PRESIDENCY UNIVERSITY

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PROGRAMME REGULATIONS & CURRICULUM

2024-28

PRESIDENCY SCHOOL OF COMPUTER SCIENCE & ENGINEERING

BACHELOR OF TECHNOLOGY (B.TECH.)

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

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

PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Program Regulations and Curriculum

2024-2028

B.Tech., COMPUTER SCIENCE AND ENGINEERING (Data Science)

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/SOCSE04/CSD/2024-28

August – 2024

Resolution No. 10 of the 24th Meeting of the Academic Council held on 3rdAugust 2024, and Ratified by the Board of Management in its 24th Meeting held on 5th August 2024

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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 Computer Science and Engineering

To be a value based, practice-driven School of Computer Science and Engineering, committed to developing globally-competent Engineers, dedicated to developing cutting-edge technology, towards enhancing Quality of Life.

1.4 Mission of Presidency School of Computer Science and Engineering

▪ Cultivate a practice-driven environment, with computing-based pedagogy, integrating theory and practice.

· Attract and nurture world-class faculty to excel in Teaching and Research, in the realm of Computing Sciences.

· Establish state-of-the-art computing facilities, for effective Teaching and Learning experiences.

· Promote Interdisciplinary Studies to nurture talent for global impact.

· Instill Entrepreneurial and Leadership Skills to address Social, Environmental and Community-needs.

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 Industrial Based Project Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

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

3. Short Title and Applicability

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

4. Definitions

In these Regulations, unless the context otherwise requires:

a. *"Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;*
b. *"Academic Council" means the Academic Council of the University;*
c. *"Academic Regulations" means the Academic Regulations, of the University;*
d. *"Academic Term" means a Semester or Summer Term;*
e. *"Act" means the Presidency University Act, 2013;*
f. *"AICTE" means All India Council for Technical Education;*
g. *"Basket" means a group of courses bundled together based on the nature/type of the course;*
h. *"BOE" means the Board of Examinations of the University;*
i. *"BOG" means the Board of Governors of the University;*
j. *"BOM" means the Board of Management of the University;*
k. *"BOS" means the Board of Studies of a particular Department/Program of Study of the University;*
l. *"CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;*
m. *"Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;*
n. *"COE" means the Controller of Examinations of the University;*
o. *"Course In Charge" means the teacher/faculty member responsible for developing and organising the delivery of the Course;*
p. *"Course Instructor" means the teacher/faculty member responsible for teaching and evaluation of a Course;*
q. *"Course" means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;*
r. *"Curriculum Structure" means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the*

Curriculum structure of the specific program and relevant approvals should be taken from the BOS and Academic Council at that time.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

gg. *"PSCS" means the Presidency School of Computer Science and 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. *"Statutes" means the Statutes of Presidency University;*

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

mm. *"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;*

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

oo. *"UGC" means University Grant Commission;*

pp. *"University" means Presidency University, Bengaluru; and*

qq. *"Vice Chancellor" means the Vice Chancellor of the University.*

5. Program Description

B.Tech. Degree Programs are offered in the following branches / disciplines by the respective parent Departments under Presidency School of Computer Science and Engineering (PSCSE) as indicated in Table 1 below:

Table 1: B.Tech. Degree Programs and respective Parent Departments

S.No.	*B.Tech. Program (Branch / Discipline)*	*Parent Department*
1.	B.Tech. Computer Science and Engineering	Presidency School of Computer Science and Engineering
2.	B. Tech. Computer Science and Technology (Big Data)	Presidency School of Computer Science and Engineering
3.	B. Tech. Computer Science and Engineering (Block Chain)	Presidency School of Computer Science and Engineering
4.	B. Tech. Computer Science and Technology (DevOps)	Presidency School of Computer Science and Engineering
5.	B. Tech. Computer Science and Engineering (Cyber Security)	Presidency School of Computer Science and Engineering
6.	B. Tech. Computer Science and Engineering (Internet of Things)	Presidency School of Computer Science and Engineering
7.	B. Tech. Computer Science and Engineering (Data Science)	Presidency School of Computer Science and Engineering
8.	B. Tech. Computer Science and Technology [Artificial Intelligence and Machine Learning]	Presidency School of Computer Science and Engineering
9.	B. Tech. Information Science and Technology [Artificial Intelligence and Data Science]	Presidency School of Computer Science and Engineering
10.	B. Tech. Computer Science and Information Technology	Presidency School of Computer Science and Engineering
11.	B. Tech. Computer Science and Engineering (Networks)	Presidency School of Computer Science and Engineering
12.	B. Tech. Computer Engineering	Presidency School of Computer Science and Engineering
13.	B. Tech. Information Science and Engineering [Artificial Intelligence and Robotics]	Presidency School of Computer Science and Engineering
14.	B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning)	Presidency School of Computer Science and Engineering

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

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 (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:

PEO 01: Demonstrate as a Computer Engineering Professional with innovative skills and moral and ethical values

PEO 02: Engage in life long learning through Research and professional development

PEO 03: An entrepreneur in the computer and other related areas of specialization.

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:

PSO 01: [Problem Analysis]: Identify, formulate, research literature, and analyse complex engineering problems related to Artificial Inteligence and Machine learning principles & practice, Programming, Big Data computing & analytics Substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PSO 02: [Design/development of Solutions]: Design solutions for complex engineering problems related to Data Science principles & practice, Programming, Big Data Computing & analytics 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.

PSO 03: [Modern Tools Usage]: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities related to Data Science principles & practice, Programming, Computing & analytics with an understanding of the limitations.

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. Computer Science and Engineering (Data Science) 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. Computer Science and Engineering in Data Science 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 Presidency 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, 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, Four Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the B.Tech. Program of the University.

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

11 Change of Branch / Discipline / Specialization

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

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

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

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

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

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

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

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

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

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

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

12.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 8.10 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.**) 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

			CA	Mid-Term	End-term			

	(L-T-P-C)	Percentage/Marks	Theory	Practical	Theory	Practical	Theory	Practical			
1	3-0-0-3	Percentage	25%	-	25%	-	50%	-	-	100 %	Mid-Term & End Term by CoE
		Marks	50	-	50	-	100	-	-	200	
2	2-0-2-3	Percentage	12.50%	12.50%	12.50 %	12.50 %	25%	25%	-	100 %	Mid-Term & End Term by CoE
		Marks	25	25	25	25	50	50	-	200	
3	1-0-4-3	Percentage	-	50%	5%	20%	10%	15%	-	100 %	Mid-Term & End Term by School
		Marks	-	50	5	20	10	15	-	100	
4	2-0-4-4	Percentage	12.50%	12.50%	10%	15%	20%	30%	-	100 %	*Mid-Term & End Term by CoE
		Marks	25	25	20	30	40	60	-	200	
5	0-0-4-2	Percentage	-	50%	-	-	-	-	50%	100 %	Project evaluated by IC in School level
		Marks	-	50	-	-	-	-	50	100	
6	0-0-2-1	Percentage	-	100%	-	-	-	-	-	100 %	Only CA in School Level
		Marks	-	100	-	-	-	-	-	100	
7	3-0-2-4	Percentage	12.50%	12.50%	15%	10%	30%	20%	-	100 %	Mid-Term & End Term by CoE
		Marks	25	25	30	20	60	40	-	200	
8	2-0-0-2	Percentage	25%	-	25%	-	50%	-	-	100 %	Mid-Term & End Term by CoE
		Marks	50	-	50	-	100	-	-	200	

The exact weightages of Evaluation Components shall be clearly specified in the concerned PRC and 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/PRC. 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-Clause 12.6.1 and 12.6.2) 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 13.3 (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 13.3 (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 **Error! Reference source not found.** in the Academic Regulation.

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.

PART B: PROGRAM STRUCTURE

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

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

Table 3: B.Tech. (Computer Science & Engineering-Data Science) 2024-2028: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets		
Sl. No.	**Baskets**	**Credit Contribution**
1	Humanities and Social Sciences including Management Courses (HSMC)	10
2	Basic Science Courses (BSC)	19

3	Engineering Science Courses (ESC)	23
4	Professional Core Courses (PCC)	68
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Project Work (PRW)	16
8	Mandatory Courses (MAC)	0
	Total Credits	**160 (Minimum)**

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

14. 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.

15. 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.

PART C – CURRICULUM STRUCTURE

16.Curriculum Structure – Basket Wise Course List (not Semester Wise)

List of Courses Tabled – aligned to the Program Structure

(Course Code, Course Name, Credit Structure (LTPC), Contact Hours, Course Basket, Type of Skills etc., as applicable).

	Table 3.1 : List of Humanities and Social Sciences including Management Courses (HSMC)					
S.No		Course Name	L	T	P	C
1	ENG1002	Technical English	1	0	2	2
2	PPS1001	Introduction to soft skills	0	0	2	1
3	DES1146	Introduction to Design Thinking	1	0	0	1
4	ENG2001/FRLXXXX	Advanced English / Foreign Language courses	1	0	2	2
5	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1
6	MGTXXX	Managerial Economics and Financial Analysis	3	0	0	3
					Total No. of Credits	**10**

	Table 3.2 : List of Basic Science Courses (BSC)					
S.No		Course Name	L	T	P	C
1	MAT1001	Calculus and Linear Algebra	3	0	2	4
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3
1	MAT1003	Applied Statistics	2	0	0	2
1	MAT2501	Integral Transforms and Partial Differential Equations	3	0	0	3
2	MAT2605	Discrete Mathematics	4	0	0	4
1	MAT2602	Numerical Computations	3	0	0	3
					Total No. of Credits	**19**

	Table 3.3 : List of Engineering Science Courses (ESC)					
S.No		Course Name	L	T	P	C
3	MEC1006	Engineering Graphics	2	0	0	2
6	CSE1004	Problem Solving Using C	1	0	4	3
7	ECE2007	Digital Design	2	0	2	3
3	CIV1008	Basic Engineering Sciences	2	0	0	2
4	CSE1006	Problem Solving using JAVA	1	0	4	3
7	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4
9	ECE2010	Innovative Projects Using Arduino	-	-	-	1
4	CSE1500	Computational Thinking Using Python	2	0	2	3

8	CSE2510	Competitive Programming and Problem Solving	0	0	4	2
	Total No. of Credits					**23**

		Table 3.4 : List of Professional Core Courses (PCC)				
Sl No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSE1508	Data Structures	3	0	0	3
2	CSE1506	Data Communication and Computer Networks	3	0	0	3
3	CSE1510	Database Management Systems	3	0	0	3
4	CSE2021	Data Mining	3	0	0	3
5	CSE1509	Data Structures Lab	0	0	4	2
6	CSE1511	Database Management Systems Lab	0	0	2	1
7	CSE1507	Data Communication and Computer Networks Lab	0	0	2	1
8	CSE1512	Analysis of Algorithms	3	1	0	4
9	CSE2502	Operating Systems	3	0	0	3
10	CSE2514	Operating Systems Lab	0	0	2	1
11	CSE1700	Essentials of AI	3	0	0	3
12	CSE1701	Essentials of AI Lab	0	0	4	2
13	CSD1500	R programming for Data Science	3	0	0	3
14	CSD1704	Software Engineering for Data Science	3	0	0	3
15	CSE1513	Analysis of Algorithms Lab	0	0	2	1
16	CSD1501	R programming for Data Science Lab	0	0	4	2
17	CSD1703	Introduction to Data Science	3	0	0	3
18	CSD1712	Statistical Foundations of Data Science	3	0	0	3
19	CSD1705	Cloud Computing for Data Science	2	0	0	2

20	CSD1710	Data Handling and Visualization	2	0	0	2
21	CSD1706	Cloud Computing for Data Science Lab	0	0	2	1
22	CSD1711	Data Handling and Visualization Lab	0	0	4	2
23	CSD1713	Statistical Foundations of Data Science Lab	0	0	2	1
24	CSD1716	Fundamentals of Data Analytics	3	0	0	3
25	CSD1701	Social Media Analytics	3	0	0	3
26	AID1705	Explainable AI (XAI)	3	0	0	3
27	AID1707	Generative AI and Prompt Engineering	3	0	0	3
28	CSD1709	Edge AI and IoT Analytics	3	0	0	3
29	CSD1702	Social Media Analytics Lab	0	0	2	1
		Total No. of Credits				**68**

		Table 3.5 : List of course in Project Work basket (PRW)				
S.No	**Course Code**	Course Name	L	T	P	C
1	CSE7100	Mini project	-	-	-	2
2	CSE7000	Internship	-	-	-	4
3	CSE7300	Capstone Projects	-	-	-	10
					Total No. of Credits	**16**

17. 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, 2021, 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 Handout.

18.1 Internship

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

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

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

18.1.1.3 The number of Internships available for the concerned Academic Term. Further, the available number of internships shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Internship, as stated in Sub-Clause 18.1.1.2 and above.

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

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

18.2 Mini Project

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:

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

18.2.1.2 The student may do the project work in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.2.1). Provided further, that the Industry / Company or academic / research

institution offering such project work confirms to the University that the project work will be conducted in accordance with the Program Regulations and requirements of the University.

18.3 Capstone Project

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

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

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

18.3.1.3 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 18.3.1.1 above.

18.3.1.4 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 Capstone Project Policy of the University.

18.3.1.5 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:

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

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

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

Table 3.5 : Professional Electives Courses/Specialization Tracks – Minimum of 9 credits is to be earned by the student in a particular track and overall 18 credits.

Track 1 - Machine Learning and Artificial Intelligence (ML & AI)

S.No	Course Code	Course Name	L	T	P	C
1	CSD3405	Text Mining and Analytics	2	0	2	3
2	CSD3412	Graph Analytics	3	0	0	3
3	CSD3415	NextGen Predictive Analytics	2	0	2	3
4	CSD3406	Business Intelligence and Analytics	3	0	0	3
5	CSD3411	Cybersecurity and Data Privacy	3	0	0	3
6	CSD3416	Probabilistic Modeling for Machine Learning	3	0	0	3

Track 2 - Business Analytics and Data Visualization

S.No	Course Code	Course Name	L	T	P	C
1	CSD3401	Business Continuity and Risk Analysis	3	0	0	3
2	CSD3402	Web Data Analytics	2	0	2	3
3	CSD3404	E-Business and Marketing Analytics	2	0	2	3
4	CSD3410	IoT and Sensor Data Analysis	3	0	0	3
5	CSD3409	Financial Data Analysis	2	0	2	3
6	CSD3413	Data Visualization and Dashboards	3	0	0	3

Track 3 – Computational Mathematics and Statistics

S.No	Course Code	Course Name	L	T	P	C
1	CSD3403	Optimization for Data Science	2	0	2	3
2	CSD3407	Statistical Inference and Modeling	3	0	0	3
3	CSD3414	Statistics-Driven Data Science	2	0	2	3
4	CSD3408	Data Mining and Warehousing	3	0	0	3
5	CSD3417	Scientific Computing for Intelligent Systems	3	0	0	3
6	CSD3418	Feature Engineering and Model Optimization	3	0	0	3

Track 4 Intelligent Systems and Robotics						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSD3429	Cognitive Robotics	3	0	0	3
2	CSD3430	Autonomous Navigation and Vehicles	3	0	0	3
3	CSD3431	Expert Systems	3	0	0	3
4	CSD3432	Quantum Computing and AI	3	0	0	3
5	CSD3433	Computational Intelligence Research	3	0	0	3
6	CSD3434	Digital Health and Imaging	3	0	0	3
Track 5 Edge Intelligence and IoT Systems						
1	CSD3435	Edge Computing	3	0	0	3
2	CSD3436	AI Data Science for IoT	2	0	2	3
3	CSD3437	Architecting Smart IoT Devices	3	0	0	3
4	CSD3438	Industrial Internet of Things (IIoT)	3	0	0	3
5	CSD3439	Internet of Medical Things (IoMT)	3	0	0	3
6	CSD3440	Intelligent Sensors and Systems	3	0	0	3

20.List of Open Electives to be offered by the School / Department (Separately for ODD and EVEN Semesters.: Minimum Credits to be earned from this basket = 9 Credits

Table 3.7 OPEN ELECTIVE BASKETS											
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Type of Skill / Focus**	**Course Caters to**	**Prerequisites / Corequisites**	**Antirequisites**	**Future Courses that need this as Prerequisite**
Chemistry Basket											
1	**CHE1003**	**Fundamentals of Sensors**	**3**	**0**	**0**	**3**	**S**	**ES**			
2	**CHE1004**	**Smart materials for IOT**	**3**	**0**	**0**	**3**	**S**	**ES**			
3	**CHE1005**	**Computational Chemistry**	**2**	**0**	**0**	**2**	**S**	**ES**			
4	**CHE1006**	**Introduction to Nano technology**	**3**	**0**	**0**	**3**	**S**	**ES**			
5	**CHE1007**	**Biodegradable electronics**	**2**	**0**	**0**	**2**	**S**	**ES**			
6	**CHE1008**	**Energy and Sustainability**	**2**	**0**	**0**	**2**	**S**	**ES**			
7	**CHE1009**	**3D printing with Polymers**	**2**	**0**	**0**	**2**	**S**	**ES**			

8	CHE1010	Bioinformatics and Healthcare IT	2	0	0	2	S	ES			
9	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	S	ES			

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10	CHE1012	Introduction to Composite materials	2	0	0	2	S	ES			
11	CHE1013	Chemistry for Engineers	3	0	0	3	S	ES			
12	CHE1014	Surface and Coatings technology	3	0	0	3	S	ES			
13	CHE1015	Waste to Fuels	2	0	0	2	S	ES			
14	CHE1016	Forensic Science	3	0	0	3	S	ES			
Civil Engineering Basket											
1	CIV1001	Disaster mitigation and management	3	0	0	3	S	ES / HP			
2	CIV1002	Environment Science and Disaster Management	3	0	0	3	F	ES			
3	CIV2001	Sustainablility Concepts in Engineering	3	0	0	3	S	ES			
4	CIV2002	Occupational Health and Safety	3	0	0	3	S				
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	EM	ES			
6	CIV2004	Integrated Project Management	3	0	0	3	EN	HP/GS			
7	CIV2005	Enviornmental Impact Assessment	3	0	0	3	EN	ES			
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EN	ES			
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3	EM	ES			
10	CIV2045	Environmental Meteorology	3	0	0	3	S	ES			
11	CIV3046	Project Problem Based Learning	3	0	0	3	S	ES			
12	CIV3059	Sustainability for Professional Practice	3	0	0	3	S	ES			
Commerce Basket											
1	COM2001	Introduction to Human Resource Management	2	0	0	2	F	HP/GS			
2	COM2002	Finance for Non Finance	2	0	0	2	S				
3	COM2003	Contemporay Management	2	0	0	2	F				
4	COM2004	Introduction to Banking	2	0	0	2	F				
5	COM2005	Introduction to Insurance	2	0	0	2	F				
6	COM2006	Fundamentals of	2	0	0	2	F				

		Management									
7	**COM2007**	**Basics of Accounting**	**3**	**0**	**0**	**3**	**F**				
Computers Basket											
1	**CSE2002**	**Programming in Java**	**2**	**0**	**2**	**3**	**S/EM**				
2	**CSE2003**	**Social Network Analytics**	**3**	**0**	**0**	**3**	**S**	**GS**			
3	**CSE2004**	**Python Application Programming**	**2**	**0**	**2**	**3**	**S/ EM**				
4	**CSE2005**	**Web design fundamentals**	**2**	**0**	**2**	**3**	**S/ EM/EN**				
5	**CSE3111**	**Artificial Intelligence : Search Methods For Problem Solving**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
6	**CSE3112**	**Privacy And Security In Online Social Media**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
7	**CSE3113**	**Computational Complexity**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
8	**CSE3114**	**Deep Learning for Computer Vision**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
9	**CSE3115**	**Learning Analytics Tools**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
10	**CSE3116**	**No Code AI**	**2**	**0**	**2**	**3**	**S/ EM/EN**				
11	**CSE3117**	**Industrial Digital Transformation**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
12	**CSE3118**	**Blockchain for Decision Makers**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
13	**CSE3119**	**Coding Skills in Python**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
14	**CSE3121**	**Parallel Computer Architecture**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
15	**CSE3124**	**Games and Information**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
16	**CSE3140**	**Introduction To Industry 4.0 And Industrial Internet Of Things**	**3**	**0**	**0**	**3**	**S/ EM/EN**				
17	**CSE3142**	**Affective Computing**	**3**	**0**	**0**	**3**	**S/ EM/EN**				

18	CSE3112	Privacy and Security in Online Social Media	3	0	0	3	S/ EM/E N				
19	CSE3196	Foundations of Cyber Physical Systems	3	0	0	3	S/ EM/E N				
20	CSE3197	Getting Started with Competitive Programming	3	0	0	3	S/ EM/E N				
21	CSE3198	GPU Architectures And Programming	3	0	0	3	S/ EM/E N				
22	CSE3199	Artificial Intelligence: Knowledge Representation And Reasoning	3	0	0	3	S/ EM/E N				
23	CSE3200	Programming in Modern C++	3	0	0	3	S/ EM/E N				
24	CSE3201	Circuit Complexity Theory	3	0	0	3	S/ EM/E N				
25	CSE3202	Basics of Computational Complexity	3	0	0	3	S/ EM/E N				
26	CSE3212	Introduction to Computer and Network Performance Analysis Using Queuing Systems	1	0	0	1	S/ EM/E N				
27	CSE3213	C Programming And Assembly Language	1	0	0	1	S/ EM/E N				
28	CSE3214	Python For Data Science	1	0	0	1	S/ EM/E N				
29	CSE3215	Software Conceptual Design	1	0	0	1	S/ EM/E N				
Design Basket											
1	DES1001	Sketching and Painting	0	0	2	1	S				
2	DES1002	Innovation and Creativity	2	0	0	2	F				
3	DES1121	Introduction to UX design	1	0	2	2	S				
4	DES1122	Introduction to Jewellery Making	1	0	2	2	S				
5	DES1124	Spatial Stories	1	0	2	2	S				
6	DES1125	Polymer Clay	1	0	2	2	S				
7	DES2001	Design Thinking	3	0	0	3	S				
8	DES1003	Servicability of Fashion Products	1	0	2	2	F	ES			
9	DES1004	Choices in Virtual Fashion	1	0	2	2	F	ES, GS, HP			
10	DES1005	Fashion Lifestyle and Product Diversity	1	0	2	2	F	ES, GS, HP			

