**Introduction to Urban Sanitation**	Quiz		**10 Sessions**
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.				
Module 2	**Sanitation in buildings and sanitary fittings**	Assignment	Report	**12 Sessions**
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.				
Module 3	**Personal Hygiene**	Assignment	Report	**8 Sessions**
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.				
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.				
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.				
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- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	**1] CIV1006 Building Materials and Concrete Technology** **2] CIV2007 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, modeling 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 Outcomes	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-P-C**	3	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: 2. *Smart City Emergence 2019 Elsevier Inc. https://www.sciencedirect.com/book/9780128161692/smart-city-emergence*				
References: 2. Saraju P Mohanty, Uma Choppali, Elias Kougianos, *"Everything you wanted to know about Smart Cities",* IEEE Consumer Electronics Magazine, July 2016 3. Zoran Morvaj, Luca Garcic and Boran Morvaj, "*Smart Energy Cities- Transition towards a low carbon society*, UNDP, March 2012 **PU e-Library Resources** 2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=iih&AN=140442973&site=ehost-live 3. 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- P- C**	3	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			

<table>
<tr><td>Course Code: CIV3043</td><td colspan="3">Course Title: Construction Economics and Financing for Smart Cities
Type of Course: Discipline Elective and Theory only</td><td>L-P-C</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="7">1.1</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 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.</td></tr>
<tr><td>Course Objective</td><td colspan="7">The objective of the course is to familiarize the learners with the concepts of Construction Economics and Financing for Smart Cities and attain <u>Employability Skills</u> through <u>Problem Solving</u> methodologies.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">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.</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td>Construction Economics</td><td colspan="3">Assignment</td><td>Data Collection</td><td>15 Hours</td></tr>
<tr><td colspan="8">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</td></tr>
<tr><td>Module 2</td><td>Equipment economics</td><td colspan="3">Case Study</td><td>Data Collection</td><td>12 Hours</td></tr>
<tr><td colspan="8">Topics:
Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis. Depreciation, Inflation and Taxes. Benefit-cost analysis.</td></tr>
<tr><td>Module 3</td><td>Estimate & Contract Changes</td><td colspan="3">Case Study</td><td>Data Collection</td><td>8 Hours</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td colspan="8">Text Books
1. Blank, L. T. and Tarquin,A. J.,"Engineering Economy", Fourth Edition, WCB/McGraw-Hill, 1998.
2. Collier, Kieth, "Managing Construction Contracts"</td></tr>
<tr><td colspan="8">References
1. K N Jha "Construction Project Management", Second edition, Pearson.</td></tr>
</table>

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-P-C**	3	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

1. Shirin Madon , *"E-governance for Development : A Focus on Rural India"*, Palgrave Macmillan,2009

2. Ashok Agarwal, *"E-governance : Case studies"*, University Press India,2007

3. Kamalesh N. Agarwala and Murli D. Tiwari *"IT-e-Governance in India"*, Macmillan,2002

4. Subhash C. Bhatnagar "*E-Government : from Vision To Implementation: A Practical Guide With Case Studies"*, SAGE , 2004

5. 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-P- C**	1	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: CIV1001	**Course Title:** Disaster Management and Mitigation **Type of Course:** Open Elective/ Theory only course	L-P- C	3	0	3
Version No.	1.1				
Course Pre-requisites	Environmental Science and Disaster Management				
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 nnatural 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: CIV1002	**Course Title: Environmental Science and Disaster management** **Type of Course: Open Elective/ Theory Only Course**	**L-P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Students should aware of surrounding environmental components and its importance.				
Anti-requisites	**NIL**				
Course Description	This course imparts an understanding of different environmental constituents such as air, water and soil, natural resources, environment, its maintenance and the basic concepts of disaster management. This course explains role of human being in maintaining a clean and sustainable environment for the future generations, maintaining ecological balance and conservation of biodiversity. This is a theory-based course, which will give an awareness on interaction of biotic and abiotic components, energy flow, man-animal conflict, population explosion, pollution control etc.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Environmental Science and Disaster management and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes	**On successful completion of the course the students shall be able to:** 1] Recognize various types of natural resources and their issues in harnessing and utilization. 2] Differentiate terrestrial and aquatic ecosystems along with biodiversity conservation strategies. 3] Discuss about environmental problems, their impacts and mitigate measures. 4] Infer the government acts in protecting different environmental components by anthropogenic interferences.				
Course Content:					
Module 1	**Introduction to environment and natural resources**	Assignment	Data Collection/ Interpretation	**10 Sessions**	
Topics: Introduction to environment: definition, scope and importance, multidisciplinary nature of environment. Natural Resources: renewable and non-renewable resources: Forest resources: Uses, reasons for over-exploitation, deforestation effects, timber extraction, case studies. Water resources: use and overutilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: Impacts of overgrazing, effects of modern agriculture, water logging and salinity, fertilizer-pesticide problems. Land Resources: Soil erosion-types and remedial measures. Energy resources: Advantages and Disadvantages of renewable and non-renewable energy sources.					
Module 2	**Ecosystem & Biodiversity**	Assignment	Data Collection/ Interpretation	**10 Sessions**	
Topics: Structural components of ecosystem: biotic and abiotic components. Functional components of ecosystem: food chains, food webs, ecological pyramids, energy flow in the					