11	DES1006	Colour in Everyday Life	1	0	2	2	F	ES			
12	DES2080	Art of Design Language	3	0	0	3	S				
13	DES2081	Brand Building in Design	3	0	0	3	S				
14	DES2085	Web Design Techniques	3	0	0	3	S				
15	DES2089	3D Modeling for Professionals	1	0	4	3	S				
16	DES2090	Creative Thinking for Professionals	3	0	0	3	S				
17	DES2091	Idea Formulation	3	0	0	3	S				
Electrical and Electronics Basket											
1	EEE1002	IoT based Smart Building Technology	3	0	0	3	S				
2	EEE1003	Basic Circuit Analysis	3	0	0	3	S				
3	EEE1004	Fundamentals of Industrial Automation	3	0	0	3	S				
4	EEE1005	Electric Vehicles & Battery Technology	3	0	0	3	S				
5	EEE1006	Smart Sensors for Engineering Applications	3	0	0	3	S				
Electronics and Communication Basket											
1	ECE1003	Fundamentals of Electronics	3	0	0	3	F				
2	ECE3089	Artificial Neural Networks	3	0	0	3	S				
3	ECE3090	Digital System Design using VERILOG	3	0	0	3	F/EM				
4	ECE3091	Mathematical Physics	3	0	0	3	F				
5	ECE3092	Photonic Integrated Circuits	3	0	0	3	F				
6	ECE3093	Machine learning for Music Information Retrieval	3	0	0	3	F/EM				
7	ECE3094	Video Processing and Computer Vision	3	0	0	3	F/EM				

8	ECE3095	Blockchain and Cryptocurrency Technologies	3	0	0	3	S / EM / EN				
9	ECE3096	Natural Language Processing	3	0	0	3	F/ EM / EN				
10	ECE3097	Smart Electronics in Agriculture	3	0	0	3	F/EM				
11	ECE3098	Environment Monitoring Systems	3	0	0	3	F/EM				
12	ECE3099	Modern Wireless Communication with 5G	3	0	0	3	F/ EM / EN				
13	ECE3100	Underwater Communication	3	0	0	3	F/ EM / EN				

14	**ECE3101**	**Printed Circuit Board Design**	**3**	**0**	**0**	**3**	**S/F/EM**				
15	**ECE3102**	**Consumer Electronics**	**3**	**0**	**0**	**3**	**F/EM**				
16	**ECE3103**	**Product Design of Electronic Equipment**	**3**	**0**	**0**	**3**	**S/F/ EM / EN**				
17	**ECE3104**	**Vehicle to Vehicle Communication**	**3**	**0**	**0**	**3**	**F/ EM / EN**				
18	**ECE3105**	**Wavelets and Filter Banks**	**3**	**0**	**0**	**3**	**F/EM**				
19	**ECE3106**	**Introduction to Data Analytics**	**3**	**0**	**0**	**3**	**F/EM**				
20	**ECE3107**	**Machine Vision for Robotics**	**3**	**0**	**0**	**3**	**F/EM**				
English Basket											
1	**ENG1008**	**Indian Literature**	**2**	**0**	**0**	**2**		**GS/ HP**			
2	**ENG1009**	**Reading Advertisement**	**3**	**0**	**0**	**3**	**S**				
3	**ENG1010**	**Verbal Aptitude for Placement**	**2**	**0**	**2**	**3**	**S**				
4	**ENG1011**	**English for Career Development**	**3**	**0**	**0**	**3**	**S**				
5	**ENG1012**	**Gender and Society in India**	**2**	**0**	**0**	**2**		**GS/ HP**			
6	**ENG1013**	**Indian English Drama**	**3**	**0**	**0**	**3**					
7	**ENG1014**	**Logic and Art of Negotiation**	**2**	**0**	**2**	**3**					
8	**ENG1015**	**Professional Commuication Skills for Engineers**	**1**	**0**	**0**	**1**					
DSA Basket											
1	**DSA2001**	**Spirituality for Health**	**2**	**0**	**0**	**2**	**F**	**HP**			
2	**DSA2002**	**Yoga for Health**	**2**	**0**	**0**	**2**	**S**	**HP**			
3	**DSA2003**	**Stress Management and Well Being**	**2**	**0**	**0**	**2**	**F**				
Kannada Basket											
1	**KAN1001**	**Kali Kannada**	**1**	**0**	**0**	**1**	**S**				
2	**KAN1003**	**Kannada Kaipidi**	**3**	**0**	**0**	**3**	**S**				
3	**KAN2001**	**Thili Kannada**	**1**	**0**	**0**	**1**	**S**				
4	**KAN2003**	**Pradharshana Kale**	**1**	**0**	**2**	**2**	**S**				
5	**KAN2004**	**Sahithya Vimarshe**	**2**	**0**	**0**	**2**	**S**				
6	**KAN2005**	**Anuvadha Kala Sahithya**	**3**	**0**	**0**	**3**	**S**				
7	**KAN2006**	**Vichara Manthana**	**3**	**0**	**0**	**3**	**S**				
8	**KAN2007**	**Katha Sahithya Sampada**	**3**	**0**	**0**	**3**	**S**				
9	**KAN2008**	**Ranga Pradarshana Kala**	**3**	**0**	**0**	**3**	**S**				
Foreign Language Basket											
1	**FRL1004**	**Introduction of French Language**	**2**	**0**	**0**	**2**	**S**	**S**			
2	**FRL1005**	**Fundamentals of French**	**2**	**0**	**0**	**2**	**S**	**S**			
3	**FRL1009**	**Mandarin Chinese for Beginners**	**3**	**0**	**0**	**3**	**S**	**S**			

Law Basket											
1	**LAW1001**	**Introduction to Sociology**	**2**	**0**	**0**	**0**	**2**	**F**	**HP**		
2	**LAW2001**	**Indian Heritage and Culture**	**2**	**0**	**0**	**0**	**2**	**F**	**HP/GS**		
3	**LAW2002**	**Introdcution to Law of Succession**	**2**	**0**	**0**	**0**	**2**	**F**	**HP/GS**		
4	**LAW2003**	**Introduction to Company Law**	**2**	**0**	**0**	**0**	**2**	**F**	**HP**		
5	**LAW2004**	**Introduction to Contracts**	**2**	**0**	**0**	**2**	**F**	**HP**			
6	**LAW2005**	**Introduction to Copy Rights Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
7	**LAW2006**	**Introduction to Criminal Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
8	**LAW2007**	**Introduction to Insurance Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
9	**LAW2008**	**Introduction to Labour Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
10	**LAW2009**	**Introduction to Law of Marriages**	**2**	**0**	**0**	**2**	**F**	**HP/GS**			
11	**LAW2010**	**Introduction to Patent Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
12	**LAW2011**	**Introduction to Personal Income Tax**	**2**	**0**	**0**	**2**	**F**	**HP**			
13	**LAW2012**	**Introduction to Real Estate Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
14	**LAW2013**	**Introduction to Trademark Law**	**2**	**0**	**0**	**2**	**F**	**HP**			
15	**LAW2014**	**Introduction to Competition Law**	**3**	**0**	**0**	**3**	**F**	**HP**			
16	**LAW2015**	**Cyber Law**	**3**	**0**	**0**	**3**	**F**	**HP**			
17	**LAW2016**	**Law on Sexual Harrassment**	**2**	**0**	**0**	**2**	**F**	**HP/GS**			
18	**LAW2017**	**Media Laws and Ethics**	**2**	**0**	**0**	**2**	**F**	**HP/GS**			
Mathematics Basket											
1	**MAT2008**	**Mathematical Reasoning**	**3**	**0**	**0**	**3**	**S**				
2	**MAT2014**	**Advanced Business Mathematics**	**3**	**0**	**0**	**3**	**S**				
3	**MAT2041**	**Functions of Complex Variables**	**3**	**0**	**0**	**3**	**S**				
4	**MAT2042**	**Probability and Random Processes**	**3**	**0**	**0**	**3**	**S**				
5	**MAT2043**	**Elements of Number Theory**	**3**	**0**	**0**	**3**	**S**				
6	**MAT2044**	**Mathematical Modelling and Applications**	**3**	**0**	**0**	**3**	**S**				
Mechanical Basket											
1	**MEC1001**	**Fundamentals of Automobile Engineering**	**3**	**0**	**0**	**3**	**F**				
2	**MEC1002**	**Introduction to Matlab and Simulink**	**3**	**0**	**0**	**3**	**S/EM**				

3	MEC1003	Engineering Drawing	1	0	4	3	S				
4	MEC2001	Renewable Energy Systems	3	0	0	3	F	ES			
5	MEC2002	Operations Research & Management	3	0	0	3	F				
6	MEC2003	Supply Chain Management	3	0	0	3	S/ EM / EN				
7	MEC2004	Six Sigma for Professionals	3	0	0	3	S/EM			MEC 2008	
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	0	3	F				
9	MEC2006	Safety Engineering	3	0	0	3	S/EM	ES			
10	MEC2007	Additive Manufacturing	3	0	0	3	F/EM				
11	MEC3069	Engineering Optimisation	3	0	0	3	S/EM				
12	MEC3070	Electronics Waste Management	3	0	0	3	F/S	ES			
13	MEC3071	Hybrid Electric Vehicle Design	3	0	0	3	S/EM	ES			
14	MEC3072	Thermal Management of Electronic Appliances	3	0	0	3	S/EM				
15	MEC3200	Sustainable Technologies and Practices	3	0	0	3	S/EM				
16	MEC3201	Industry 4.0	3	0	0	3	S/EM				
Petroleum Basket											
1	PET1005	Geology for Engineers	2	0	0	2	S	ES / HP		NIL	
2	PET1006	Overview of Energy Industry	2	0	0	2	S	ES / HP		NIL	
3	PET1007	Introduction to Energy Trading and Future Options	2	0	0	2	S	ES / HP		NIL	
4	PET1008	Sustainable Energy Management	2	0	0	2	S	ES / HP		NIL	
5	PET2026	Introduction to Computational Fluids Dynamics	3	0	0	3	S	HP		NIL	
6	PET2028	Polymer Science and Technology	3	0	0	3	E	ES / HP		NIL	
7	PET2031	Overview of Material Science	3	0	0	3	E	ES / HP		NIL	
8	PET2032	Petroleum Economics	3	0	0	3	E	HP		NIL	
9	PHY1003	Mechanics and Physics of Materials	3	0	0	3	F/S				
10	PHY1004	Astronomy	3	0	0	3	F				
11	PHY1005	Game Physics	2	0	2	3	F/S				
12	PHY1006	Statistical Mechanics	2	0	0	2	F				
13	PHY1007	Physics of Nanomaterials	3	0	0	3	F				

14	PHY1008	Adventures in nanoworld	2	0	0	2	F				
15	PHY2001	Medical Physics	2	0	0	2	F	ES			
16	PHY2002	Sensor Physics	1	0	2	2	F/S				
17	PHY2003	Computational Physics	1	0	2	2	F				
18	PHY2004	Laser Physics	3	0	0	3	F	ES			
19	PHY2005	Science and Technology of Energy	3	0	0	3	F	ES			
20	PHY2009	Essentials of Physics	2	0	0	2					
Management Basket											
1	MGT1001	Introduction to Psychology	3	0	0	3	F	HP			
2	MGT1002	Business Intelligence	3	0	0	3	EN				
3	MGT1003	NGO Management	3	0	0	3	S				
4	MGT1004	Essentials of Leadership	3	0	0	3	EM/ EN	GS/ HP			
5	MGT1005	Cross Cultural Communication	3	0	0	3	S/EM/ EN	HP			
6	MGT2001	Business Analytics	3	0	0	3	S/ EM/EN				
7	MGT2002	Organizational Behaviour	3	0	0	3	F	HP			
8	MGT2003	Competitive Intelligence	3	0	0	3	S				
9	MGT2004	Development of Enterprises	3	0	0	3	S/EM/EN				
10	MGT2005	Economics and Cost Estimation	3	0	0	3	S/EM				
11	MGT2006	Decision Making Under Uncertainty	3	0	0	3	S				
12	MGT2007	Digital Entrepreneurship	3	0	0	3	S/EM/EN				
13	MGT2008	Econometrics for Managers	3	0	0	3	S				
14	MGT2009	Management Consulting	3	0	0	3	S/EM/EN				
15	MGT2010	Managing People and Performance	3	0	0	3	S/EM/EN	HP/GS			
16	MGT2011	Personal Finance	3	0	0	3	F				
17	MGT2012	E Business for Management	3	0	0	3	S/EM				
18	MGT2013	Project Management	3	0	0	3	EN / EM	GS/HP/ES			
19	MGT2014	Project Finance	3	0	0	3	EN / EM	HP			
20	MGT2015	Engineering Economics	3	0	0	3	S				

21	MGT2016	Business of Entertainment	3	0	0	3	EM/ EN				
22	MGT2017	Principles of Management	3	0	0	3	S/EM/EN				
23	MGT2018	Professional and Business Ethics	3	0	0	3	S/EM/EN	HP			
24	MGT2019	Sales Techniques	3	0	0	3	S/EM/EN	HP			
25	MGT2020	Marketing for Engineers (Digital Marketing)	3	0	0	3	S/EM/EN	HP			
26	MGT2021	Finance for Engineers	3	0	0	3	S/EM/EN	HP			
27	MGT2022	Customer Relationship Management	3	0	0	3	S/EM/EN	HP			
28	MGT2023	People Management	3	0	0	3	S/EM/EN	HP			
Media Studies Basket											
1	BAJ3050	Corporate Filmmaking and Film Business	0	0	4	2	EM	HP			
2	BAJ3051	Digital Photography	2	0	2	3	EM	HP			
3	BAJ3055	Introduction to News Anchoring and News Management	0	0	2	1					
Research URE Basket											
1	URE2001	University Research Experience	-	-	-	3		S/EM/EN			
2	URE2002	University Research Experience	-	-	-	0		S/EM/EN			

(Computer Science and Engineering (Data Science))

21 List of MOOC (NPTEL) Courses

21.1 NPTEL - Open Elective Courses for B. Tech. (Computer Science and Engineering (Data Science))

Sl. No	Course Code	Course Name	Total Credits	L-T-P-C
1	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	3-0-0-3
2	CSE3112	Privacy And Security In Online Social Media	3	3-0-0-3
3	CSE3113	Computational Complexity	3	3-0-0-3
4	CSE3114	Deep Learning for Computer Vision	3	3-0-0-3
5	CSE3115	Learning Analytics Tools	3	3-0-0-3
6	CSE502	Technical Skills in JAVA	3	0-0-6-3
7	CSE503	Technical Skills in Python	3	0-0-6-3
8	CSE504	Comprehensive Technical Skills	5	0-0-10-5
9	CSE505	The Joy Of Computing Using Python	3	3-0-0-3
10	CSE3119	Coding Skills in Python	3	3-0-0-3
11	CSE3121	Parallel Computer Architecture	3	3-0-0-3
12	CSE3124	Games and Information	3	3-0-0-3
13	CSE3140	Introduction To Industry 4.0 And Industrial Internet Of Things	3	3-0-0-3
14	CSE3142	Affective Computing	3	3-0-0-3
15	CSE3112	Privacy and Security in Online Social Media	3	3-0-0-3
16	CSE3196	Foundations of Cyber Physical Systems	3	3-0-0-3
17	CSE3197	Getting Started with Competitive Programming	3	3-0-0-3
18	CSE3198	GPU Architectures And Programming	3	3-0-0-3
19	CSE3199	Artificial Intelligence: Knowledge Representation And Reasoning	3	3-0-0-3
20	CSE3200	Programming in Modern C++	3	3-0-0-3
21	CSE3201	Circuit Complexity Theory	3	3-0-0-3
22	CSE3202	Basics of Computational Complexity	3	3-0-0-3
23	CSE3212	ion to Computer and Network Performance Analysis Using Queuing	1	1-0-0-1
24	CSE3213	C Programming And Assembly Language	1	1-0-0-1
25	CSE3214	Python For Data Science	1	1-0-0-1
26	CSE3215	Software Conceptual Design	1	1-0-0-1
27	CSE3117	Industrial Digital Transformation	3	3-0-0-3
28	CSE3118	Blockchain for Decision Makers	3	3-0-0-3
29	CSE3349	Technology for Lawyers	3	3-0-0-3
30	CSEXXXX	Deep Learning for Natural Language Processing	3	3-0-0-3
31	CSEXXXX	Machine Learning for Engineering and science applications	3	3-0-0-3
32	CSEXXXX	Algorithms in Computational Biology and Sequence Analysis	3	3-0-0-3
33	CSEXXXX	Introduction to Large Language Models (LLMs)	3	3-0-0-3
34	CSEXXXX	Quantum Algorithms and Cryptography	3	3-0-0-3

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

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Course
Semester I (Physics Cycle)					TOTAL	**19**		
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	BSC
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	BSC

3	MEC1006	Engineering Graphics	2	0	0	2	2	ESC
4	ENG1002	Technical English	1	0	2	2	3	HSMC
5	PPS1001	Introduction to soft skills	0	0	2	1	2	HSMC
6	CSE1004	Problem Solving Using C	1	0	4	3	5	ESC
7	ECE2007	Digital Design	2	0	2	3	4	ESC
8	DES1146	Introduction to Design Thinking	1	0	0	1	1	HSMC
Semester II (Basic Engineering Science Cycle)					**TOTAL**	**15**	**23**	
1	MAT1003	Applied Statistics	2	0	0	2	2	BSC
2	CHE1018	Environmental Science	1	0	2	0	3	MAC
3	CIV1008	Basic Engineering Sciences	2	0	0	2	2	ESC
4	CSE1006	Problem Solving using JAVA	1	0	4	3	5	ESC
5	ENG2001/FRL XXXX	Advanced English / Foreign Language courses	1	0	2	2	3	HSMC
6	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1	2	HSMC
7	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4	5	ESC
8	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	0	1	MAC
9	ECE2010	Innovative Projects Using Arduino	-	-	-	1	0	ESC
Semester 3						**26**	**31**	
1	MAT2501	Integral Transforms and Partial Differential Equations	3	0	0	3	3	BSC
2	MAT2605	Discrete Mathematics	4	0	0	4	4	BSC
3	CSE1508	Data Structures	3	0	0	3	3	PCC
4	CSE1500	Computational Thinking Using Python	2	0	2	3	4	ESC
5	CSE1506	Data Communication and Computer Networks	3	0	0	3	3	PCC
6	CSE1510	Database Management Systems	3	0	0	3	3	PCC
7	CSE2021	Data Mining	3	0	0	3	3	PCC
8	CSE1509	Data Structures Lab	0	0	4	2	4	PCC
9	CSE1511	Database Management Systems Lab	0	0	2	1	2	PCC
10	CSE1507	Data Communication and Computer Networks Lab	0	0	2	1	2	PCC

Semester 4						25	31	
1	MAT2602	Numerical Computations	3	0	0	3	3	BSC
2	CSE1512	Analysis of Algorithms	3	1	0	4	4	PCC
3	CSE2502	Operating Systems	3	0	0	3	3	PCC
4	CSE2514	Operating Systems Lab	0	0	2	1	2	PCC
5	CSE1700	Essentials of AI	3	0	0	3	3	PCC
6	CSE1701	Essentials of AI Lab	0	0	4	2	4	PCC
7	CSD1500	R programming for Data Science	3	0	0	3	3	PCC
8	CSD1704	Software Engineering for Data Science	3	0	0	3	3	PCC
9	CSE1513	Analysis of Algorithms Lab	0	0	2	1	2	PCC
10	CSD1501	R programming for Data Science Lab	0	0	4	2	4	PCC
Semester 5						25	30	
1	CSDXXXX	Professional Elective – I	3	0	0	3	3	PEC
2	XXXXX	Open Elective - I	3	0	0	3	3	OEC
3	CSD1703	Introduction to Data Science	3	0	0	3	3	PCC
4	CSD1712	Statistical Foundations of Data Science	3	0	0	3	3	PCC
5	CSD1705	Cloud Computing for Data Science	2	0	0	2	2	PCC
6	CSD1710	Data Handling and Visualization	2	0	0	2	2	PCC
7	CSD1706	Cloud Computing for Data Science Lab	0	0	2	1	2	PCC
8	CSD1711	Data Handling and Visualization Lab	0	0	4	2	4	PCC
9	CSD1713	Statistical Foundations of Data Science Lab	0	0	2	1	2	PCC
10	CSD1716	Fundamentals of Data Analytics	3	0	0	3	3	PCC
11	CSE7000	Internship	-	-	-	2	0	PRW
Semester 6						**24**	**29**	
1	CSD1701	Social Media Analytics	3	0	0	3	3	PCC
2	AID1705	Explainable AI (XAI)	3	0	0	3	3	PCC
3	AID1707	Generative AI and Prompt Engineering	3	0	0	3	3	PCC
4	CSDXXXX	Professional Elective – II	3	0	0	3	3	PEC
5	CSDXXXX	Professional Elective – III	3	0	0	3	3	PEC
6	CSD1709	Edge AI and IoT Analytics	3	0	0	3	3	PCC
7	MGTXXX	Managerial Economics and Financial Analysis	3	0	0	3	3	HSMC

8	PPSXXXX	Industry Preparedness Program	2	0	0	0	2	MAC
8	CSE2510	Competitive Programming and Problem Solving	0	0	4	2	4	ESC
9	CSD1702	Social Media Analytics Lab	0	0	2	1	2	PCC
Semester 7						**16**	**12**	
1	CSDXXXX	Professional Elective – IV	3	0	0	3	3	PEC
2	CSDXXXX	Professional Elective – V	3	0	0	3	3	PEC
3	CSDXXXX	Professional Elective – VI	3	0	0	3	3	PEC
4	XXXXXXX	Open Elective – II	3	0	0	3	3	OEC
5	CSE7100	Mini Project				4	0	PRW
Semester 8						**10**	**0**	
1	CSE7300	Capstone Project	-	-	-	10	0	PRW

23.Course Catalogue

Course Catalogue of all Courses Listed including the Courses Offered by other School / Department and Discipline / Programme Electives – Course Code, Course Name, Prerequisite, Anti-requisite, Course Description, Course Outcome, Course Content (with Blooms Level, CO, No. of Contact Hours), Reference Resources.

Course Catalogues:

Course Code: MAT1001	**Course Title: Calculus and Linear Algebra** **Type of Course: School Core Lab Integrated**	**L-T- P-C**	**2**	**1**	**2**	**4**
Version No.	3.0					
Course Pre-requisites	Basic Concepts of Limits, Differentiation, Integration					
Anti-requisites	**NIL**					
Course Description	The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software.					
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**					

Course Out Comes	On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations. 5) Demonstrate the use of MATLAB software to deal with a variety of mathematical problems.			
Course Content:				
Module 1	**Linear Algebra**			**10 Classes**
Review: Types of matrices, elementary transformations, rank of a matrix, normal form, Solution of systems of linear equations: (Homogenous and non-homogenous system) AX = O and AX = B using rank method. **Linear Algebra:** Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.				
Module 2	**Partial Derivatives**			**10 CLASSES**
Review: Differential calculus with single variable. **Partial Derivatives:** Homogeneous functions and Euler‘s theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor‘s series for functions of two variables, Maxima and minima of functions of two variables, Lagrange‘s method of undetermined multipliers. Engineering Applications of partial derivatives.				
Module 3	**Advanced Integral calculus**			**12 Classes**
Review: Integral calculus for single integrals.				

Advanced Integral calculus:

Beta and Gamma functions–interrelation-evaluation of integrals using gamma and beta functions; error function-properties. Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates.

Engineering applications of partial derivatives.

Module 4	**Ordinary Differential Equations**	**Assignment**	**Programming**	**12 Classes**

Review: First order and first-degree Ordinary Differential Equations, Method of separation of variables, Homogeneous and Non- Homogeneous Equations reducible to Homogeneous form.

Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non- Exact Differential Equations, Higher order Differential Equation with constant coefficients and with right hand side of the form e^{ax}, sinax, cosax, $e^{ax}f(x)$, $x^nf(x)$ etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, D-operators and Inverse D- operators, Method of Variation of Parameters.

Engineering applications of differential equations.

List of Laboratory Tasks:

Introductory Task: Introduction to usage of the software and simple programming tasks. [3 Sessions]
Experiment N0 1: Solution of Simple differentiation with single variable and use of chain Rule.
Experiment No. 2: Solution based on application of Tailors' Series using software
Experiment No. 3: Application of Maxima and Minima condition using software.
Experiment No. 4 Computation of different functions for a specific problem
Experiment No. 5 Computation of Area under a curve.
Experiment No. 6 Solution of a set of simultaneous equations in matrix method
Experiment No. 7 Computation of Eigen Values and Eigen Vectors.
Experiment No. 8 Solution of Partial Differential equation
Experiment No. 9 solution using Cauchy Equation and Lagrange's Equation

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

Assignment:

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

Text Book

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

References:

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

E-resources/ Web links:

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

Topics relevant to the development of Foundation Skills: All solution methods

Topics relevant to development of Employability skills: Use of Matlab software.

Course Code: PHY1002	**Course Title: Optoelectronics and Device Physics** **Type of Course: 1] School Core & Laboratory integrated**	L-T-P-C	2-0-2-3
Version No.	1.0		

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

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

	Level 2: To determine current transfer characteristics and transistor parameters of a given transistor. Experiment No. 6: Determination of Fermi energy and Fermi temperature of a given metal and bimetallic wire. Level 1: Determination of Fermi energy and Fermi temperature of given metal wire. Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire. Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage. Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance. Level 2: To measure the photo-current as a function of the irradiance at constant voltage. Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance. Level 1: To study the I-V characteristics Level 2: I-R characteristics of a solar cell as a function of the irradiance. Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. . Level 1: Calculate the numerical aperture. Level 2: study the losses that occur in optical fiber cable. Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method. Level 1: To determine the magnetic susceptibility of a given diamagnetic substance. Level 2: To determine the magnetic susceptibility of a given paramagnetic substance. Experiment No. 11: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage. Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs Level 2: Determination of knee voltage. Experiment No. 12: Determination of Stefan's constant and verification of Stefan-Boltzmann Law. Level 1: Determination of Stefan's constant Level 2: Verification of Stefan-Boltzmann Law.
	Targeted Application & Tools that can be used: 1. Areas of application are optoelectronics industry, Solar panel technologies, quantum computing software, electronic devices using transistors and diodes, memory devices, endoscopy, SQUIDS in MRI, Advanced material characterizations using SEM and STM. **2.** Origin, excel and Mat lab soft wares for programming and data analysis.
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	Assessment Type

	• Midterm exam • Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.) • Quiz • End Term Exam • Self-Learning 1. Prepare a comprehensive report on non-conventional energy resources in Karnataka and their pros and cons. 2. Write a report on importance of quantum entanglement in supercomputers.
	Text Book 1. Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications,2018.
	References: 1. Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002. 2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011. 3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017. 4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012. 5. Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019
	E-Resourses: 1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live 2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live 3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live 4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live 5. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=486032&site=ehost-live
	Topics relevant to "SKILL DEVELOPMENT": Fundamentals of materials, Lasers and optical fibers. for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.

Course	**Course Title: Engineering Graphics** **Type of Course: School Core & Theory Only**	**L- T-P- C**	2-0-0-2

Code: MEC1006				
Version No.	1.2			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	The course is designed with the objective of giving an overview of engineering graphics. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings. The course emphasizes on projection of points, lines, planes and solids and isometric projections.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of "**Engineering Graphics**" and attain **SKILL DEVELOPMENT** through Problem solving methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** **(1)** Demonstrate competency of Engineering Graphics as per BIS conventionsand standards. **(2)** Comprehend the theory of projection for drawing projections of Points, Lines and Planes under different conditions. **(3)** Prepare multiview orthographic projections of Solids by visualizing them in different positions. **(4)** Prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions**.**			
Course Content:				
Module 1	Introduction to Drawing	Assignment	Standard technical drawing	**02 Sessions**
Topics: Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Line conventions, dimensioning, Selection of drawing sheet size and scale. [02 Hours: Comprehension Level]				
Module 2	Orthographic projections of Points, Straight Linesand Plane Surfaces	Assignment	Projection methods Analysis	**10 Sessions**

Topics:

Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points inall 4 quadrants.

Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only.

[10 Hours: Application Level]

Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	**10 Sessions**

Topics:

Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron indifferent positions (Problems resting on HP only and First angle projection).

[10 Hours: Application Level]

Module 4	Isometric Projections of Solids (Using isometric scale only)	Assignment	Spatial Visualization	**8 Sessions**

Topics:

Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects.

[8 Hours: Application Level]

Text Book:

1.N. D. Bhatt, "Engineering Drawing: Plane and Solid Geometry," Charotar Publishing House Pvt. Ltd.

References:

1. K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.

2. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.

3. D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill.

Web resources:

https://nptel.ac.in/courses/112103019

Topics relevant to "SKILL DEVELOPMENT": Projection in first and third angle for **SKILL DEVELOPMENT** through **Problem Solving methodologies**. This is attained through the assessment component mentioned in the course handout.

Course Code: ENG1002	**Course Title: Technical English** **Type of Course:1] School Core**	**L-T-P-C**	1-0-2-2

	2] Laboratory integrated		
Version No.	1.0 V. 3		
Course Pre-requisites	Intermediate Level English		
Course Anti-requisites	NIL		
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.		
Course Objectives	The objective of this course is to develop the learners' **EMPLOYABILITY SKILLS** by using **EXPERIENTIAL LEARNING** and **PARTICIPATIVE LEARNING TECHNIQUES.**		
Course Outcomes	**On successful completion of the course, the students shall be able to:** 1. Develop proficiency in using technical vocabulary and terminology. 2. Apply language skills for better speaking skills in technical fields. 3. Write technical descriptions 4. Demonstrate writing skills in writing technical documents such as reports, manuals, and articles.		
Course Content:			
Module 1	**Fundamentals of Technical Communication**	**Worksheets& Quiz**	**Vocabulary building**	**9 Classes**
Introduction to Technical English Differences between Technical English and General English Technical Writing Basics Technical Vocabulary				
Module 2	**Technical Presentation**	**Presentations**	**Speaking Skills**	**12 Classes**
Introduction Planning the Presentation Creating the Presentation				

Giving the Presentation				
Module 3	**Technical Description**	**Assignment**	**Group Presentation**	**12 Classes**
Product Description Process Description User Manuals Transcoding: Diagrams, charts and images				
Module 4	**Technical Writing**	**Assignment**	**Writing Skills**	**12 Classes**
Email Writing Persuasive and Descriptive Language Professional Email Etiquette Writing clear and concise technical emails Communicating technical information effectively **Technical Report Writing** Types of technical reports (Lab reports, research reports, etc.) Components of technical reports Writing an abstract and executive summary Structure and content organization Transcoding: diagrams, charts and images				
List of Laboratory Tasks: 1. Module-1 Level 1: Worksheets Level 2: Worksheets 2. Module 2 Level 1: Preparing Presentation Level 2: Giving Presentation (Individual) 3. Module-3 Level 1: Product Description & User Manual Level 2: Process Description & Transcoding 4. Module 4 Level 1: Email Writing				

Level 2: Report Writing

Targeted Applications & Tools that can be used:

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

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

Bring out the essence of technical communication with reference to the conventions of technical communication, with examples

Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.

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

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

Text Books

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

Reference Book:

Chauhan, Gajendra Singh, and Kashmiramka, Smita, ***Technical Communication.*** Cengage Publication. 2018.

Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.

John Bowden. "Writing a Report: How to Prepare, Write & Present Really Effective Reports?". 9th Edition 2011

Comfort, Jeremy et. al. 1984. *Business Reports in English*. Cambridge University Press.

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

Web Resources:

1:https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307.

2;https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdcb8f4a5%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih

3: Last,Suzan, et. al. ***Technical Writing Essentials.*** University of Victoria, British Columbia, 2019 (E- Book)

4 Wambui, Tabita Wangare, et al. ***Communication Skills- Volume 1,*** LAP LAMBRET, USA, 2012 (E Book)

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

Course Code: PPS 1001	**Course Title: Introduction to Soft Skills** **Type of Course: Practical Only Course**	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.		
Anti-requisites	NIL		
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.		
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**		
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of soft skills CO2: **Illustrate** effective communication while introducing oneself and others CO3: **List** techniques of forming healthy habits CO4: **Apply** SMART technique to achieve goals and increase productivity		
Course Content:			
Module 1	INTRODUCTION TO SOFT SKILLS	**Classroom activity**	**04 Hours**
Topics: Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality			
Module 2	EFFECTIVE COMMUNICATION	**Individual Assessment**	**10 Hours**
Topics: Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email-writing, Resume Building- Digital, Video, Traditional.			

Module 3	HABIT FORMATION		**Worksheets & Assignment**	**4 Hours**
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right				
Module 4	Goal setting & Time Management		**Goal sheet**	**8 Hours**
A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity				
Targeted Application & Tools that can be used: LMS				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
1) Individual Assessment 2) LMS MCQ				
The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE1004	Course Title: Problem Solving Using C Type of Course: School Core Lab Integrated.	L- T-P-C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs and applications in C. AC Also by learning the basic programming constructs they can easily switch over to any other language in future.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Problem Solving Using C and attain Employability through Problem Solving Methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Write algorithms and to draw flowcharts for solving problems 2. Demonstrate knowledge and develop simple applications in C programming constructs 3. Develop and implement applications using arrays and strings 4. Decompose a problem into functions and develop modular reusable code 5. Solve applications in C using structures and Union 6. Design applications using Sequential and Random Access File Processing.					
Course Content:						

Module 1	Introduction to C Language	Quiz	Problem Solving	9 Hrs.
Topics: Introduction to Programming – Algorithms – Pseudo Code - Flow Chart – Compilation – Execution – Preprocessor Directives (#define, #include, #undef) - Overview of C – Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making and Looping.				
Module 2	Introduction to Arrays and Strings	Quiz	Problem Solving	9 Hrs.
Topics: Arrays: Introduction – One Dimensional Array – Initialization of One Dimensional Arrays – Example Programs – Sorting (Bubble Sort, Selection Sort) – Searching (Linear Search) - Two Dimensional Arrays – Initialization of Two Dimensional Arrays. Example Programs – Matrix operations. Strings: Introduction – Declaring and Initializing String Variables – Reading Strings from Terminal – Writing String to Screen – String Handling Functions.				
Module 3	Functions and Pointers	Quiz	Problem Solving	9 Hrs.
Topics: Functions: Introduction – Need for User-defined functions – Elements of User-Defined Functions: declaration, definition and function call–Categories of Functions – Recursion. Pointers: Introduction – Declaring Pointer Variables – Initialization of Variables – Pointer Operators – Pointer Arithmetic – Arrays and Pointers – Parameter Passing: Pass by Value, Pass by Reference.				
Module 4	Structures and Union	Quiz	Problem Solving	9 Hrs.
Topics: Structures: Introduction – Defining a Structure – Declaring Structure Variable – Accessing Structure Members – Array of Structures – Arrays within Structures – Union: Introduction – Defining and Declaring Union – Difference Between Union and Structure.				
Module 5	File handling	Case Study	Problem Solving	9 Hrs.
Topics: Files: Defining and Opening a File – Closing a File – Input / Output Operations on File – Random Access Files				
List of Practical Tasks Lab Sheet 1 (Module I) CHE1018 Lab Sheet 2 (Module II) Programs using Arrays and Strings Lab Sheet 3 (Module III) Programs using Functions and Pointers Lab Sheet 4 (Module IV) Programs using Structures and Unions Lab Sheet 5 (Module V) Programs using Files				
Text Book(s): 1. E. Balaguruswamy, “Programming in ANSI C”, 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316- 513-0.				
Reference Book(s): 1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020. 2. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016. 3. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015 4. Schildt Herbert, “C: The Complete Reference”, Tata McGraw Hill Education, 4th Edition, 2014. 5. Stephen G. Kochan, “Programming in C”, Addison-Wesley Professional, 4th Edition, 2014.				
Web Links and Video Lectures: 1. https://nptel.ac.in/courses/106/105/106105171/ 2. https://archive.nptel.ac.in/courses/106/104/106104128/				

Course Code: ECE2007	**Course Title: Digital Design Type of Course: Theory &Integrated Laboratory**	**L- T-P- C**	**2**	**0**	**2**	**3**
Version No.	2.0					
Course Pre-requisites	**[1] Elements of Electronics/Electrical Engineering, 2] Basic concepts of number representation, Boolean Algebra**					
Anti-requisites	**NIL**					
Course Description	**The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. The course emphasizes on minimization techniques for making canonical and low-cost digital circuit implementations. This course deals with analysis and design of digital electronic circuits. The course also creates a foundation for future courses which includes Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc.** The course enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through** EXPERIENTIAL **LEARNING.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** i. **Describe** the concepts of number systems, Boolean algebra and logic gates. ii. **Apply** minimization techniques to simplify Boolean expressions. iii. **Demonstrate** the Combinational circuits for a given logic iv. Demonstrate the Sequential and programmable logic circuits v. **Implement** various combinational and sequential logic circuits using gates.					
Course Content:						
Module 1	**Fundamentals of Number systems- Boolean algebra and digital logic**	Application Assignment	Data Analysis task		**06 classes**	
Topics: Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don't care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations. Introduction to HDL.						
Module 2	**Boolean function simplification**	Application Assignment	Data Analysis task		**08 Classes**	
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders, HDL Models of combinational circuits.						

Module 3	Combinational Logic circuits:	Application Assignment	Programming Task & Data Analysis task	08 Classes

Topics:

Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters. HDL Models of Sequential circuits.

List of Laboratory Tasks:

Experiment N0 1: Verify the Logic Gates truth table
Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

Experiment No. 2: Verify the Boolean Function and Rules
Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

Experiment No. 3: Design and Implementations of HA/FA
Level 1: By using basic logic gates and Trainer Kit
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 4: Design and Implementations of HS/FS
Level 1: By using basic logic gates and Trainer Kit
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 5: Design and Implementations of combinational logic circuit for specifications
Level 1: Specifications given in the form of Truth table
Level 2: Specification should be extracted from the given scenario

Experiment No. 6: Study of Flip flops

Experiment No. 7: Design and Implementations of sequential logic circuit for specifications
Level 1: Specifications given in the form of Truth table
Level 2: Specification should be extracted from the given scenario

Experiment No.8: HDL coding for basic combinational logic circuits
Level 1: Gate level Modeling
Level 2: Behavioral Modeling

Experiment No.9: HDL coding for basic sequential logic circuit
Level 1: Gate level Modeling
Level 2: Behavioral Modeling

Targeted Application & Tools that can be used:

Digital electronics is the foundation of all modern electronic devices such as cellular phones, MP3 players, laptop computers, digital cameras, high definition televisions, Home Automation, Communication in systems in industries

Professionally Used Software: HDL/VHDL/Verilog HDL/ OOPS

Text Book(s):

1. Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education, 6th edition
2. Thomas L. Floyd "DIGITAL LOGIC DESIGN" , Pearson Education, fourth edition.

Reference(s):

Reference Book(s):

R1. Jain, R. P., "Modern Digital Electronics", McGraw Hill Education (India), 4th Edition

R2. Roth, Charles H., Jr and Kinney Larry L., "Fundamentals of logic Design", Cengage Learning, 7th Edition

Online Resources (e-books, notes, ppts, video lectures etc.): Book Free Download (studymaterialz.in)

1. **eBook1**: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education.
2. {[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download }
3. **eBook2:**Floyd "DIGITAL LOGIC DESIGN" fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.
4. NPTEL Course- NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits
5. Digital Logic Design PPT Slide 1 (iare.ac.in)
6. Lab Tutorial: Multisim Tutorial for Digital Circuits - Bing video

CircuitVerse - Digital Circuit Simulator online

Learn Logisim➠ Beginners Tutorial | Easy Explanation! - Bing video

Digital Design 5: LOGISIM Tutorial & Demo

7. https://presiuniv.knimbus.com/user#/home

E-content:

1. Z. Xin-Li and W. Hong-Ying, "The Application of Digital Electronics in Networking Communication," 2016 Eighth International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2016, pp. 684-687, doi: 10.1109/ICMTMA.2016.168.
2. An encoding technique for design and optimization of combinational logic circuit DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMurase2010 13th International Conference on Computer and Information Technology (ICCIT)
3. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029.
4. A. Matrosova, V. Provkin and E. Nikolaeva, "Masking Internal Node Faults and Trojan Circuits in Logical Circuits," *2019 IEEE East-West Design & Test Symposium (EWDTS)*, 2019, pp. 1-4, doi: 10.1109/EWDTS.2019.8884434.