ecosystem, ecological succession. Structure and function of terrestrial and aquatic ecosystem: forest, grassland, desert, pond, streams, lake, river, ocean and estuaries. Biodiversity: Definition, levels of biodiversity: genetic, species and ecosystem diversity. Bio-geographical classification of India. Types of Regional Biodiversity. Values of biodiversity: consumptive, productive, social, ethical, aesthetic and optional values. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife and man-wildlife conflicts. Red data book- List of endangered species in India and world. Conservation of biodiversity: *In situ* and *ex situ* conservation of biodiversity.

Module 3	**Environmental Pollution and Global Environment Problems**	Case study	Data Interpretation / Analysis	**9 Sessions**

Topics: Environmental pollution: definition, causes, effects and control measures of air pollution, water pollution and thermal pollution. Solid waste: Definition, types, management and disposal methods. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: floods, earthquake, cyclone and landslides. Urban problems related to energy, Water conservation Strategies: rain water harvesting, watershed management. Environmental impact assessment: definition, steps and methods of impact analysis (Checklist and matrice) and environmental management plan. Climate change: global warming, greenhouse effect, acid rain and ozone depletion.

Module 4	**Human Population, Sustainability and Environmental Legislation**	Case study	Data Interpretation / Analysis	**8 Sessions**

Topics: Population growth, population characteristics and family welfare programme, value education, women and child welfare. Role of information technology in environment and human health. Sustainable development: Key elements, carrying capacity and measure to achieve sustainability. Environment legislation: Air (prevention and control of pollution) act, water (prevention and control of pollution) act, wildlife protection act, forest conservation act and environmental protection act.

Targeted Application & Tools that can be used:

This course helps the students to understand the basic concepts of Global environmental problems, sustainable development and anthropogenic causes for natural hazards. Professionally Used Software: WaterCAD, StromCAD, MS office.

Text Books:

T1. Benny Joseph, *"Environmental Studies", McGraw-Hill. 2018.*

T2. Anubha Kaushik and C.P. Kaushik, "*Perspectives in Environmental Studies", New Age, 2006. international Publishers.*

References:

R1. R. Rajagopalan, *"Environmental studies–From Crisis to Cure", Oxford University Press. 2015.*

R2. P. Anandan and R. Kumaravelan, *"Environmental Science and Engineering", Scitech.2008.*

R3. ErachBharucha, *"Environmental Studies for Undergraduate courses", Universities Press. 2014.*

Web sources:

W1.

https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=150765391&site=ehost-live

W2.

https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=159264384&site=ehost-live

Topics relevant to "SKILL DEVELOPMENT": Environmental Ethics as Conservation and Preservation, Environment laws, Environmental pollution control bodies 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. 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: CIV2001	**Course Title: Sustainability Concepts Engineering** **Type of Course: Open Elective/ Theory Only Course**	**L-P- C**	3	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. Discuss 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		**12 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 let	Case studies		**12 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	**14 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., S*ustainability 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

https://nptel.ac.in/courses/112104225

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: CIV2002	**Course Title: Occupational Health and Safety Type of Course: Open Elective/ Theory Only Course**	**L-P-C**	3	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 Outcomes	**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: CIV2003	**Course Title: Sustainable Materials and Green Buildings** **Type of Course: Open Elective/ Theory based Course**	**L-P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Basic knowledge of environmental sciences and disaster management with basics of sustainability.				
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	Case study	**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	Quiz	**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 modeling.					

Targeted Application & Tools that can be used: [Mention here the application area of the contents of the Module and the name of any specialized professionally used tools (Like software, Hard ware, any other form of tool) relevant to the contents of the module.]
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: CIV2004	**Course Title: Integrated Project Management** **Type of Course: Open Elective & Theory only**	**L-P-C**	3	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	8 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

Course Code: CIV2005	**Course Title:** Environmental Impact Assessment **Type of Course:** Open Elective/ Theory Only Course	**L-P-C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Nil				
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. 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.				