Topics relevant to "SKILL DEVELOPMENT": Adders, Multiplexers, Decoders / Encoders; Flip-Flops, Counters and Registers for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: DES1146	**Course Title: Introduction to Design Thinking** **Type of Course: Theory**		**L-T-P- C**	**1**	**0**	**0**	**1**
Version No.		**1.0**				
Course Pre-requisites		**NIL**				
Anti-requisites		**NIL**				
Course Description		**The course aims to introduce students to the fundamental principles processes of Design Thinking and will learn to apply Design Think methodologies to real-world challenges. The course emphasizes empa creativity, and collaboration, equipping students with essential skills successful engineering practice.**				
Course Objective		**This course is designed to develop and familiarize the learners with concepts of creating thinking and attain Entrepreneurship by us Participative Learning techniques.**				
Course Outcomes		**On successful completion of the course the students shall be able to:** **1. Understand the concept and importance of Design Thinking.** **2. Differentiate between traditional problem-solving and Des Thinking.** **3. Identify the core stages of the Design Thinking process.**				
Course Content:		**All assignments and projects must be developed using the refere materials available from the PU e-resource database – JSTOR, EBS Library OPAC, NPTEL Videos, etc.**				
Module 1	**Introduction to Design Thinking**	**Visual journal, book of essays, context-specific assignment/project**		**Visual output generation, by Visual Journal and narrative development.**	**3 hours**	
Topic **1. Definition and Introduction to Design Thinking** **2. Understand the Design Thinking Process**						
Module 2	**Design Thinking in Action**	**Visual journal, book of essays, context-specific assignment/project**		**Visual output generation, by visual journal and narrative development.**	**12 hour**	
Topics:						

1. **Introduction to the steps of Design Thinking Process**
2. **Understand use cases of Design thinking**
3. **Design Thinking and Research Tools pertaining to Consumer Tech. , Home Tech. , Perso Tech. , Auto Tech. or Extended Reality.**

Targeted Application & Tools that can be used:

1. **Design ideation tools like Miro , SCAMPER etc.**
2. **Research Tools for Human Centric Design using forecasting tools like WGSN**
3. **Feedback tools like Google Forms , etc.**
4. **Expert Lectures**

Text Book

Thinking Design by S Balaram. New Delhi [India]: Sage Publications Pvt. Ltd. 2010. eBook., Databa eBook Collection (EBSCOhost)

https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=6&sid=18ab1f43-1f92-4d02- ae2e-a9c06dc06d8c%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=354920&db=nlebk

References

Design Thinking by Clarke, Rachel Ivy. Series: Library Futures, Vol. 4. Chicago: ALA Neal-Schum 2020. eBook., Database: eBook Collection (EBSCOhost)

https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=4&sid=c80a7d79-eda4-4b7e a0d6-afafe437962b%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=2433506&db=nlebl

The Pocket Universal Methods of Design: 100 Ways to Research Complex Problems, Deve Innovative Ideas, and Design Effective Solutions by Bruce Hanington; Bella Martin. Minneapo Rockport Publishers. 2017. eBook., Database: eBook Collection (EBSCOhost)

https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=11&sid=f086b8c2-260e-4caa 8c48-d732c21a7724%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1638693&db=nleb

What Is Design Thinking and Why Is It Important? By Rim Razzouk and Valerie Shute - Review Educational Research, Vol. 82, No. 3 (September 2012), pp. 330-348 (19 pages), Published by: Ameri Educational Research Association

https://puniversity.informaticsglobal.com:2054/stable/23260048?Search=yes&resultItemClick=true earchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bth ing%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3Acb1be24976e25734cb5fc13a8af6fdfb&seq=1#metadata_info_tab_contents

Abductive Thinking and Sensemaking: The Drivers of Design Synthesis by John Kolko, Design Issu Vol. 26, No. 1 (Winter, 2010), pp. 15-28 (14 pages), Published by: The MIT Press

https://puniversity.informaticsglobal.com:2054/stable/20627839?Search=yes&resultItemClick=true earchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bth ing%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3A0b89336ea274d63c010536b01316d7bb&seq=1#metadata_info_tab_contents

Designerly Ways of Knowing: Design Discipline versus Design Science by Nigel Cross, Design Issu Vol. 17, No. 3 (Summer, 2001), pp. 49-55 (7 pages), Published by: The MIT Press **https://puniversity.informaticsglobal.com:2054/stable/1511801?Search=yes&resultItemClick=true&archText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3A0d5b607b163f60876ca973ed90e22b1c&seq=1#metadata_info_tab_contents**		
Catalogue prepared by		**Dr. Ashok A Itagi / Mr. Abhinav Srivastava**
Recommended by the Board of Studies on		
Date of Approval by the Academic Council		

Course Code: MAT1003	**Course Title: Applied Statistics** **Type of Course:** School Core	**L T P C**	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "**Applied Statistics" and attain **Skill Development Through Problem Solving techniques**.					
Expected Outcome:	At the end of this course, students will be in a position to apply the techniques of descriptive statistics effectively interpret the ideas of probability and conditional probability demonstrate the knowledge of probability distributions					

	Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.			
Module 1	**Descriptive Statistics**	Assignment	Coding needed	**10 classes**
Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson's Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression **.**				
Module 2	**Probability**			**6 classes**
Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye's theorem with examples				
Module 3	**Random Variables and Probability Distributions**		Coding needed	**14 classes**
Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, **Negative Binominal (Self Study)**, Poisson, Normal and Exponential distributions				
Module 4	**Sampling Theory**		Coding needed	**15 classes**
Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and **Difference of Means (Self Study)**, Small Sample Tests: Student's t-Test for Single Mean and **Difference of Means,** F-Test, Chi-Square Test.				
Targeted Application & Tools that can be used: The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems. Tools used: R Software / MS-Excel				
Text Book 1. Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016.				
References				

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

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

Course Code: CHE1018	**Course Title: Environmental Science** **Type of Course: School Core- Theory and Lab**	**L- T-P- C**	1	0	2	0
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education. **This course is designed to cater to Environment and Sustainability**					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Environmental Science" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.**					

Course Outcomes	On successful completion of this course the students shall be able to: Appreciate the historical context of human interactions with the environment and the need for eco-balance. Describe basic knowledge about global climate change with particular reference to the Indian context. Understand biodiversity and its conservation Develop an understanding on types of pollution and ways to protect the environment Learn about various strategies on Global environmental management systems			
Course Content:				
Module 1	**Humans and the Environment**	Assignment	Data Collection	**01 class**
Topics: The man-environment interaction: Mastery of fire; Origin of agriculture; Emergence of city states; Great ancient civilizations and the environment. ***Self-learning topics:*** Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Environmental Ethics and emergence of environmentalism.				
Module 2	**Natural Resources and Sustainable Development**	Assignment		**03 Classes**
Topics: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. **Water resources**: Types of water resources- fresh water and marine resources; **Soil and mineral resources**: Important minerals; Mineral exploitation Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Advantages and disadvantages. ***Self- learning topics:*** Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges.; Environmental problems due to extraction of minerals and use; Sustainable Development Goals (SDGs)- targets, indicators, and challenges for SDGs.				
Module 3	**Environmental Issues: Local, Regional and Global**	Case study		**02 Classes**
Topics: **Environmental Pollution**: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Trans- boundary air pollution; Acid rain; Smog. **Land use and Land cover change**: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change ***Self -learning topics:*** Environmental issues and scales				
Module 4	**Conservation of Biodiversity and Ecosystems**	Assignment		**02 Classes**
Topics: **Biodiversity-**Introduction, types, Species interactions, Extinct, endemic, endangered and rare species, Threats to biodiversity: Natural and anthropogenic activities. **Self-learning topics:** Mega-biodiversity, Hot-spots, Major conservation policies. Biodiversity loss: past and current trends, impact.				
Module 5	**Environmental Pollution and Health**	Case study		**03 Classes**

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

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

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

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

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

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

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

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

	Module 7	**Environmental Management**	Case study	Data analysis	**02 Classes**

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

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

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

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

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

List of laboratory tasks : Any eight experiments will be conducted

ermination of total alkalinity of a water sample (knowledge)

Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)

mation of copper from industrial effluents by colorimetric method (Comprehensive)

mation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)

mation of nickel from industrial effluents by titrimetric method (Comprehensive)

mation of chloride in drinking water by titrimetric method (Comprehensive)

mation of fluoride in ground water by colorimetric method (Comprehensive)

ermination of calcium in aqueous solution (Comprehensive)

ermination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)

Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)

Biological oxygen demand of waste water sample (Comprehensive)

Determination of dissolved oxygen of an industrial effluent (Comprehensive)

Quality monitoring analysis of a soil sample (knowledge)

Flame photometric estimation of Sodium and potassium (Application)

Gas Chromatographic analysis of volatile organic compounds (Application)

Targeted Application & Tools that can be used:

Application areas are Energy, Environment and sustainability

Tools: Statistical analysis of environmental pollutants using excel, origin etc.

Project work/Assignment:

Assessment Type

term exam

Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screenshot accessing the digital resource.)

evaluation/Assignment

Term Exam

-learning

Assignment 1: Write a Statement of Environment report of your town/city/state/country

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

Text Book

yler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA

nnamurthy, K.V. (2003) Text book of Biodiversity, Science Publishers, Plymouth, UK.

Jackson, A.R. & Jackson, J.M. (2000), Environmental Science: The natural environment and human impact, Pearson Education.

Reference Books

Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.

William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.

ıa N., (2020) Wild and Wilful. Harper Collins, India.

www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/

Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.

Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

E-resources:

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_18126
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_8761
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_3333
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3063
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_20719
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_16824
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3954
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_491
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SPRINGER_INDEST_1_171
https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129
https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TEXTBOOK_LIBRARY01_06082022_395&xIndex=4
https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf

Topics relevant to Skill Development:

Industrial revolution and its impact on the environment, Environmental impact of over-exploitation of water resources, pollution and ill effects, lab experiments for Skills development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.

All topics in theory component are relevant to Environment and Sustainability.

Course Code: CIV1008	Course Title: Basic Engineering Sciences Type of Course: Theory Only	L-T-P-C	2	0	0	2

Version No.	1.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering.			
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: 1] Recognize the significance of various disciplines in Civil Engineering 2] Discuss the recent evolutions in Civil Engineering 3] Explain various energies, energy generating machineries and energy consumption machineries 4] Describe the fundamental concept and terminology associated with the Petroleum Industry 5] Distinguish between conventional and modern manufacturing techniques.			
Course Content:				
Module 1	**Introduction to various fields in Civil Engineering**	Assignment	Case studies on different Civil Engineering Projects	**6 Sessions**
Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure.				

Module 2	**Current Trends and Evolution in Civil Engineering**	Assignment	Article Review	**6 Sessions**
Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities.				
Module 3	**Power Production and Consumption Machinery**	Assignment & Quiz	Data Collection	**6 Sessions**
Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications.				
Module 4	**Overview of Petroleum Engineering**	Assignment & Quiz	Article Review	**6 Sessions**
Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering				
Module 5	**Industry 4.0**	Assignment & Quiz	Data Collection	**6 Sessions**
Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process. Modern Manufacturing process: 3D Printing / Additive Manufacturing.				
Targeted Application & Tools that can be used: Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities				
Project work/Assignment:				
Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering Assignment 2: Review Articles on current evolutions in Civil Engineering. Assignment 3: Collect data related to renewable energy generation (Wind, Solar) Assignment 4: Prepare an energy consumption chart for a compressor or pumps.				

Assignment 5: Prepare a report on role of 3D printing across various industries.
Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.

Text Book:

T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers

T2. Elements of Mechanical Engineering, by VK Manglik

T3. Fundamentals of Oil & Gas Industry for Beginners by Samir Dalvi, Notion Press; 1st edition

References

1. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters and Publishers Pvt Ltd, Mumbai.
2. Nontechnical Guide to Petroleum Geology, Exploration, Drilling & Production by Norman J. Hyne, PennWell Books; 3rd Revised edition

Web-resources:

1. Basic Civil Engineering

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2706932&site=ehost-live

2. Post-parametric Automation in Design and Construction

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live

3. Smart Cities : Introducing Digital Innovation to Cities

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live

4. Innovation Energy: Trends and Perspectives or Challenges of Energy Innovation

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2323766&site=ehost-live

5. Mechanical Engineering
   https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705
6. Additive Manufacturing: Opportunities, Challenges, Implications
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live
7. Society of Petroleum Engineers (SPE)
   https://www.spe.org/en/
8. PetroWiki: A comprehensive online resource created by the Society of Petroleum Engineers that provides information on various aspects of petroleum engineering.
   https://petrowiki.spe.org/PetroWiki
9. Rigzone: A resource for news and information about the oil and gas industry, including job postings and industry trends.
   https://www.rigzone.com/

Topics relevant to the development of SKILLS: Engines-Turbines and their applications. Mechanization in Construction. Digitization in Petroleum Industries

Course Code: **CSE1006**	**Course Title:** Problem Solving using JAVA **Type of Course: Lab Integrated**	**L- T-P- C**	1	0	4	3
Version No.	2.0					
Course Pre-requisites	CSE1004 – Problem-Solving Using C					
Anti-requisites	Nil					
Course Description	This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real-time secure applications by applying these concepts and also for effective problem-solving. The students interpret and understand the need for object-oriented programming to build applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques					
Course Out Comes	**On successful completion of the course, the students shall be able to:** **C.O. 1:** Describe the basic programming concepts. [Knowledge]					

	C.O. 2: Apply the concept of classes, objects and methods to solve problems. [Application] **C.O. 3:** Apply the concept of arrays and strings. [Application] **C.O. 4:** Implement inheritance and polymorphism in building secure applications. [Application] **C.O. 5:** Apply the concepts of interface and error handling mechanism. [Application]			
Course Content:				
Module 1	**Basic Concepts of Programming and Java**	Assignment	Data Collection/Interpretation	**12 Sessions**
Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.				
Module 2	**Classes, objects, methods and Constructors**	Case studies / Case let	Case studies / Case let	**12 Sessions**
Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods.				

Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.

Module 3	**Arrays, String and String buffer**	Quiz	Case studies / Case let	**14 Sessions**

Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi–Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer.

Module 4	**Inheritance and Polymorphism**	Quiz	Case studies / Case let	**14 Sessions**

Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.

Module 5	**Input & Output Operation in Java**	Quiz	Case studies / Case let	**14 Sessions**

Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Objects, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.

List of Laboratory Tasks:

P1 - Problem Solving using Basic Concepts.

P2 - Problem Solving using Basic Concepts and Command Line Arguments.

P3 - Programming assignment with class, objects, methods and Constructors.

P4 - Programming assignment with method overloading.

P5 - Programming assignment with constructor overloading.

P6 - Programming assignment with Static members and static methods.

P7 - Programming assignment with Nested classes.

P8 - Programming assignment using Arrays.

P9 - Programming assignment using Strings.

P10 - Programming assignment using String Builder.

P11 - Programming assignment using Inheritance and super keyword.

P12 - Programming assignment using Method overriding and Dynamic method invocation.

P13 - Programming assignment using Final keywords.

P14 - Programming assignment using Abstract keywords.

P15 - Programming assignment using Interface.

P16 - Programming assignment using Interface.

P17 - Programming assignment CharacterStream Classes

P18 - Programming assignment Read/Write Operations with File Channel

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

Text Book

T1 Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education.

References

R1: Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Pearson

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

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

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

Web **resources**

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

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

Topics relevant to the development of "Skill Development":

1. Static Polymorphism
2. Method overloading, constructors
3. constructor overloading

4. this keyword
5. static keyword and Inner classes
6. Inheritance and Polymorphism.

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

ENG2001	**Advanced English**	**L- T- P- C**	**1**	**0**	**2**	**2**
Version No.	**1.3**					
Course Pre-requisites	**ENG1002 Technical English**					
Anti-requisites	**NIL**					
Course Description	**The course emphasizes on technical communication at advanced level by exploring critical reading, technical presentation and review writing. The purpose of the course is to enable learners to review literature in any form or any technical article and deliver technical presentations. Extensive activities in practical sessions equip to express themselves in various forms of technical communications. Technical presentations and the module on career setting focus on learners' area of interests and enhance their English language writing skills to communicate effectively.**					
Course Out Come	**On successful completion of the course the students shall be able to:** **1. Develop a critical and informed response reflectively, analytically, discursively, and creatively to their reading.** **2. Communicate effectively, creatively, accurately and appropriately in their writing.** **3. Deliver technical presentations** **4. Design resume and create professional portfolio to find a suitable career**					
Course Content: Theory						
Module 1	**Critical Reasoning and Writing**	**Writing Essays**	**Critical Reading**		**4 Classes**	
Topics: • **A Catalog of Reading Strategies** • **The Myth of Multitasking** • **A Guide to Writing Essays Speculating about Causes or Effects**						

- **Is Google Making Us Stupid (Self Study)**

Module 2	**Technical Presentation**	**Presentation**	**Oral Skills**	**3 Classes**

Topics:

- **Planning the presentation**
- **Creating the presentation**
- **Giving the presentation**

Module 3	**Writing Reviews**	**Prezi**	**Review Writing**	**4 Classes**

Topics:

- **Review Writing**
- **Short film reviews**
- **Advanced English Grammar (Self Study)**

Module 4	**Starting your Career**	**Online Writing Lab**	**Writing Skills**	**4 Classes**

Topics:

- **Preparing a Resume**
- **Writing Effective Application Letter**
- **Creating a Professional Portfolio**

Course Content: Practical Sessions

Module 1	**Critical Reasoning and Writing**	**8 Classes**

1. **Reading and Analyzing**

Level 1 – Annotation

Level 2 - Assumptions

2. **Writing Narrative Essays**

Level 1 – Draft 1

Level 2 – Draft 2

Module 2	**Technical Presentation**	**10 Classes**

3. **Fishbowl**

In Fishbowl, students form concentric circles with a small group inside and a larger group outside. Students in the inner circle engage in an in-depth discussion, while students in the outer circle listen and critique content, logic, and group interaction.

Level 1 – within group

Level 2 – Among 2 group

4. Technical Group Presentation		
Module 3	**Writing Reviews**	**4. Classes**
5. Practice Worksheets **Level 1 – Eliminating the Passive Voice** **Level 2 – Simple, compound and complex sentences** **6. Writing Short Film Reviews**		
Module 4	**Starting your Career**	**6. Classes**
7. Collaborative Project **Job search and writing report** **Writing Resume**		
Module 1-4	**Academic Journal**	**2 Classes**
8. Academic Journal Writing **Level 1- Mid Term** **Level 2 – End Term**		
Targeted Application & Tools that can be used: Writing reports, Review writing, Group Discussion, Dyadic interviews, Grammarly.com		
Project work/Assignment:		
Academic Journal – Assignment **In Academic Journal (CIJ), students compile task and activities completed in each module and submit to the instructor at the middle and end of the semester.**		

References

1. **Hering, Heik. *How to Write Technical Reports: Understanding Structure, Good Design, Convincing Presentation*. Springer.**
2. **Johnson, Richard. (2010) *Technical Communication Today.* Pearson, 2015**
3. **Rice B. Adelrod, Charles R. Cooper and Ellen C. Carillo. (2020) *Reading Critically Writing Well: A Reader and Guide*. Beford/St. Martin's Macmillan Learning, New York.**
4. **The Princeton Review. (2010) *MCAT Verbal Reasoning & Writing.* The Princeton Review, Inc.**
5. **https://www.hitbullseye.com/Strong-and-Weak-Arguments.php Accessed on 10 Dec 2021**
6. **https://www.inc.com/guides/how-to-improve-your-presentation-skills.html Accessed on 10 Dec 2021**

Topics Relevant to "employability": Critical Reasoning, Presentation, Review Writing and Starting Career

Topics Relevant to "Human Values and Professional Ethics": Critical reasoning

Course Code- FRL1002	**Course Title: Basic French** **Type of Course: Open Elective**	**L- T-P- C**	**2-0-0-2**
Version No.	**4.0**		
Course Pre-requisites	**Not Applicable**		
Anti-requisites	**Not Applicable**		
Course Description	**This Course is for beginners and gives an introduction of the French Language (basic grammar, conjugation, daily used vocabulary words, and basic conversations) and French culture. This Course is designed to build up all of the basic skills of French listening, reading, speaking, and writing introduced in the lessons. Besides, this Course offers an access to the French world, helping students to break cultural boundaries and raise cultural literacy.**		
Course Objective	**This course is designed to improve the learners Employability skills by using participative learning techniques to develop students' language proficiency and cross-cultural competence by active and participatory teaching methods.**		
Course Outcomes	**On successful completion of the course the students shall be able to:** **1. Identify the basics of French Grammar, vocabulary and Conjugation** **2. Apply the basics strategies of listening, reading, speaking and writing skills** **3. Use of French on everyday topics such as greetings, personal information, time and schedule** **4. Practice conversations in French language with peer speakers in different situations**		
Course Content:	**Learning of Basic French skills**		
Module 1	**Greetings and Introducing yourself**	**[Remember]**	**6 Periods**
Chapter 1. Greetings **Objectives: Greetings, introducing yourself, how to welcome someone,** **Grammar: Construction of a sentence, the days of the weeks and the months** **Chapter 2. Introducing yourself**			

Objectives: Introduce oneself / ask for someone's personal information. **Grammar: Mas or Fem noun, adjectives, present tense of the 1st group** **Usage of audio visual files**				
Module 2	**Expressing likes/dislikes and introducing someone**		**[Apply]**	**6 Periods**
Chapter 3. Expressing likes and dislikes **Objectives: How to expressing what you like and dislike.** **Grammar: Negative form, singular and plural.** **Culture: The polite way to address people in French** **Assignment** **Chapter 4. Introducing someone** **Objectives: How to describe someone,** **Grammar: Vocabulary of the family, Demonstrative adjectives,** **Present tense of verbs of the 2nd and 3rd group**				
Module 3	**Inviting someone and asking questions**		**[Apply]**	**9 Periods**
Chapter 5. Inviting someone **Objectives: How to invite someone, accept or refuse the invitation, Read the time,** **Grammar: Future tense, Interrogation.** **Culture: The art of accepting and declining an invitation politely in French** **Internal** **Chapter 6. Asking for information,** **Objectives: How to ask for information, giving information**				
Module 4	**Making a reservation and giving directions**		**[Apply]**	**9 Periods**
Chapter 7: Making a Reservation **Objectives: How to make a reservation, future tense** **Chapter 8 : Giving directions** **Objectives: How to ask for directions, Imperative tense** **Group discussions**				
Targeted Application & Tools that can be used				

Project work /Assignments **1. Assignment (Essay writing / presentation)** **2. Internal** **3. Group work / Group discussions**
Text Book **L'Atelier 1 - - Méthode de Français--- Niveau A1 (Didier – 2019)** **Festival 1- - Méthode de Français--- Niveau A1 (CLE International – 2005)**
References **Learning materials designed by the instructor**
Topics relevant to development of 'Employability Skills' through participative learning techniques: **Foreign language proficiency and cross-cultural competence by active and participatory teaching methods.**

Course Code: **PPS 1012**	**Course Title: Enhancing Personality through Soft Skills** Type of Course: Practical Only Course	L- T - P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	• Students are expected to understand Basic English. • Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites	NIL					
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Personality Development through Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**					

<table>
<tr><td>Course Out Comes</td><td colspan="3">On successful completion of this course the students shall be able to:
CO 1 Identify the stages of team formation (Remember)
CO 2 Demonstrate effective presentation skills (Apply)
CO3 Prepare professional social media profile (Apply)</td></tr>
<tr><td>Course Content:</td><td colspan="3"></td></tr>
<tr><td>Module 1</td><td>Team Building</td><td>Classroom and outbound team building activities.</td><td>6 Hours</td></tr>
<tr><td colspan="4">Topics: Importance of team, stages of Team Formation, Trust and collaboration, Virtual Team.
Activity: Team Building outbound activity</td></tr>
<tr><td>Module 2</td><td>Art of Questioning</td><td>Role plays</td><td>4 Sessions</td></tr>
<tr><td colspan="4">Topics: Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions</td></tr>
<tr><td>Module 3</td><td>Presentation Skills</td><td>Practice and evaluation of individual / group presentation</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics: Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges.
Activity: Individual presentations and team presentation</td></tr>
<tr><td>Module 4</td><td>Professional Brand Building</td><td>Brand Framework Activity</td><td>4 Sessions</td></tr>
<tr><td colspan="4">Topics: Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies.
Activity: Create a basic online profile</td></tr>
<tr><td>Module 5</td><td>Recap / Revision /Feedback Session</td><td></td><td>1 Session</td></tr>
<tr><td colspan="4">Targeted Application & Tools that can be used:
1. TED Talks
2. You Tube Links</td></tr>
</table>

3. Activities

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

3) Presentation Evaluation

Targeted Application & Tools that can be used:

1. TED Talks
2. YouTube Links
3. Videos by L&D Team shared on Edhitch/YouTube.com
4. LMS

Assignments proposed for this course

1. Evaluation on Presentation
2. Assignment on LinkedIn Post

YouTube Links: https://youtu.be/z__jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010)

References

1. "Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1-250-04112-8
2. "The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014
3. "The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006
4. "Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

Web links:

1. https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills

https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/

2. https://hbr.org/2022/05/the-art-of-asking-great-questions

Topics relevant to development of "SKILL": Art of Presentation, Team building, Art of questioning and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: EEE1007	Course Title: Basics of Electrical and Electronics Engineering.	L-T-P-C	3	0	2	4

	Type of Course: Engineering Science - Theory & Integrated Laboratory					
Version No.	**1.0**					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	**This is a fundamental Course which is designed to know the use of basics of electrical and electronics engineering principles occurs in various fields of Engineering. The course emphasis on the characteristics and applications of Electrical and Electronics devices, working, analysis and design of electrical circuits using both active & passive components, fundamentals of electrical machines and basics of transistors and its application. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance, using both hardware and simulation tools.**					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Basics of Electrical and Electronics Engineering and attain Skill Development through Experiential Learning techniques.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** **1. Explain basic laws of Electrical Engineering to compute voltage, currents and other parameters in the circuits.** **2. Discuss various fundamental parameters appearing in the characteristics of semiconductor devices and their applications.** **3. Summarize the operations of different biasing configurations of BJTs and amplifiers.** **4. Summarizethe performance characteristics and applications of various electrical Machines.** **5. Demonstrate the working of electrical machines to observe performance characteristics** **6. Demonstrate the working of electronic circuits to obtain the V-I Characteristics of various semiconductor devices.**					
Course Content:						
Module 1	**Introduction to Electrical Circuits**		**Assignment/ Quiz**	**Numerical solving Task**	**10 Sessions**	
DC Circuits: Concept of Circuit and Network, Types of elements, Network Reduction Techniques- Series and parallel connections of resistive networks, Star–to-Delta Transformations, Mesh Analysis, Numerical examples.						

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

Introduction to three phase system and relation between line and phase values in Star & Delta connection, Numerical examples.

Module 2	**Semiconductor and Diode applications**	**Assignment/ Quiz**	**Memory Recall based Quizzes**	**11 Sessions**

Mass Action Law, Charge densities in a semiconductor, Types of SC, Junction diodes - Ideal and practical behaviour, Modelling the Diode Characteristic, and Diode applications like rectifiers, Clipping and clamping circuits. Zener diode, characteristics and its applications like voltage regulator.

Module 3	**Fundamentals of Electrical Machines**	**Assignment/ Quiz**	**Memory Recall-based Quizzes**	**12 Sessions**

Electrical Machines: Single phase transformers: principle of operation and EMF equation, Numerical examples. DC Motor: principle of operation, Back EMF, torque equation, Numerical examples. AC Motor: Principle operation of Induction Motors and its Applications.

Special Machines: Introduction to special electrical machines and its applications.

Module 4	**Transistors and its Applications**	**Assignment/ Quiz**	**Numerical solving Task**	**12 Sessions**

Transistor characteristics, Current components, BJT Configurations (CB, CC, CE configurations) and their current gains. Operating point, Biasing & stabilization techniques: Fixed Bias, Voltage divider bias and its stability factor and load line analysis. Single and multistage amplifier, Darlington pair.

JFET (Construction, principal of Operation and Volt –Ampere characteristics). Pinch- off voltage, Comparison of BJT and FET. MOSFET (Construction, principal of Operation and symbol), MOSFET characteristics in Enhancement and Depletion modes.

List of Laboratory Tasks:

Experiment No 1: Verification of KVL and KCL for a given DC circuit.

Level 1: Study and Verify KVL and KCL for the given electrical Circuit.

Level 2: For the same circuit considered in level 1, perform the simulation using NI LabVIEW/Multisim/MATLAB.

Experiment No 2: Analyse AC series circuits – RL, RC and RLC .

Level 1: Conduct an experiment to perform and verify the impedance, current and power of Series RL and RC circuits

Level 2:

Experiment No 3: Calculation of power and power factor of the given AC Circuit.

Level 1: Conduct an experiment to measure the power and power factor for given resistive load.

Level 2: Conduct an experiment to measure the power and power factor for given inductive load.

Experiment No 4: Perform the experiments on given Transformer.

Level 1: Verify the EMF equation of a transformer and compute the voltage transformation ratio.

Level 2: Study the effect of load on the secondary side of the transformer and verify the EMF equation under load conditions.

Experiment 5: Load test on DC shunt motor

Level 1: Conduct load test on DC shunt motor and find its efficiency at different loads

Level 2:Conduct load test on DC shunt motor and plot the performance characteristics.

Experiment 6: Study of PN-Junction Diode Characteristics in Forward and Reverse Bias Conditions.

Level 1:Carry out an experiment to plot VI Characteristics and hence find the cut-in voltage on forward characteristics for the Silicon P-N Junction diode.

Level 2: Carry out an experiment to plot VI Characteristics of Zener diode and hence find the zener voltage on reverse characteristics for the Silicon P-N Junction zener diode.

Experiment 7: To observe the output waveform of half wave and full wave rectifier circuit and compute ripple factor and efficiency

Level 1:Identify the components required for a rectifier circuit, rig up the circuit, and sketch the output waveforms without filter.

Level 2: Rig up the rectifier circuit with RC filter, observe the output waveforms, determine the efficiency and ripple factor.

Experiment 8: To construct clipping and clamping circuits for different reference voltages and to verify the responses.

Level 1:Identify the components required for building a Clipper / Clamper circuit. Rig up the circuit according to the circuit diagram given and sketch the output waveform.

Level 2: Given a sinusoidal input of 10 V p-p, implement a positive / negative clipper with output clipped at 2 V.

Experiment 9: To calculate various parameters of emitter follower circuit using BJT

Level 1: Identify the components required to implement an emitter follower circuit. Rig up the circuit and observe the variations in output waveform with respect to the variations in input waveform.

Level 2: Determine the values of Z_{in} input impedance and Z_{out} output impedance for Emitter Follower.

Experiment 10: To Implement RC Coupled amplifier using a BJT and sketch the frequency response.

Level 1: Identify the components required to implement an RC coupled amplifier circuit. Rig up the circuit and sketch the frequency response.

Level 2: From the frequency response curve determine the value of the mid band gain and the bandwidth.

Targeted Application & Tools that can be used:

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

Professionally Used Software: Matlab/Multisim/ PSpice

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

Text Book(s):

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

Reference Book (s):

1. **John Hiley, Keith Brown and Ian McKenzie Smith, "HUGHES Electrical and Electronic Technology", 10th Edition (Indian Edition published by Dorling Kindersley), Pearson,2011**
2. **Samarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, Prentice Hall India, 2007.**

3. **K Uma Rao, A Jaya Lakshmi, "Basic Electrical engineering" IK International publishing house Pvt. Ltd**
4. **R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education India 7th Edition.**
5. **A K. Maini, V. Agrawal, "Electronic Devices & Circuits", Wiley, 2nd Edition**
6. **A.S Sedra, K. C. Smith, "Microelectronic Circuits", Oxford University Press, 6th Edition**

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

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

https://nptel.ac.in/courses/117/103/117103063/

7. **"Introduction to Electrical Machines https://nptel.ac.in/courses/108/102/108102146/"**
8. **M. -Y. Kao, H. Kam and C. Hu, "Deep-Learning-Assisted Physics-Driven MOSFET CurrentVoltageModeling," in IEEE Electron Device Letters, vol. 43, no. 6, pp. 974-977, June 2022, doi: 10.1109/LED.2022.3168243**

https://ieeexplore-ieee-org-resiuniv.knimbus.com/document/9758727

9. **F. Bonet, O. Aviñó-Salvadó, M. Vellvehi, X. Jordà, P. Godignon and X. Perpiñà, "Carrier**

Concentration Analysis in 1.2 kV SiCSchottky Diodes Under Current Crowding," in IEEE Electron DeviceLetters, vol. 43, no. 6, pp. 938-941, June 2022, doi: 10.1109/LED.2022.3171112. https://ieeexplore-ieeeorg-presiuniv.knimbus.com/document/9764749

10. **M. Chanda, S. Jain, S. De and C. K. Sarkar, "Implementation of Subthreshold Adiabatic Logic for Ultralow-Power Application," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. .23, no. 12, pp. 2782-2790, Dec. 2015.**

https://ieeexplore.ieee.org/document/7018053

11. **R. Raut and O. Ghasemi, "A power efficient wide band trans-impedance amplifier in submicron**

CMOS integrated circuit technology," 2008 Joint 6th International IEEE Northeast Workshop on Circuits and Systems and TAISA Conference, 2008, pp. 113-116, doi: 0.1109/NEWCAS.2008.4606334. https://ieeexplore.ieee.org/document/4606334						
Topics relevant to "SKILL DEVELOPMENT": Performing suitable experiments to compute the Electrical and electronics circuit parameters, performance operation of Machines, and semiconductor devices for Skill Developmentthrough Experiential Learning techniques. This is attained through assessment component mentioned in course plan.						
Course Code: LAW1007	**Course Title: Indian Constitution and Professional Ethics for Engineers** **Type of Course: Theory**	**L-T- P-C**	1	-	-	0
Version No.						
Course Prerequisites						
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students to the theory, concepts and practice of Constitution of India which is the law of the land. Further, the course aims at acquainting the students with basic approaches and methodologies to analyse and decide on the ethical dilemma in the field of engineering. The course is both conceptual and analytical. The course develops critical thinking skills by augmenting the student's ability to such engineers' comprehend the conceptual and legal framework of Constitution of India. Ethics and values are very beautifully weaved into the tapestry of the Indian Constitution. Therefore, the course provides an introduction to the essential theoretical basis of engineering ethics and its application through a range of industry relevant topics as responsibility for safety and risks, responsibility of employers, rights of engineers etc.					
Course Objective	1. To introduce the students to the conceptual framework of Constitution of India and engineering ethics. 2. To enhance the practical knowledge on responsibility of engineering professionals as citizens of India. 3. To acquaint the student with the relevant contemporary issues surrounding constitutional values and professional ethics. 4. To orient the students about the ethical concepts and frameworks enabling them to identify the codes and moral values relevant to the professional world.					
Course Outcomes	**On successful completion of this course the students shall be able:** **1. To understand foundational Indian constitutional law concepts and values.** **2. To identify the different pillars of democracy and their functions.**					

	3. To analyse the role of the engineers' responsibility in ensuring safety of the **society and the employer.**

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

Module 2	Sensory Devices	Hands-on	Interfacing Task and Analysis	4 Sessions

Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switches and actuators, sensor interface with Arduino.

Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications. Introduction to online Simulators: Working with Tinkercad Simulator.

Topics: Types of Arduino boards, sensors, 3D Printer

Targeted Application & Tools that can be used:

Application Area:

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

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

Project work/Assignment:

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

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

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

Textbook(s):

Monk Simon "Programming Arduino: Getting Started with Sketches", Mc Graw Hill Publications Second Edition
References **Reference Book(s)** **1. Neerparaj Rai "Arduino Projects for Engineers" BPB publishers,first edition, 2016.** **2. Ryan Turner "Arduino Programming " Nelly B.L. International Consulting Ltd. first edition,2019.** **Online Resources (e-books, notes, ppts, video lectures etc.):** **1. Arduino trending Projects < https://www. https://projecthub.arduino.cc/>** **2. Introduction to Arduino < https://onlinecourses.swayam2.ac.in/aic20_sp04/preview>** **3. Case studies on Wearable technology< https://www.hticiitm.org/wearables>** **E-content:** **1. Cattle Health Monitoring System Using Arduino and IOT (April 2021| IJIRT | Volume 7 Issue 11 | ISSN: 2349-6002)** **2. M H Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, Pragya Singh" IOT BASED SMART SECURITY SYSTEM USING ARDUINO" 2021 JETIR August 2021, Volume 8, Issue 8.** **3. R. Maheswar, P. Jayarajan, S. Vimalraj, G. Sivagnanam, V. Sivasankaran and I. S. Amiri, "Energy Efficient Real Time Environmental Monitoring System Using Buffer Management Protocol," 2018, pp. 1-5, doi: 10.1109/ICCCNT.2018.8494144. https://ieeexplore.ieee.org/document/8494144.** **4. Yaser S Shaheen,Hussam., " Arduino Mega Based Smart Traffic Control System ," December 2021 Asian Journal of Advanced Research and Reports 15(12): 43-52, 2021(15(12): 43-52, 2021):15(12): 43-52, 2021.**
Topics relevant to development of "SKILL": System design for achieving Sustainable Development Goals.

Course Code: **MAT2010**	**Course Title: Integral Transforms and Partial Differential Equations** **Type of Course:1] School Core**	**L-T- P- C**	**3**	**0**	**0**	**3**
Version No.		**1.0**				
Course Pre-requisites		**Calculus and Differential Equations**				
Anti-requisites		**NIL**				

Course Description		**This course aims to introduce various transform techniques such as Laplace transform, Fourier transform and Z-transform in addition to expressing functions in terms of Fourier series. The course covers applications of Laplace transform to LCR circuits and solutions of different equations using Z-transform. The course also deals with the analytical methods for solving partial differential equations and the classical applications of partial differential equations.**
Course Objective		**The objective of the course is to familiarize the learners with the concepts of "Transform Techniques, Partial Differential Equations" and attain Skill Development through Problem Solving Techniques.**
Course Out Comes		**On successful completion of the course the students shall be able to:** **1. CO1 - Express functions in terms of uniformly convergent Fourier series.** **2. CO2 - Apply Laplace transform technique to solve differential equations.** **3. CO3 - Employ Z-transform techniques to solve difference equations.** **4. CO4 - Solve a variety of partial differential equations analytically.**
Course Content:		

Module 1	**Laplace Transforms**		**(12 Classes)**
Definition and Laplace transform of elementary functions. Properties of Laplace transform, and Laplace transform of periodic function, unit-step function and Impulse function – related problems. Inverse Laplace transform of standard functions - problems, initial and final value theorem. Convolution theorem, solution of linear and simultaneous differential equations and LCR Circuit.			
Module 2	**Fourier Series**	**Assignment**	**(8 Classes)**
Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2p and arbitrary period. Half range Fourier series. Practical harmonic analysis.			
Module 3	**Fourier Transforms and Z - Transforms**		**(13 Classes)**
Fourier Transforms: Definitions, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms, Problems. **Difference equations and Z-transforms: Z-transforms – Basic definitions, Standard Z-transforms, Linearity property, Damping rule, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-transforms. Difference equations – Basic definitions, Application of Z-transforms to solve difference equations.**			
Module 4	**Partial Differential Equations**	**Assignment**	**(12 Classes)**

Formation of PDE, Solution of non-homogeneous PDE by direct integration, Solution of homogeneous PDE involving derivative with respect to one independent variable only (Both types with given set of conditions) Method of separation of variables. (First and second order equations) Solution of Lagrange's linear PDE. of the type P p + Q q = R.

Applications of PDE: Derivation of one-dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two-dimensional Laplace's equation – various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems).

Targeted Application & Tools that can be used:

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

Assignment:

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

Text Book

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

References:

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

E-resources/ Web links:

1. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_140238**
2. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_233298**
3. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_204892**
4. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_246791**
5. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_223548**
6. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_134719**

7. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_32614 8. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 9. https://www.scu.edu.au/study-at-scu/units/math1005/2022/
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving. This is attained through the assessment component mentioned in course handout.

Course Code: **CSE1508**	**Course Title: Data Structures** **Type of Course: Theory**	**L-T- P- C**	**3**	**0**	**0**	**3**
Version No.	**1.0**					
Course Pre-requisites						
Anti-requisites	**NIL**					
Course Description	**This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.**					
Course Objective	**The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques**					
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1: Describe the concept of basic data structure, stacks, queues, and arrays and their operations. [Understand]** **CO2: Utilize linked lists for real-time scenarios. [Apply]** **CO3: Apply an appropriate non-linear data structure for a given scenario. [Apply]** **CO4: Demonstrate different searching and sorting techniques. [Apply]**					
Course Content:						

Module 1	**Introduction to Data Structure and Linear Data Structure – Stacks and Queues**	**Assignment**	**Program activity**	**9 Hours**
Introduction – Introduction to Data Structures, Types and concept of Arrays. **Stack - Concepts and representation, Stack operations, stack implementation using array and Applications of Stack.** **Queues - Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.**				
Module 2	**Linear Data Structure- Linked List**	**Assignment**	**Program activity**	**12 Hours**
Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list. **Recursion - Recursive Definition and Processes.**				
Module 3	**Non-linear Data Structures - Trees**	**Assignment**	**Program activity**	**12 Hours**
Topics: Trees - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post - Order traversal, Binary Serach Tree, AVL Trees - Red Black Tree, Expression Tree , Heaps.				
Module 4	**Non-linear Data Structures - Graphs and Hashing**	**Assignment**	**Program activity**	**6 Hours**
Topics: Graphs: Basic Concept of Graph Theory and its Properties, Representation of Graphs . ADT, Elementary graph operations, Minimum Cost spanning trees, Shortest path and Transitive closure. **Hashing: Introduction, Static Hashing, Dynamic Hashing**				
Module 5	**Searching & Sorting**	**Assignment**	**Program activity**	**6 Hours**
Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort, Quick sort, Merge Sort, Bubble sort.				
List of Laboratory Tasks: **Lab sheet -1** **Level 1: Prompt the user, read input and print messages.Programs using class, methods and objects** **Level 2: Programming Exercises on fundamental Data structure - Arrays based on Scenario.** **Lab sheet -2**				

Level 1: Programming Exercises on Stack and its operations

Level 2: Programming Exercises on Stack and its operations with condition

Lab sheet -3

Level 1: Programming on Stack application infix to postfix Conversion

Level 2: -

Lab sheet -4

Level 1: Programming on Stack application – Evaluation of postfix

Lab sheet -5

Level 1: Programming Exercises on Queues and its operations with conditions

Level 2: -

Lab sheet -6

Level 1: Programming Exercises on Linked list and its operations.

Level 2: Programming Exercises on Linked list and its operations with various positions

Lab sheet -7

Level 1: Programming Exercises on Circular Linked list and its operations.

Level 2: Programming Exercises on Circular Linked list and its operations with various positions

Lab sheet -8

Level 1: Programming Exercises on factorial of a number

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9

Level 1: -

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -10

Level 1: Programming Exercise on Doubly linked list and its operations

Level 2: -

Lab sheet -11

Level 1: Program to Construct Binary Search Tree and Graph

Level 2: Program to traverse the Binary Search Tree in three ways(in-order, pre-order and post-order) and implement BFS and DFS

Lab sheet -12

Level 1: Program to Implement the Linear Search & Binary Search

Level 2: Program to Estimate the Time complexity of Linear Search

Lab sheet -13

Level 1: Program to Implement and Estimate the Time complexity of Selection Sort

Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort

Lab sheet -14 (Beyond syllabus activity)

Level 1: Program to Construct AVL Tree

Level 2:

Lab sheet -15 (Beyond syllabus activity)

Level 1: Program to Construct RED BLACK Tree

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Modern IDE like VS Code and Eclipse for lab programs to execute.

Project work/Assignment:

Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.

Text Book

T1 Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, reprint 2018.

T2 Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

References

R1 Data structures and program design in C by Robert Kruse, Tondo C L, Bruce Leung, Pearson education publishers, 2017.

R2 Programming and Data Structure by Jackulin C Salini etal., Ane books publishers, 2019.

Web resources:

1. **For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview**
2. **https://puniversity.informaticsglobal.com/login**

Topics relevant to development of "Skill Development":

Linked list and stacks

Topics relevant to development of "Environment and sustainability: Queues	
Catalogue prepared by	**Muthuraj**
Recommended by the Board of Studies on	**09th BOS held on 04/05/19**
Date of Approval by the Academic Council	**Academic Council Meeting No. 11, Dated 11/06/19**

Course Code: CSE1510	**Course Title: Database Management Systems** **Type of Course: Theory**	**L-T-P-C**	**3**	**0**	**0**	**3**
Version No.						
Course Pre-requisites	**Foundational understanding of data types, data structures, basic programming knowledge, familiarity with operating systems and file management. Basic knowledge of set theory, logic, and discrete mathematics to understand relational algebra and query formulation.**					
Anti-requisites	**NIL**					
Course Description	**This course introduces the foundational principles of database management systems, including data models, schemas, and architectures. This course provides a solid foundation on the relational model of data and the use of relational algebra. It develops skills in SQL for data definition, manipulation, and control, enabling students to construct and execute complex queries. The course also introduces the concept of object oriented and object relational databases and modern database technologies like NoSQL. The also course allows the students to gain insights into data storage structures and indexing strategies for optimizing query performance.**					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain Employability through Problem Solving Methodologies.**					
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Describe the fundamental elements of relational database management systems. [Understand]**					

	2. **Examine databases using SQL query processing and Optimization. [Apply]** 3. **Design simple database systems applying the normalization constraints and demonstrate the database transaction processing, recovery, and security. [Apply]** 4. **Interpret the concept of advanced databases and its applications. [Apply]**

Course Content:

Module 1	**Introduction to Database Modelling and Relational Algebra (Understand)**	**Assignment**	**Problem Solving**	**10 Sessions**

Topics:

Introduction to Database: Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model.