Course Objectives	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**.			
Course Outcomes	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] Discuss the implications of current jurisdictional and institutional arrangements in relation to environmental impact assessment			
Course Content:				
Module 1	EIA Scope and process in India	Assignment	Case study	10 classes
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				
Module 2	Prediction and Assessment of Impacts on the Environment	Case Study	Data Collection and Analysis	12 classes
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.				
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://web.p.ebscohost.com/ehost/detail/detail?vid=3&sid=b4ee81da-8105-4ec1-9f5c-46d35545a001%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#**				
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: CIV2006	**Course Title: Infrastructure Systems for Smart Cities** **Type of Course: Open Elective and Theory only**	**L-P-C**	3	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
"Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development (http://indiansmartcities.in/downloads/CONCEPT NOTE-3.12.2014 REVISED AND LATEST .pdf)
Kent E. Calder (2016),"Singapore Smart City, Smart State" Brookings Institution Press publication.
PU e-Library Resource
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

<table>
<tr><td>Course Code: CIV2044</td><td colspan="3">Course Title: Geospatial applications for Engineers
Type of Course: Open Elective
Theory & Lab 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">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">No prior knowledge required to know the course and it provides basic awareness of Geospatial techniques to be applied by engineers.</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">Nil</td></tr>
<tr><td>Course Description</td><td colspan="7">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.</td></tr>
<tr><td>Course objectives</td><td colspan="7">The objective of the course is to familiarize the learners with the concepts of Geospatial applications for Engineers and attain <u>Entrepreneurial Skills</u> through <u>Experiential Learning</u> techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On successful completion of the course the students shall be able to:
1] Discuss the basic concepts of geospatial technologies.
2] Interpret 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.</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td>Introduction</td><td>Case Study and Assignment</td><td>Data Collection, interpretation and analysis.</td><td colspan="3">08 Classes</td></tr>
<tr><td colspan="8">Topics:
Introduction to Geospatial basics – General description of geospatial, & its components and descriptions of remote sensing, GPS, GIS and Google earth.</td></tr>
</table>

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, Haroon Sajjid and Bhagwan Singh Chaudry, "*Applications and Challenges of Geospatial Technology – Potential and future Trends"*, Springer International publishing, 1st Edition, 2018 (E-book). **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/ **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: CIV2045	**Course Title:** Environmental Meteorology **Type of Course:** Open Elective Theory Only Course	**L-P-C**	3	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: CIV3046	**Course Title: Projects/Problem Based Learning (PPBL)** **Type of Course:** Open Elective and Theory only	**L-P-C**	3	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 Outcomes	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
2. An Overview of Project-Based Learning Practices Within the Context of 21st Century Skills
3. 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

Course Code: CIV3059	Course Title: Sustainability for Professional Practice **Type of Course:** Open Elective and Theory only	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	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.				
Course Objectives	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.				
Course Outcomes	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.				
Course Content:					
Module 1	Fundamentals of Sustainability in Professional Practice	Assignment	Data Collection		**10 Sessions**
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.					
Module 2	Sustainability in Professional Projects	Case Study	Mind mapping/ Programming/		**12 Sessions**
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.					

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: Life Cycle Assessment (LCA) Project: Choose a common consumer product (e.g., a smartphone, or a beverage container) and conduct a comprehensive LCA. LEED Certification Analysis: Select a building project and evaluate its potential for LEED certification. Sustainable Design Proposal: Formulate a sustainable design proposal for a public space (e.g., a park, plaza, community center). Green Building Simulation: Simulate the energy performance of a building using BIM software. 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: "Introduction to Sustainability" by Robert Brinkmann, - Publisher: John Wiley & Sons, Edition: 2nd Edition (2014). "Sustainable Construction: Green Building Design and Delivery" by Charles J. Kibert, Publisher: Wiley-Blackwell, Edition: 4th Edition (2015). "Sustainable Development and Planning VII: Sustainable Development and Green Buildings" edited by C. A. Brebbia, Publisher: WIT Press, Edition: 1st Edition (2015). "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). "Sustainable Construction" by Charles. K. Alexander and Poonam Sharma, Publisher: CRC Press, Edition: 1st Edition (2018). "LEED Green Associate Study Guide" by Megan Ritchie Saffitz and Holly Williams Leppo, Publisher: John Wiley & Sons, Edition: 2nd Edition (2016)				
References: "Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products" by Mary Ann Curran, Publisher: John Wiley & Sons, Edition: 1st Edition (2012). "Handbook on Sustainable Buildings" by Centre of Science and Environment (CSE), Publisher: Centre for Science and Environment (CSE), Edition: 1st Edition (2013). "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