Relational Algebra with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.

Module 2	**Fundamentals of SQL and Query Optimization (Apply)**	**Assignment**	**Programming**	**11 Sessions**

Topics:

SQL Database Querying, DDL, DML, Constraints, Operators, Set Operators, Aggregate Functions, Joins, Views, Procedures, Functions and Triggers.

Database programming issues and techniques: Embedded SQL, Dynamic SQL; SQL / PSM and NoSQL.

Query Optimization: Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.

Module 3	**Relational Database Design & Transaction Management (Apply)**	**Assignment**	**Problem Solving**	**12 Sessions**

Topics:

Relational database design: Problems in schema design, redundancy and anomalies, Normal Forms based on Primary Keys-(1NF,2NF, 3NF), Boyce-Codd Normal Form, Multi valued Dependency (Fourth Normal Form), Join

Dependencies (Fifth Normal Form), lossy and lossless decompositions, Database De-normalization.

Transaction Management: The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; The write-ahead log protocol; Check pointing; Recovering from a System Crash; Media Recovery; Other approaches and interaction with concurrency control.

Module 4	**Advanced DBMS Topics (Apply)**	**Assignment**	**Case Study**	**12 Sessions**

Topics:

Advanced topics: Object oriented database management systems, Deductive database

management systems, Spatial database management systems, Temporal database management systems, Constraint database management systems.

New database applications and architectures such as Data warehousing, Multimedia, Mobility, NoSQL, Native XML databases (NXD), Document-oriented databases, Statistical databases.

Targeted Application & Tools that can be used:

Application Area: Relational database systems for Business, Scientific and Engineering Applications. Tools/Simulator used: MySQL DB for student practice.

Also demonstration of ORACLE DB on object-relational database creation and JDBC connection.

1. **Problem Solving: Constructing ER-Diagrams for a given real time requirements, Normalizing the databases, querying the databases using relational algebra.**
2. **Programming: Implementation of any given scenario using MySQL.**

Text Books:

T1. Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.

T2. RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.

T3. W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.

References

R1 Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019. **R2 M. Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly, 2017.**
Topics relevant to development of "FOUNDATION SKILLS": S - Skill Development: Relational database design using ER- Relational mapping, Implementation of given database scenario using MYSQLDB. **Topics relevant to development of Employability: Develop, test and implement computer databases, creating sophisticated, interactive and secure database applications** **Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil**

Course Code: CSE1511	**Course Title: Database Management Systems Laboratory** **Type of Course: Lab**	**L-T-P-C**	**0**	**0**	**2**	**1**
Version No.	**1.0**					
Course Pre-requisites	**Foundational understanding of data types, basic programming knowledge, operating systems and file management.**					
Anti-requisites	**NIL**					
Course Description	**The Database Management Systems (DBMS) Laboratory is designed to provide students with hands-on experience in database design, implementation, and management using SQL and database management tools such as MySQL. The lab complements theoretical concepts learned in database courses by allowing students to practice database creation, querying, and optimization techniques. The DBMS Lab enables students to develop industry-relevant skills in database management, preparing them for careers in software development, data engineering, and database administration.**					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain Employability through Problem Solving Methodologies.**					
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Demonstrate the database concepts, practice, and SQL queries. [Apply]** **2. Design and implement database schemas while applying normalization techniques to optimize structure. [Apply]]**					

	3. **Develop and implement stored procedures, triggers, and views for automation and efficiency. [Apply]** 4. **To Design and build database applications for real world problems. [Apply]**

Course Content:

List of Laboratory Tasks:

Create Employee, Student, Banking and Library databases and populate them with required data. Do the following experiments of different lab sheets on those databases.

Labsheet-1 [3 Practical Sessions]

Experiment No 1: [1 Session]

1. To study and implement the different language of Structured Query Language.

Level 1: Perform operations using Data Definition Language and Data Manipulation Language commands including different variants of SELECT on Student DB.

Level 2: Identify the given requirements; valid attributes and data types and Perform DDL and DML operations on a given scenario. [Banking Databases]

Experiment No. 2: [2 Sessions]

2. To study and implement the concept of integrity constraints in SQL.

Level 1: Create tables on Banking database using PRIMARY KEY, NOT NULL, UNIQUE, FOREIGN KEY and demonstrate the working of relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators on Student Database.

Level 2: Enforce different types of data and referential integrity constraints. Then try queries with special operators based on the student database. [Banking Database].

Labsheet-2 [3 Practical Sessions]

Experiment No. 3: [1 Session]

3. Implement complex queries in SQL.

Level 1: Implement the conjugate of GROUP BY, ORDER BY and aggregate functions on Banking Database. Level 2: Implement MySQL DB queries on library database using appropriate clauses and aggregate functions. Also order the data either in ascending and descending order using corresponding clause. [Library databases].

Experiment No. 4: [2 Session]

4. To study and implement different types of Set and Join Operations [2 Slots]

Level 1: Demonstrate different types of Set Operations (UNION, UNION ALL, INTERSECT, MINUS) and Join Operations (INNER JOINs, OUTER JOINS, CROSS JOIN, NATURAL JOIN) on two or more tables of Airline Database. Level 2: Use Set and Join operations to retrieve the data from two or more relations(tables) as per the given

scenario. [Airline Database]

Labsheet-3 [2 Practical Sessions]

Experiment No. 5: [2 sessions]

5. To study and implement Views, and Procedures in MySQL DB.

Level 1: Implement MySQL Views, and Procedures in ORACLE DB on Employee database.

Level 2: Analyze the requirement and construct views, and Procedures on Mini Project Domain. [Banking Database]

Labsheet-4 [2 Practical Sessions]

Experiment No. 6: [2 Sessions]

6. To study and implement Functions, and Triggers in MySQL DB.

Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.

Level 2: Analyze the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-5 [2 Practical Sessions]

Experiment No. 7: [2 Sessions]

7. To study and implement Functions, and Triggers in MySQL DB.

Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.

Level 2: Determine the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-6 [4 Practical Sessions]

Experiment No. 8: [2 Sessions]

8. To implement the concept of forms and reports.

Level 1: Implement the concept of forms and reports.

Level 2: Examine the schema relationship.

Experiment No. 9: [2 Sessions]

9. Create the database using the given schema. (Flight Management)

Level 1: Implement a relational database based on the provided schema for the Flight Management system, including the creation of tables, relationships, and constraints.

Level 2: Demonstrate schema relationships by defining primary and foreign keys to ensure data integrity within the Flight Management database.

Labsheet-7 [4 Practical Sessions]

Experiment No. 10: [2 Sessions]

10. Create the database using the given schema. (Company database)

Level 1: Implement the database schema by defining tables, relationships, and constraints according to the given Company Database schema.

Level 2: Demonstrate the schema's relationships and data integrity by creating and linking tables as per the specified requirements.

Experiment No. 11: [2 Sessions]

11. Create the database using the given schema. (Student Library)

Level 1: Implement forms and reports based on the provided Student Library database schema, ensuring effective data entry and reporting mechanisms.

Level 2: Demonstrate the schema relationships within the Student Library database, demonstrating how these relationships influence the creation and functionality of forms and reports.

Labsheet-8 [1 Sessions]

12. Design a mini project based on the databases such as Inventory Management System, University Management System, Hospital Management System, etc.

Level 1: Implement the real time database.

Level 2: Analyze the working of database in real time.

Targeted Application & Tools that can be used:

Application Area: Relational database systems for Business, Scientific and Engineering Applications. Tools/Simulator used: MySQL DB for student practice.

Also demonstration of ORACLE DB on object-relational database creation and JDBC connection.

Percentage of changes in this version: 50% of changes from earlier version. New topics are highlighted in italic.
1. **Problem Solving: Constructing ER-Diagrams for a given real time requirements, Normalizing the databases, querying the databases using relational algebra.** 2. **Programming: Implementation of any given scenario using MySQL.**
Text Books: **T1. Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.** **T2. RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.** **T3. W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.**
References **R1 Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.** **R2 M. Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly, 2017.**
Topics relevant to development of "FOUNDATION SKILLS": S - Skill Development: Relational database design using ER- Relational mapping, Implementation of given database scenario using MYSQLDB. **Topics relevant to development of Employability: Develop, test and implement computer databases, creating sophisticated, interactive and secure database applications** **Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil**

Course Code: **CSE1500**	**Course Title: Computational Thinking using Python** **Type of Course: Engineering Science** **Theory Integrated**	**L-T-P-C**	**2**	**0**	**0**	**2**

Version No.		**1.0**
Course Pre-requisites	•	•
Anti-requisites		**NIL**
Course Description		**The course efficiently introduces fundamental ideas including conditionals, loops, functions, lists, strings, and tuples through some inspiring examples. It then discusses dynamic programming like handling exceptions and file usage. In terms of data structures, the course covers Python dictionaries, classes, and objects for constructing user-defined datatypes like linear and binary search.**
Course Object		**The objective of the course is to familiarize the learners with the concepts of Computational Thinking using Python and attain Skill Development through Participative Learning techniques.**
Course Out Comes		**On successful completion of the course the students shall be able to:** **1. Describe algorithmic solutions for basic computing issues.. (Understand)** **2. Explain data types and operators. (Understand)** **3. Demonstrate control structures and Functions. (Apply)** **4. Apply the data structures for the given data. (Apply)** **5. Demonstrate the file operations. (Apply)**
Course Content:		

Module 1	**Computational Thinking And Problem Solving**	**Assignment**		**Programming**	**6 Sessions**
	Topics: **Fundamentals of Computing– Identification of Computational Problems Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi**				
Module 2	**Datatypes, Expressions, Statements**	**Assignment**		**Programming**	**6 Sessions**
	Topics: **Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values**				

	of two variables, circulate the values of n variables, distance between two points.				
Module 3	**Control flow, Functions, Strings**	**Assignment**		**Programming**	**6 Sessions**
	Topics: **Conditionals:Boolean values and operators, conditional (if), alternative (if else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.**				
Module 4	**Lists, Tuples, Dictionaries**	**Assignment**		**Programming**	**6 Sessions**
	Topics: **Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing- list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.**				
Module 5	**Files**	**Assignment**		**Programming**	**6 Sessions**
	Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).				
	Project work/Assignment:				
1.	**2. Assignment 1 on (Module 1 and Module 2)** **3. Assignment 2 on (Module 3 and Module 4 & 5)**				
	Text Book **1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021** **2. Eric Matthes, Python Crash Course,: A Hands-On, Project-Based Introduction to Programming, 3rd Edition, 2023**				

	References **1.Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.** **2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.** **Web Resources** **1. https://onlinecourses.nptel.ac.in/noc20_cs70/preview**
	Topics relevant to development of "Employability": Data structures using python. **Topics relevant to "PROFESSIONAL ETHICS": Naming and coding convention for simple programs using python.**

Course Code:CSD1703	**Course Title: Introduction to Data Science** **Type of Course: Program Core**	**L-P-C**	3	0	0	3
Version No.	1.0					
Anti-requisites	NIL					
Course Description	This course offers a comprehensive introduction to the interdisciplinary field of Data Science. Students will explore the data science lifecycle, beginning with data acquisition and progressing through cleaning, exploratory analysis, visualization, and basic predictive modeling. Emphasis is placed on using Python-based tools (Pandas, NumPy, Matplotlib, Seaborn, Scikit-learn) to perform real-world data tasks. The course fosters critical thinking, statistical reasoning, and data-driven decision-making essential for modern data science roles.					
Course Objectives	To introduce students to the fundamentals and workflow of Data Science To impart practical experience with Python tools used in data analysis To develop understanding of data exploration, transformation, and visualization techniques To build foundational knowledge of statistical methods and basic predictive modeling					
Course Out Comes	CO1: Describe the stages of the data science lifecycle and tools used CO2: Perform data wrangling, cleaning, and exploratory analysis with Python CO3: Create and interpret data visualizations for effective communication CO4: Apply basic statistical concepts and develop predictive models					

Course Content:				
Module 1	**Introduction to Data Science**	**Quiz**	**Knowledge based**	**10 Hours**
Introduction to Data Science: Definitions and Applications, Data Science Lifecycle, Python for Data Science: Syntax, Variables, Data Types, Control Flow, Setting up Environment: Jupyter Notebook, Anaconda, Google Colab, Working with Python Libraries: NumPy and Pandas Basics, Real-world applications of Data Science (case studies from healthcare, finance, and social media)				
Module 2	**Data Wrangling and Exploration**	**Assignment**	**Implementation**	**12 Hours**
DataFrames and Series in Pandas , Data Cleaning: Missing Values, Duplicates, Data Type Conversion, Data Transformation: Sorting, Filtering, Merging, Grouping,Feature Engineering Basics, Exploratory Data Analysis (EDA): Descriptive Statistics, Distributions, Outlier Detection, Hands-on: Analyzing a public dataset (e.g., Titanic, Iris)				
Module 3	**Data Visualization and Communication**	**Term paper/Assignment**	**Implementation**	**11 Hours**
Introduction to Data Visualization: Importance & Principles,Visualization with Matplotlib and Seaborn Line Charts, Bar Charts, Histograms, Boxplots, Pairplots, Heatmaps, KDE plots, and advanced visualizations, Creating Dashboards using Plotly or Streamlit (Intro), Data Storytelling: How to Present Data Insights Effectively , Project: Create an interactive EDA dashboard				
Module 4	**Introduction to Statistics & Predictive Modeling**	**Term paper/Assignment**	**Implementation**	**12 Hours**
Descriptive Statistics: Mean, Median, Mode, Variance, Standard Deviation, Probability Basics and Distributions , Hypothesis Testing: t-Test, p-value, Confidence Intervals, Correlation and Causation, Introduction to Regression: • Simple and Multiple Linear Regression • Classification Overview: Logistic Regression Introduction to Model Evaluation: Accuracy, Confusion Matrix, Precision, Recall, Case Study: Predictive modeling on a real dataset				
Textbook(s): **Title:** *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter* ,**Author:** Wes McKinney,**Publisher:** O'Reilly Media, **Edition:** 3rd Edition, 2023				

References:

1. **Title:** *Practical Statistics for Data Scientists: 50+ Essential Concepts,* **Authors:** Peter Bruce, Andrew Bruce, Peter Gedeck, **Publisher:** O'Reilly Media, 2nd Edition (2021)
2. **Title:** *Doing Data Science,* **Authors:** Cathy O'Neil, Rachel Schutt, **Publisher:** O'Reilly Media
3. **Title:** *An Introduction to Statistical Learning with Applications in R,* **Authors:** Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, **Publisher:** Springer, 2nd Edition (2021)

Course Code: CSE1700	**Course Title: Essentials of AI** **Type of Course: Engineering Sciences Core -Theory**	**L-T-P-C**	**3**	**0**	**0**	**3**
Version No.	**1.0**					
Course Pre-requisites	**CSEXXXX – Data Structures and Algorithms**					
Anti-requisites	**NIL**					
Course Description	**This course introduces the student to the basics of artificial intelligence. In this course, the student first learns the various search methods for problem-solving, followed by knowledge-based logic representations. After that, the student will learn about uncertainty in AI, as well as approaches to solve such challenges such as Naïve Bayes Classifier and Hidden Markov Models.** **Topics: Uninformed search, Heuristic search, Local search, Adversarial search, Constraint satisfaction, logic, First Order Resolution, Probability, Naïve Bayes Classifier, and Hidden Markov Model (HMM).**					
Course Objectives	**The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.**					
Course Out Comes	**On successful completion of this course the students shall be able to:** **1. Explain different methods of searching, proving, and analysis in AI [Understand]** **2. Implement various graphical and adversarial search algorithms. [Apply]** **3. Prove, by resolution, different situations using First Order Logic [Apply]** **4. Solve sequence labeling problems using HMM [Apply]**					
Course Content:						
Module 1	**Search Methods for Problem-Solving**	**Problem-Solving Tests**	**NPTEL Assignments**	**No. of Sessions: 13**		
Introduction – State Space Search; General Formulation of Search Problems; Data Structures used in Searching. Uninformed Search Algorithms – Breadth First Search, Depth						

First Search, Uniform Cost Search, Generalized Uniform Cost Search (a.k.a Dijkstra's Single-Source Shortest Path), Iterative Deepening Depth-First Search, Time and Space Complexity Analysis of Uninformed Search Algorithms. Heuristic Search Algorithms – Heuristics and Admissibility, Greedy Best-First Search, A* Search and weighted A* Search.				
Module 2	**Advanced Search Methods**	**Problem-Solving Tests**	**NPTEL Assignments**	**No. of Sessions: 12**
Local Search – Local Search, Hill Climbing, Genetic Algorithms, Gradient Descent. Adversarial Search – Minimax Search, Alpha-Beta Pruning, Ideal Ordering. Constraint Satisfaction – Constraint Satisfaction Problems Definitions and Examples – Map Colouring, N Queens, Cryptarithmetic, Generalized CSP; Back-tracking Heuristics; Arc Consistency and Path Consistency				
Module 3	**Knowledge-Based Logic Representation**	**Automated Theorem Proving using FOL Resolution**	**NPTEL Assignments**	**No. of Sessions: 10**
Propositional Logic – Syntax and Semantics of Propositional Logic. Logical connectives. Inference Rules. Conjunctive and Disjunctive Normal Forms. First Order Logic – Syntax and Semantics of Propositional Logic. Logical connectives. Inference Rules. Conjunctive and Disjunctive Normal Forms. Resolution – Resolution Principle. Propositional and First Order Resolution. Applications for solving story problems using Resolution				
Module 4	**Uncertainty in AI**	**Representing problems as HMM**	**NPTEL Assignments**	**No. of Sessions: 06**
Probability – Probability Definitions. Conditional Probability. Bayes Theorem. Naïve Bayes Classifier. Using Naïve Bayes Classifier for Supervised Learning. Hidden Markov Models – Definition of HMM. Sequence Labeling and Markov Assumption. Sub-Problems in HMM and their solutions – Forward Probability and Viterbi Algorithm. Applications of Sequence Labeling in Natural Language Processing (Eg. Part-of-Speech Tagging). Introduction to Deep Learning – Artificial Neurons, Activation Functions, Multilayer Perceptron.				
Targeted Application & Tools that can be used: **1. Implementation of a shortest-path finder using different search algorithms.** **2. Implementation of a sequence labeler using Viterbi Algorithm.**				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course **1. Group project on one of the topics mentioned above (Eg. Adversarial search).**				
Textbook(s): **1. Stuart Russel and Peter Norvig. *Artificial Intelligence: A Modern Approach*. 4th Edition. Pearson Education. 2022.** **2. Lavika Goel. *Artificial Intelligence: Concepts and Applications*. 1st Edition. Wiley. 2021.**				

3. **Elaine Rich, Kevin Knight and Shivashankar B Nair. *Artificial Intelligence*. 4th Edition. MedTech Science Press. 2024.**

References:

1. **Deepak Khemani. *A First Course in Artificial Intelligence*. 1st Edition. 6th Reprint, 2018.**
2. **Munesh Chandra Trivedi. *A Classical Approach to Artificial Intelligence*. 2nd Edition. Khanna Publishers. 2018.**
3. **George Luger. *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*. 6th Edition. Pearson Education. 2021.**

Weblinks

1. **NPTEL Courses: Mausam (IIT Delhi), "An Introduction to Artificial Intelligence" Link: https://nptel.ac.in/courses/106102220.**
2. **Shyamanta M. Hazarika (IIT Guwahati), "Fundamentals of Artificial Intelligence".[Text Wrapping Break]Link: https://nptel.ac.in/courses/112103280. Useful for the full course.**
3. **Deepak Khemani (IIT Madras), "Artificial Intelligence: Search Methods for Problem-Solving". [Text Wrapping Break]Link: https://nptel.ac.in/courses/106106226. Useful for Module 1 and 2**
4. **Deepak Khemani (IIT Madras), "Artificial Intelligence: Knowledge Representation and Reasoning". [Text Wrapping Break]Link: https://nptel.ac.in/courses/106106140. Useful for Module 3.**
5. **Deepak Khemani (IIT Madras), "AI: Constraint Satisfaction". Link: https://nptel.ac.in/courses/106106158. Useful for Module 2.**

Catalogue prepared by	**Dr. Sandeep Albert Mathias**
Recommended by the Board of Studies on	**BOS NO: SOCSE 2nd BOS held on 17/03/25**
Date of Approval by the Academic Council	**Academic Council Meeting No 21, Dated 17/03/25**

Course Code: CSE1701	**Course Title: Essentials of AI Lab** **Type of Course:** **Engineering Sciences Core - Lab**	**L-T-P-C**	**0**	**0**	**4**	**2**
Version No.	**1.0**					
Course Pre-requisites						

Anti-requisites	**NIL**
Course Description	**This course introduces the student to the basics of artificial intelligence. In this course, the student first learns the various search methods for problem-solving, followed by knowledge-based logic representations. After that, the student will learn about uncertainty in AI, as well as approaches to solve such challenges such as Naïve Bayes Classifier and Hidden Markov Models.** **Topics: Uninformed search, Heuristic search, Local search, Adversarial search, Constraint satisfaction, logic, First Order Resolution, Probability, Naïve Bayes Classifier, and Hidden Markov Model (HMM).**
Course Objectives	**The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.**
Course Out Comes	**On successful completion of this course the students shall be able to:** **1. Explain different methods of searching, proving, and analysis in AI [Understand]** **2. Implement various graphical and adversarial search algorithms. [Apply]** **3. Prove, by resolution, different situations using First Order Logic [Apply]** **4. Solve sequence labeling problems using HMM [Apply]**

Course Content:	**No. of Sessions: 30 (60 hours)**

NOTE: Each experiment will be run across TWO lab sessions. In the first lab session, the students will have to do a preliminary experiment (Eg. Implement an uninformed search algorithm like BFS). In the second lab session, they will have to test their solution using a given input which is read from a file.

Experiment No. 1: File Handling

Level 1: Read text files using Python

Level 2: Parse text files using Python

Experiment No. 2: Implementation of Graph Representations

Level 1: Implement graph representations by taking input from the console

Level 2: Implement graph representations by taking input from files.

Experiment No. 3 & 4: Implementation of Uninformed Search Algorithms

Level 1: Implement uninformed search algorithms – BFS and DFS – on unweighted graphs.

Level 2: Implement uninformed search algorithms – Uniform Cost Search and Dijkstra's SSSP – on weighted graphs

Experiment No. 5: Implementation of Heuristic Search Algorithms

Level 1: Calculate the upper-bounds of admissible heuristics using Dijkstra's SSSP.

Level 2: Implement Greedy Best-First Search and A* Search Algorithms.

Experiment No. 6 & 7: Implementation of Adversarial Search

Level 1: Implement a Game Tree

Level 2: Perform Alpha-Beta Pruning and Ideal Ordering

Experiment No. 8 & 9: Implementation of a CSP Solver

Level 1: Implement a CSP solver to solve a cryptarithmetic problem

Level 2: Implement a CSP solver for map colouring

Experiment No. 10: Using Python Packages for CSP

Level 1: Implement a CSP solver for Sudoku

Level 2: Implement a CSP solver for Addoku

Experiment No. 11: Implement a Family Tree Parser

Level 1: Perform logic programming using logpy.

Level 2: Implement a family tree parser

Experiment No. 12 & 13: Implement a Decision Maker

Level 1: Implement a Minesweeper solver

Level 2: Implement a Battleship solver

Experiment No. 14 & 15: Hidden Markov Model

Level 1: Implement a generic HMM

Level 2: Build a PoS Tagger using a HMM with the Brown Corpus and the Universal Dependencies Tagset.

Targeted Application & Tools that can be used:

1. **Google Colab**

2. **Python IDEs like PyCharm**
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course **The course is a lab-based course with all the assessments centrally evaluated. Every experiment consists of two sessions. The first session involves exploring a solution to the problem. The second session involves solving a particular problem.**
Textbook(s): 1. **Stuart Russel and Peter Norvig. *Artificial Intelligence: A Modern Approach*. 4th Edition. Pearson Education. 2022.** 2. **Prateek Joshi and Alberto Artasanchez. *Artificial Intelligence with Python*. 2nd Edition. Packt. 2020.**
References: 1. **Deepak Khemani. *A First Course in Artificial Intelligence*. 1st Edition. 6th Reprint, 2018.** 2. **Munesh Chandra Trivedi. *A Classical Approach to Artificial Intelligence*. 2nd Edition. Khanna Publishers. 2018.**

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

Course Code: **CSE1509**	**Course Title: Data Structures Lab** **Type of Course:Lab**	**L-T- P- C**	**0**	**0**	**4**	**2**
Version No.	**1.0**					
Course Pre-requisites						
Anti-requisites	**NIL**					
Course Description	**This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.**					

Course Objective	**The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques**			
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1: Describe the concept of basic data structure, stacks, queues, and arrays and their operations. [Understand]** **CO2: Utilize linked lists for real-time scenarios. [Apply]** **CO3: Apply an appropriate non-linear data structure for a given scenario. [Apply]** **CO4: Demonstrate different searching and sorting techniques. [Apply]**			
Course Content:				
Module 1	**Introduction to Data Structure and Linear Data Structure – Stacks and Queues**	**Assignment**	**Program activity**	**9 Hours**
Introduction – Introduction to Data Structures, Types and concept of Arrays. **Stack - Concepts and representation, Stack operations, stack implementation using array and Applications of Stack.** **Queues - Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.**				
Module 2	**Linear Data Structure- Linked List**	**Assignment**	**Program activity**	**12 Hours**
Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list. **Recursion - Recursive Definition and Processes.**				
Module 3	**Non-linear Data Structures - Trees**	**Assignment**	**Program activity**	**12 Hours**
Topics: Trees - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post - Order traversal, Binary Serach Tree, AVL Trees - Red Black Tree, Expression Tree , Heaps.				
Module 4	**Non-linear Data Structures - Graphs and Hashing**	**Assignment**	**Program activity**	**6 Hours**
Topics: Graphs: Basic Concept of Graph Theory and its Properties, Representation of Graphs . ADT, Elementary graph operations, Minimum Cost spanning trees, Shortest path and Transitive closure. **Hashing: Introduction, Static Hashing, Dynamic Hashing**				

Module 5	Searching & Sorting	Assignment	Program activity	6 Hours

Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort, Quick sort, Merge Sort, Bubble sort.

List of Laboratory Tasks:

Lab sheet -1

Level 1: Prompt the user, read input and print messages.Programs using class, methods and objects

Level 2: Programming Exercises on fundamental Data structure - Arrays based on Scenario.

Lab sheet -2

Level 1: Programming Exercises on Stack and its operations

Level 2: Programming Exercises on Stack and its operations with condition

Lab sheet -3

Level 1: Programming on Stack application infix to postfix Conversion

Level 2: -

Lab sheet -4

Level 1: Programming on Stack application – Evaluation of postfix

Lab sheet -5

Level 1: Programming Exercises on Queues and its operations with conditions

Level 2: -

Lab sheet -6

Level 1: Programming Exercises on Linked list and its operations.

Level 2: Programming Exercises on Linked list and its operations with various positions

Lab sheet -7

Level 1: Programming Exercises on Circular Linked list and its operations.

Level 2: Programming Exercises on Circular Linked list and its operations with various positions

Lab sheet -8

Level 1: Programming Exercises on factorial of a number

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9

Level 1: -

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -10

Level 1: Programming Exercise on Doubly linked list and its operations

Level 2: -

Lab sheet -11

Level 1: Program to Construct Binary Search Tree and Graph

Level 2: Program to traverse the Binary Search Tree in three ways(in-order, pre-order and post-order) and implement BFS and DFS

Lab sheet -12

Level 1: Program to Implement the Linear Search & Binary Search

Level 2: Program to Estimate the Time complexity of Linear Search

Lab sheet -13

Level 1: Program to Implement and Estimate the Time complexity of Selection Sort

Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort

Lab sheet -14 (Beyond syllabus activity)

Level 1: Program to Construct AVL Tree

Level 2:

Lab sheet -15 (Beyond syllabus activity)

Level 1: Program to Construct RED BLACK Tree

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Modern IDE like VS Code and Eclipse for lab programs to execute.

Project work/Assignment:

Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.

Text Book

T1 Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, reprint 2018.

T2 Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

References

R1 Data structures and program design in C by Robert Kruse, Tondo C L, Bruce Leung, Pearson education publishers, 2017. **R2 Programming and Data Structure by Jackulin C Salini etal., Ane books publishers, 2019.** **Web resources:** **1. For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview** **2. https://puniversity.informaticsglobal.com/login**
Topics relevant to development of "Skill Development": **Linked list and stacks** **Topics relevant to development of "Environment and sustainability: Queues**

Catalogue prepared by	**Muthuraj**
Recommended by the Board of Studies on	**09th BOS held on 04/05/19**
Date of Approval by the Academic Council	**Academic Council Meeting No. 11, Dated 11/06/19**

Course Code: **MAT2011**	**Course Title: Numerical Computation** **Type of Course:1] School Core**	**L-T- P- C**	**3**	**0**	**0**	**3**
Version No.		**1.0**				
Course Pre-requisites		**Calculus, Linear Algebra, Differential Equations**				
Anti-requisites		**NIL**				
Course Description		**The course explores mathematical techniques used to approximate solutions to complex problems that are difficult to solve analytically, often utilizing computers to perform calculations, including methods for root finding, interpolation, numerical differentiation and integration, solving systems of linear equations, and approximating solutions to differential equations, with applications across various scientific and engineering fields. It focuses on understanding the theoretical basis behind these methods, their implementation in programming languages, and analyzing their accuracy and stability.**				
Course Objective		**The objective of the course is to equip students with understanding and ability to apply various numerical techniques**				

		to approximate solutions to complex mathematical problems that are difficult or impossible to solve analytically, particularly focusing on areas like solving systems of equations, finding roots of functions, interpolation, numerical differentiation, and integration, often utilizing computational tools to implement these methods.
Course Out Comes		**On successful completion of the course the students shall be able to:** **CO1 - Calculate errors induced in the values by truncation of a series expansion.** **CO2 - Demonstrate the applications of numerical methods to find the roots of** **polynomial equations and eigen values of real symmetric matrices.** **CO3 - Apply the knowledge of numerical methods in modelling of various physical and engineering phenomena.** **CO4 - Apply various numerical methods for solving linear Ordinary & Partial differential equations arising in engineering field.**
Course Content:		

Module 1	**Solution of Linear Systems of Equation**		**(12 Classes)**
Numerical Computation: Motivation and Objectives, Number Representation, Machine Precision, Round-of Error, Truncation Error, Random Number Generation. **Solution of algebraic and transcendental equations: Various types of errors - Bisection method, Regula-Falsi method, Newton-Raphson method, Graffe's method - Bairstow's method - Newton's method for solving f(x,y) = 0 and g(x,y) = 0, secant method, Fixed point iteration method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel, Sufficient conditions for convergence - LU decomposition method, Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.**			
Module 2	**Interpolation and Approximation**	**Assignment**	**(8 Classes)**
Interpolation with equal intervals, Newton's forward and backward difference formulae, Interpolation with unequal intervals, Lagrange's interpolation, Newton's divided difference interpolation, Cubic Splines, Difference operators and relations.			
Module 3	**Numerical Differentiation and Integration**		**(10 Classes)**
Numerical differentiation, Approximation of derivatives using interpolation polynomials, Numerical integration using Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule, Romberg's Method, Two point and three point Gaussian quadrature formulae, Evaluation of double integrals by Trapezoidal rule and Simpson's one-third rule			

Module 4	**Initial & Boundary Value Problems for Ordinary & Partial Differential Equations**	**Assignment**	**(15 Classes)**

Single step methods — Taylor's series method, Modified Euler's method, Fourth order Runge-Kutta method for solving first order equations, Multi step methods, Milne's and Adams, Bash forth predictor corrector methods for solving first order equations.

Finite difference methods for solving second order, two-point linear boundary value problems, Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain, One-dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods, One-dimensional wave equation by explicit method.

Targeted Application & Tools that can be used:

The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design.

Tools Used: Python.

Assignment:

1. **Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.**

Text Book

1. **C.F.Gerald and P.O.Wheatley", Applied Numerical Analysis", McGraw-Hill, 1981.**
2. **Cheneg and Kincaid, "Introduction to Numerical Computing", Tata McGraw-Hill, 1998.**

References:

1. **SRK Iyengar & RK Jain, Numerical Methods, New Age Internationals.**
2. **Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition**
3. **B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.**

E-resources/ Web links:

1. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_135224**
2. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_141727**
3. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_217628**
4. **http://.ac.in/courses.php?disciplineID=111**
5. **http://www.class-central.com/subject/math(MOOCs)**
6. **http://academicearth.org/**

7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 8. https://www.scu.edu.au/study-at-scu/units/math1005/2022/
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving. This is attained through the assessment component mentioned in course handout.

Course Code: **MAT2013**	**Course Title: Discrete Mathematics** **Type of Course:1] School Core**	**L-T- P- C**	**4**	**0**	**0**	**4**
Version No.		**1.0**				
Course Pre-requisites		**Linear Algebra**				
Anti-requisites		**NIL**				
Course Description		**The course explores the study of mathematical structures that are fundamentally discrete (not continuous), focusing on concepts like set theory, logic, graph theory, combinatorics, and number theory, with applications primarily in computer science fields like algorithms, software development, and cryptography; it covers topics such as propositional logic, proof techniques, relations, functions, counting principles, and basic graph algorithms, providing a foundation for analyzing discrete problems and structures within computer science.**				
Course Objective		**The main objective of the course is that students should learn a particular set of mathematical facts and how to apply them. It teaches students how to think logically and mathematically through five important themes: mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking, and applications and modeling. A successful discrete mathematics course should carefully blend and balance all five themes.**				
Course Outcomes		**On successful completion of the course the students shall be able to:** **CO1 - Explain logical sentences through predicates, quantifiers and logical connectives.** **CO2 - Deploy the counting techniques to tackle combinatorial problems** **CO3 - Comprehend the basic principles of set theory and different types of relations.** **CO4 - Apply different types of structures of trees for developing programming skills**				

Course Content:			
Module 1	**Fundamentals of Logic**		**(10 Classes)**
Basic Connectives and Truth Tables, Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.			
Module 2	**Principle of Counting**	**Assignment**	**(15 Classes)**
The Well Ordering Principle – Mathematical Induction **The Basics of Counting, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Generating Permutations and Combinations** **Advanced Principle Counting: The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.**			
Module 3	**Relations and Functions**		**(10 Classes)**
Cartesian Products and Relations, Functions, One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions. **Relations, Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders, Lattice, Hasse Diagrams, Equivalence Relations and Partitions.**			
Module 4	**Recurrence Relations and Generating Functions**		**(10 Classes)**
Homogeneous and inhomogeneous recurrences and their solutions - solving recurrences using generating functions - Repertoire method - Perturbation method - Convolutions - simple manipulations and tricks.			
Module 5	**Graph Theory & Algorithms on Networks**	**Assignment**	**(15 Classes)**
Definitions and basic results - Representation of a graph by a matrix and adjacency list - Trees - Cycles - Properties - Paths and connectedness - Sub graphs - Graph Isomorphism - Operations on graphs - Vertex and edge cuts - Vertex and edge connectivity, Euler and Hamilton Paths, Shortest-Paths. **Tree - Definitions, Properties, and Examples, Routed Trees, Binary search tree, Decision tree, spanning tree: BFS, DFS.** **Algorithms on Networks - Shortest path algorithm- Dijikstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm.**			
Targeted Application & Tools that can be used: **Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.**			
Assignment:			
1. **Assignment 1: Logic Equivalences and Predicate calculus.** 2. **Assignment 2: Equivalence Relations and Lattices**			

3. **Assignment 3: Recurrence Relations**
Text Book 1. **Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill,s 8th Edition,2019.** 2. **Harary – Graph Theory, Addison-Wesley Publishing Company.**
References: 1. **Arthur Gill, "Applied Algebra for Computer Science", Prentice Hall.** 2. **K.D. Joshi, "Discrete Mathematics", Wiley Eastern Ltd.** 3. **Ralph. P. Grimaldi., "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia.** **E-resources/ Web links:** 1. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_54588** 2. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_375** 3. **https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html** 4. **https://www.scu.edu.au/study-at-scu/units/math1005/2022/** 5.
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving. This is attained through the assessment component mentioned in course handout.

Course Code: **CSE1512**	**Course Title: Analysis of Algorithms** **Type of Course: Theory**	**L- T-P-C**	**3**	**1**	**0**	**4**
Version No.	**1.0**					
Course Pre-requisites						
Anti-requisites	**Nil**					
Course Description	**This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. This course discusses the classic approaches for algorithm design such as Divide and Conquer, Dynamic Programming, Greedy method. This course also describes other basic strategies searching solution space. The core concepts of analyzing**					

	algorithms and classifying them into various complexity classes is covered in the end.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Analysis of Algorithms 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 efficiency of a given algorithm.[Apply]** **2. Apply divide and conquer technique for searching and sorting Problems.[Apply]** **3. Apply the Dynamic Programming technique for a given problem. [Apply]** **4. Apply greedy technique for solving a Problem.[Apply]** **5. Demonstrate Back tracking technique and limitations of Algorithms.[Apply]**			
Course Content:				
Module 1	**Introduction**	**Assignment**	**Simulation/Data Analysis**	**10 Sessions**
Introduction, Asymptotic Notations and its properties, Best case, worst case and average case- Sequential search, Sorting; Mathematical analysis for Recursive and Non-recursive algorithms: Substitution method and Master's Theorem.				
Module 2	**Divide-and-conquer**	**Assignment**	**Simulation/Data Analysis**	**08 Sessions**
Introduction. Insertion Sort; Merge sort, Quick sort, Binary search.				
Module 3	**Dynamic programming**	**Term paper/Assignment**	**Simulation/Data Analysis**	**10 Sessions**
Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Chain Matrix Multiplication.				
Module 4	**Greedy technique**	**Term paper/Assignment**	**Simulation/Data Analysis**	**09 Sessions**
Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm				
Module 5	**Complexity Classes**	**Term paper/Assignment**	**Simulation/Data Analysis**	**08 Sessions**
Complexity Classes- P,NP- NP Hard and NP Complete - Boolean Satisfiability Problem (SAT). **Branch and Bound: Knapsack problem; Backtracking, - N-Queens problem.**				
Text Book				

1. **Anany Levitin, "*Introduction to the Design and Analysis of Algorithms*", 3rd edition, Pearson Education, 2018.** 2. **Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "*Introduction to Algorithms*", 4th edition, MIT Press, 2022.**
References 1. **J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005.** 2. **Tim Roughgarden, "*Algorithms Illuminated"* (books 1 through 3), "Operating Systems Design and Implementation", Soundlikeyourself Publishing, 2017-2019.** 3. **AV Aho, J Hopcroft, JD Ullman, "*The Design and Analysis of Algorithms"*, Addison-Wesley, 1974.** 4. **Donald E. Knuth, "*The Art of Computer Programming",* Volumes 1and 3 Pearson.** **Web-Resources** 1. **NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs47/preview** 2. **Coursera: Analysis of Algorithms by Princeton University** 3. **Algorithms Specialization in Coursera by Stanford University(Group of 4 courses).** 4. **Algorithms Coding Contest Links maintained by Prof Gerth Stølting Brodal of Aarhus University**
Topics relevant to "SKILL DEVELOPMENT": knapsack, prim's, kruskal's algorithm, quick sort, binary search for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CSE3190	Course Title: Fundamentals of Data Analytics Type of Course: Theory only	L- P- C	3	0	3
Version No.	2.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	Fundamentals of Data Analytics is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, and supports in decision-making. The course begins by covering Data extraction, pre-processing, and transformation. It delivers the basic statistics and taught in an				

	intuitive way to analysis the data. This course will help the students to apply the knowledge on data analysis to a wide range of applications.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Data Analytics and attain SKILL DEVELOPMENT through PROBLEM SOLVING Methodologies.			
Course Out Comes	On successful completion of the course the students shall be able to: 1) Explain different types of data and variables. 2) Interpret data using appropriate statistical methods. 3) Demonstrate the collection, processing and analysis of data for any given application and Illustrate various charts using visualization methods. 4) Apply the Data Analysis techniques by MAT Lab			
Course Content:				
Module 1	Introduction to Data Analysis	Assignment	Data Collection , data analysis	6 Sessions
Topics: Introducing Data, overview of data analysis: Data in the Real World, Data vs. Information, The Many “Vs” of Data, Structured Data and Unstructured Data, Types of Data, Data Analysis Defined, Types of Variables, Central Tendency of Data, Scales of Data, Sources of Data, Data preparation: Cleaning the data, Removing variables, Data Transformations.				
Module 2	Statistical functions	Assignment	Data analysis	8 Sessions
Topics: Descriptive Statistics, Inferential Statistics (T test, Z test,), Probability Uses In Business and Calculating Probability from a Contingency Tables.				
Module 3	Data Collection, Processing and Analysis	Project based MAT Lab	MAT LAB	6 Sessions
Topics: Collection of Primary Data(Observation Method, Interview Method, Collection of Data through Questionnaires ,Collection of Data through Schedule) Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data ,Difference between Survey and Experiment Processing Operations, correlation. Introduction: Overview, Classification, Regression, Building a prediction model				
Module 4	Data Visualization	Project MAT Lab	Data Collection, visualization and data analysis	6 Sessions

	and Charting Prediction			
Topics: Types of charts and their significance, Organize data interactively with tables , Visualizing data with charts, Analyzing data with pivot tables, Build presentation ready dashboards and turn real world data into business insights, Tracking trends and making forecasts, Interpretation and report writing				
Module 5	Introduction to MATLAB	Project MAT Lab	Data analysis with optimization	12 Sessions
Topics: Defining Categories of Data, Analyzing Groups within Data, Importing Data from Multiple Files, Review Project ,Images and 3-D Surface Plots, Importing Unstructured Data				
Targeted Application & Tools that can be used: Application Area are Decision making in business, health care, financial sector, Medical diagnosis etc... MAT Lab				
Text Books Glenn J. Myatt and Wayne P. Johnson, “Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback”, Import, 22 July 2014. William Menke And Joshua Menke,”Environmental Data Analysis with MAT Lab”, Elsevier, 2012. https://matlabacademy.mathworks.com/details/matlab-for-data-processing-and-visualization/mlvi				
References Paul McFedries , “Excel Data Analysis-visual blue print”,Wiley 4th Edition September 2019. Gerald Knight, “Analyzing Business Data with Excel”,O′Reilly; 1st Edition,13 January 2006. https://people.highline.edu/mgirvin/AllClasses/348/348/AllFilesBI348Analytics.htm Hansa Lysander,”Data Analysis and business modelling using Microsoft Excel”, PHI, 2017. Web Links: https://presiuniv.knimbus.com/user#/home				
Topics relevant to development of “FOUNDATION SKILLS”: Statistical Concepts for data, visualization techniques. Data collection for project based assignments. Inferential Statistics (T test, Z test) Probability Calculation for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				

Course Code: CSE3351	**Course Title: Operating Systems** **Type of Course: Program Core and Theory Only**	**L-T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE2009- Computer Organization, Problem solving using C Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended.					
Anti-requisites	**NIL**					
Course Description	This course introduces the concepts of operating system operations, operating system structure and its design and implementation. It covers the classical operating systems internal algorithms such as process scheduling, synchronization, deadlocks detection and recovery and memory management. The course also enhances the problem solving, systems programming ability and case studies.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the fundamental concepts of operating Systems and case studies. [**Knowledge**] 2] Demonstrate various CPU scheduling algorithms. .[**Application**] 3] Apply various tools to handle synchronization problems.[**Application**] 4] Demonstrate deadlock detection and recovery methods **[Application]** 5] Illustrate various memory management techniques.[**Application**]					
Course Content:						
Module 1	Introduction to Operating System	Assignment	Programming		**9 Hours**	
Topics: Introduction to OS , Operating-System Operations, Operating System Services, , System Calls and its types, Operating System Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source operating system						

Module 2	Process Management	Assignment/Case Study	Programming/Simulation	**11 Hours**
Topics: Process Concept, Operations on Processes, Inter Process Communication, Communication in client-server systems (sockets, RPC, Pipes), Introduction to threads - Multithreading Models, Thread Libraries, Threading Issues, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR and Priority.				
Module 3	Process Synchronization and Deadlocks	Assignment	Programming	**11 Hours**
Topics: The Critical-Section Problem- Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization with Semaphore Solution- Producer-Consumer Problem, Reader-Writer problems, Dining Philosopher's Problem, . Introduction to Deadlocks, Necessary conditions for deadlock, Resource allocation Graph, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation, Deadlock detection & Recovery from Deadlock.				
Module 4	Memory Management	Assignment	Programming/Simulation	**10 Hours**
Topics: Introduction to Memory Management, Basic hardware-Base and Limit Registers, Memory Management Unit(MMU), Dynamic loading and linking, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Virtual Memory and Demand Paging – Page Faults and Page Replacement Algorithms, Copy-on-write, Allocation of Frames, Thrashing Introduction to File system management: File System Interface (access methods, directory structures), File system implementation.				
Targeted Application: **Application area is traffic management system, banking system, health care and many more systems where in there are resources and entities that use and manage the resources.** **Software Tools:** Oracle Virtual Box/VMWare Virtualization software [Virtual Machine Managers]. Used to install and work on multiple guest Operating Systems on top of a host OS. Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.				
Project work/Assignment				

Demonstrate process concepts in LINUX OS. **Simulation of CPU scheduling algorithms.** **Develop program to demonstrate use of Semaphores in threads.** **Develop program to demonstrate use of deadlock avoidance algorithms.** **Develop program to demonstrate use of page replacement algorithms.** **Simulation of memory allocation strategies [first fit, best fit and worst fit].**
Text Book Silberschatz A, Galvin P B and Gagne G , “Silberschatz's Operating System Concepts”, Paperback, Global Edition Wiley, 2019
References Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts”, 10th edition Wiley, 2018. William Stallings, “Operating Systems”,Ninth Edition, By Pearson Paperback ,1 March 2018. Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, “ Cracking the Operating System skills”, Dreamtech, paperback, 2020 Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , “Operating Systems: Three Easy Pieces, Amazon digital Services”, September 2018. **E-resources/Weblinks** https://www.os-book.com/OS9/ https://pages.cs.wisc.edu/~remzi/OSTEP/ https://codex.cs.yale.edu/avi/os-book/OS10/index.html

Course Code: **CSD1500**	**Course Title: R Programming For Data Science** **Type of Course: Integrated**	**L- T - P- C**	**2**	**0**	**0**	**2**
Version No.	**1**					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	**This course is designed to provide the core concepts of data analytics in the R environment. Initially train them with basic R, then progressively increase the difficulty as they move along in the course, capping with advanced techniques through case studies. Mastering the core concepts and techniques of data analytics in R, will help the students to apply their knowledge to a wide range of Data Analytics. R is now considered one of the most popular analytics tools in the world.**					

<table>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of R Programming For Data Science and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of this course the students shall be able to:
CO1: Summarize the R functions effectively to perform fundamental data analysis. [Understand]
CO2: Apply suitable statistical methods to interpret diverse types of data [Apply]
CO3:Illustrate Regression analysis on provided datasets [Apply]
CO4: Demonstrate analytical and evaluative skills in machine learning classification [Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction TO R</td><td>Assignment</td><td>Data Collection/Interpretation</td><td>15 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction to R, Overview of data analysis, Working with directory in R, Loading and handling data in R, Data Visualization with ggplot2, Data Transformation with dplyr.</td></tr>
<tr><td>Module 2</td><td>Exploratory Data Analysis</td><td>Coding Assignment</td><td>Case Study</td><td>20 Sessions</td></tr>
<tr><td colspan="5">Topics:
Exploring a new dataset, Anomalies in numerical data, Visualizing relations between variables, Assumptions of Linear Regression, Validating Linear Assumption, Missing Values, Covariation, Patterns and Models, ggPlot2 Calls.</td></tr>
<tr><td>Module 3</td><td>Regression Analysis</td><td>Coding Assignment</td><td>Project</td><td>20 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction, Types of Regression Analysis Models, Linear Regression, Simple Linear Regression, Non-Linear Regression, Regression Analysis with Multiple Variables, Cross Validation, Principal Component Analysis, Factor Analysis.</td></tr>
<tr><td>Module 4</td><td>Classification</td><td>Quiz</td><td>Project</td><td>20 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Neatest Neighbors, Naïve Bayes Classifier, Decision Tree Classification, Random Forest Classification, Evaluation.</td></tr>
<tr><td colspan="5">List of Laboratory Tasks:</td></tr>
</table>

1. Introduction to R and RStudio

a. Setting up R and RStudio

b. Basic R syntax and data types

c. Arithmetic operations in R

d. Working with variables and assignments.

e. Printing and displaying data

2. Working with directory in R, Loading and handling data in R

Data Structures in R

a. Vectors: creating, indexing, and operations

b. Matrices and arrays

c. Lists and data frames

d. Factors and character vectors

e. Basic data manipulation and exploration

3. Data Visualization with ggplot2

a. Installing and loading ggplot2

b. Creating scatter plots, bar plots, line plots, and histograms

c. Customizing plot aesthetics and themes

d. Faceting and combining plots

4. Data Transformation with dplyr.

a. Introduction to dplyr package

b. Selecting, filtering, and arranging data

c. Grouping and summarizing data

d. Joining and merging data sets

5. Introduction to Machine Learning with R

a. Installing and loading necessary packages

b. Splitting data into training and testing sets

c. Building a simple machine learning model

d. Model evaluation and prediction

6. Correlation and covariance

a. Find the correlation matrix.

b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data

7. Regression model - Create a regression model for a given dataset

8. Implement the multiple regression model for the given dataset.

9. Principal Component Analysis - Perform Principal Component Analysis (PCA) using R

10. Implement k-Nearest Neighbors (kNN) classification using R

11. Evaluate the performance of Naive Bayes classifier using R.

12. Evaluate the performance of the Decision Tree classifier using R.

13. Evaluate the performance of Random Forest Classifier using R.

14. Mini Project - Applying R programming skills to a real-world dataset

a. **Data cleaning, visualization, analysis, and interpretation**

b. **Presentation of findings**

Targeted Application & Tools that can be used

Tools: RStudio / Google Colab

Project work/Assignment:

Assignment:

During the course, students would need to do coding assignments to learn to train and use different models. Sample coding assignments include:

Analysis of Sales Report of a Clothes Manufacturing Outlet.

Comcast Telecom Consumer Complaints.

Web Data Anslysis

Text Book

1. **Hadley Wickham and Garrett Grolemund, R for Data Science Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, 2017.**
2. **Thomas Mailund, Beginning Data Science in R, Data Analysis, Visualization, and Modelling for the Data Scientist, APress, 2022.**
3. **Gareth James Daniela Witten Trevor Hastie Robert Tibshirani, An Introduction to Statistical Learning Gareth James Daniela Witten Trevor Hastie Robert Tibshirani with Applications in R, Springer, 2017.**

References

1. **Nina Zumel and John Mount Foreword By Jeremy Howard and Rachel Thomas, Practical Data Science with R, MANNING SHELTER ISLAND, 2020.**
2. **Dr. Bharati Motwani, "Data Analytics using R", Wiley, 2019.**

Web resources:

1. **https://machinelearningmind.com/2019/10/27/assumptions-of-linear-regression-how-to-validate-and-fix/** 2. **https://www.geeksforgeeks.org/machine-learning-model-evaluation/** 3. **https://www.geeksforgeeks.org/r-programming-for-data-science/** 4. **https://r4ds.had.co.nz/** 5. **https://nptel.ac.in/courses/106102064**
Topics relevant to "SKILL DEVELOPMENT": Regression model, classifier for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: **CSD1501**	**Course Title: R Programming For Data Science** **Type of Course: Theory Only**	**L- T - P- C**	**0**	**0**	**4**	**2**
Version No.	**1**					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	**This course is designed to provide the core concepts of data analytics in the R environment. Initially train them with basic R, then progressively increase the difficulty as they move along in the course, capping with advanced techniques through case studies. Mastering the core concepts and techniques of data analytics in R, will help the students to apply their knowledge to a wide range of Data Analytics. R is now considered one of the most popular analytics tools in the world.**					
Course Objective	**This lab-based course equips students with practical skills in R programming for statistical computing and data analysis.** **Students will work hands-on with real-world datasets to perform data preprocessing, visualization, and modeling.** **The course covers key machine learning algorithms including regression, classification, and dimensionality reduction using R.** **By the end of the course, students will develop, implement, and evaluate end-to-end analytics workflows using R and RStudio.**					
Course Out Comes	**After successful completion of the lab course, students will be able to:**					

	CO1: Develop foundational R scripts to manage data types, structures, and apply basic transformations. **CO2: Visualize and explore data using ggplot2 and dplyr, drawing meaningful insights.** **CO3: Implement and evaluate regression, classification, and dimensionality reduction models using R.** **CO4: Execute mini-projects demonstrating analytical thinking and data-driven problem-solving using real-world datasets.**
Course Content:	

List of Laboratory Tasks:

1. Introduction to R and RStudio

a. Setting up R and RStudio

b. Basic R syntax and data types

c. Arithmetic operations in R

d. Working with variables and assignments.

e. Printing and displaying data

2. Working with directory in R, Loading and handling data in R

Data Structures in R

a. Vectors: creating, indexing, and operations

b. Matrices and arrays

c. Lists and data frames

d. Factors and character vectors

e. Basic data manipulation and exploration

3. Data Visualization with ggplot2

a. Installing and loading ggplot2

b. Creating scatter plots, bar plots, line plots, and histograms

c. Customizing plot aesthetics and themes

d. Faceting and combining plots

4. Data Transformation with dplyr.

a. Introduction to dplyr package

b. Selecting, filtering, and arranging data

c. Grouping and summarizing data

d. Joining and merging data sets

5. Introduction to Machine Learning with R

a. Installing and loading necessary packages

b. Splitting data into training and testing sets

c. Building a simple machine learning model

d. Model evaluation and prediction

6. Correlation and covariance

a. Find the correlation matrix.

b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data

7. Regression model - Create a regression model for a given dataset

8. Implement the multiple regression model for the given dataset.

9. Principal Component Analysis - Perform Principal Component Analysis (PCA) using R

10. Implement k-Nearest Neighbors (kNN) classification using R

11. Evaluate the performance of Naive Bayes classifier using R.

12. Evaluate the performance of the Decision Tree classifier using R.

13. Evaluate the performance of Random Forest Classifier using R.

14. Mini Project - Applying R programming skills to a real-world dataset

a. **Data cleaning, visualization, analysis, and interpretation**

b. **Presentation of findings**

Targeted Application & Tools that can be used

Tools: RStudio / Google Colab

Project work/Assignment:

Assignment:

During the course, students would need to do coding assignments to learn to train and use different models. Sample coding assignments include:

Analysis of Sales Report of a Clothes Manufacturing Outlet.

Comcast Telecom Consumer Complaints.

Web Data Anslysis

Text Book :

1) ***Hands-On Programming with R: Write Your Own Functions and Simulations,*** **Author: Garrett Grolemund, Publisher: O'Reilly Media,Year: 2023**
2) ***R for Data Science: Import, Tidy, Transform, Visualize, and Model Data,*** **Authors: Hadley Wickham, Mine Çetinkaya-Rundel, Garrett Grolemund,Publisher: O'Reilly Media,Edition: 2nd Edition, 2023.**

Course Code: **CSE 1513**	**Course Title:** **Analysis of Algorithms Laboratory** **Type of Course: Integrated**	**L- T-P-C**	**0**	**0**	**2**	**1**
Version No.	**1**					
Course Pre-requisites	**CSE2001 - Data Structures and Algorithms.**					
Anti-requisites	**NIL**					
Course Description	**This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. This course discusses the classic approaches for algorithm design such as Divide and Conquer, Dynamic Programming, Greedy method. This course also describes other basic strategies searching solution space. The core concepts of analyzing algorithms and classifying them into various complexity classes is covered in the end.**					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Analysis of Algorithms and attain Skill Development through Experiential Learning Methodologies.**					
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Compute efficiency of a given algorithm. [Applying]** **2. Apply divide and conquer technique for searching and sorting Problems.[Applying]** **3. Apply the Dynamic Programming technique for a given problem. [Applying]** **4. Apply greedy technique for solving a Problem.[Applying]** **5. Demonstrate Back tracking technique and limitations of Algorithms.[Applying]**					
Course Content						
Module 1	**Introduction**					**3 Sessions**
Measuring running time of an algorithm, Compare running time of algorithms, Implement sorting algorithms such as bubble sort, selection sort						
Module 2	**Divide-and-conquer**					**3 Sessions**
Compare searching algorithms: Linear Search, Binary Search; Compare Sorting algorithms: Insertion Sort, Merge Sort, QuickSort.						
Module 3	**Dynamic programming**					**3 Sessions**

Introduction and memorization: Factorial; Coin Change Problem ; Floyd-Warshall's Algorithm.		
Module 4	**Greedy technique**	**3 Sessions**
Fractional Knapsack Problem; Minimal Spanning Tree Algorithms-Prim's Algorithm, Kruskal's algorithm		
Module 5	**Complexity Classes**	**3 Sessions**
Branch and Bound: Knapsack problem; Backtracking, - N-Queens problem.		
	List of Laboratory Tasks: **1. Measuring running time of an algorithm** **Objective: To experimentally determine the running time of basic algorithms for input size n=10, 100, 1000, etc. by taking difference of starting time and ending time.** **2. Compare running time of algorithms** **Objective: To execute two algorithms to solve the same problem, and to comparatively evaluate the better algorithm for large values of N.** **3. Implement sorting algorithms such as bubble sort, selection sort** **Objective: To implement comparison based sorting strategies.** **4. Compare searching algorithms** **Objective: To implement two searching strategies and compare their performance.** **5. Compare Sorting algorithms** **Objective: To implement searching strategies that follow top down design approach(Insertion sort, merge sort).** **6. Quick Sort** **Objective: To demonstrate Quick sort and its variants, and their impact on running time.** **7. Dynamic Programming** **Objective: To demonstrate Dynamic Programming approach with the help of Factorial algorithm.** **8. Coin Change Problem** **Objective: To implement an efficient algorithm for the Coin Change problem.** **9. Floyd-Warshall's Algorithm** **Objective: To demonstrate how dynamic programming is used with the help of Floyd-Warshall's algorithm.**	

	10. Fractional Knapsack Problem **Objective: To demonstrate how greedy method can be used to solve the Fractional Knapsack Problem.** **11. Minimal Spanning Tree Algorithm** **Objective: To implement greedy strategy to solve the Minimal Spanning Tree problem using Prim's Algorithm.** **12. Kruskal's Minimal Spanning Tree Algorithm** **Objective: To implement greedy strategies to solve the Minimal Spanning Tree problem using Kruskal's Algorithm.** **13. Knapsack Problem** **Objective: To implement Knapsack problem using branch and bound technique.** **14. N-Queen's Problem** **Objective: To demonstrate backtracking method with the help of N-Queen's problem.** **15. Case Study** **Objective: To demonstrate how various techniques can be used to solve the same problem with the help of Knapsack problem.**
	Targeted Application & Tools that can be used 1. **PyTorch/Jupyter Notebook – For Python programming**
	Text Book **T1 Anany Levitin, "*Introduction to the Design and Analysis of Algorithms*", 3rd edition, Pearson Education, 2018.** **T2 Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "*Introduction to Algorithms*", 4th edition, MIT Press, 2022.**
	References **R1. J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005.** **R2. Tim Roughgarden, "*Algorithms Illuminated"* (books 1 through 3), "Operating Systems Design and Implementation", Soundlikeyourself Publishing, 2017-2019.** **R3. AV Aho, J Hopcroft, JD Ullman, "*The Design and Analysis of Algorithms"*, Addison-Wesley, 1974.** **R4. Donald E. Knuth, "*The Art of Computer Programming",* Volumes 1and 3 Pearson.**

	Web Based Resources and E-books: **W1. NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs47/preview** **W2. Coursera: Analysis of Algorithms by Princeton University** **W3. Algorithms Specialization in Coursera by Stanford University(Group of 4 courses).** **W4. Algorithms Coding Contest Links maintained by Prof Gerth Stølting Brodal of Aarhus University**
	Topics relevant to "EMPLOYABILITY SKILLS": The lab experiments and assessments enable the student to acquire Skill Development through Experiential Learning techniques
Catalogue prepared by	**Dr. Murali Parameswaran**
Recommended by the Board of Studies on	**BOS NO: XXth BOS, held on N/NN/202N**
Date of Approval by the Academic Council	**Academic Council Meeting No. XX^{th,} Dated N/NN/202N**

Course Code: **CSD1712**	**Course Title: Statistical Foundations for Data Science** **Type of Course: Theory**	**L-T-P-C**	**3**	**0 0**	**3**
Version No.	**1.0**				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	**This course provides an in-depth introduction to statistics and machine learning theory, methods, and algorithms for data science. Topics include multiple regression, kernel learning, sparse regression, generalized linear models, supervised and unsupervised learning, deep learning, covariance learning, factor models, principal component analysis, and more. The**				

	course emphasizes the applicability and limitations of these methods using mathematical statistics and real-world data sets.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Statistical Foundations for Data Science and attain Employability through Participative Learning techniques.**			
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Understand the rise and significance of Big Data in various fields such as Biological Sciences, Health Sciences, Computer and Information Sciences, Economics and Finance, Business and Program Evaluation, Earth Sciences, and Astronomy.** **2. Develop a strong foundation in multiple linear regression and the Gauss-Markov theorem.** **3. Apply linear regression with random design and partial linear regression.** **4. Apply the power method and learn about factor models and structured covariance learning.**			
Course Content:				
Module 1	**Introduction**	**Assignment**	**Programming**	**No. of Classes:10**
Topics: **Introduction to bigdata, Rise of Big Data and Dimensionality in -Biological Sciences ,Health Sciences , Computer and Information Sciences , Economics and Finance, Business and Program Evaluation, Earth Sciences and Astronomy - Impact of Big Data - Impact of Dimensionality , Computation of Noise Accumulation , Spurious Correlation , Statistical theory - Aim of High-dimensional Statistical Learning.**				
Module 2	**Multiple Linear Regression**	**Assignment**	**Programming**	**No. of Classes:12**
Topics: **Multiple Linear Regression, The Gauss-Markov Theorem , Statistical Tests - Weighted Least-Squares , Box-Cox Transformation , Model Building and Basis Expansions, Polynomial Regression - Spline Regression , Multiple Covariates , Ridge Regression - Bias-Variance Tradeoff - Penalized Least Squares - Bayesian Interpretation - Ridge Regression Solution Path - Kernel Ridge Regression , Exponential family 231 5.1.2 Elements of generalized linear models , Maximum likelihood , Computing MLE: Iteratively reweighed least squares , Deviance and Analysis of Deviance, Regularization parameters, Refitted Cross-validation, Extensions to Nonparametric Modeling.**				
Module 3	**Inference in linear regression**	**Assignment**	**Programming**	**No. of Classes:14**

Topics:

Inference in linear regression - Debias of regularized regression estimators , Choices of weights , Inference for the noise level , Inference in generalized linear models , Desparsified Lasso , Decorrelated score estimator - Test of linear hypotheses , Numerical comparison - Asymptotic efficiency 345 7.3.1 Statistical efficiency and Fisher information, Linear regression with random design , Partial linear regression , Gaussian graphical models - Inference via penalized least squares , Sample size in regression and graphical models , General solutions , Local semi-LD decomposition , Data swap , Gradient approximation

Module 4	Principal Component Analysis	Assignment	Programming	No. of Classes:9

Topics:

Principal Component Analysis -Introduction to PCA , Power Method , Factor Models and Structured Covariance Learning , Factor model and high-dimensional PCA-Cluster Analysis - K-means clustering , Hierarchical clustering , Model-based clustering , Spectral clustering , Data-driven choices of the number of clusters , Variable Selection in Clustering , Sparse K-means clustering , Sparse model-based clustering , Sparse Mixture of Experts Model, Correlation Screening, Generalized and Rank Correlation Screening, Nonparametric Screening, Sure Screening and False Selection.

Targeted Application & Tools that can be used:

Tools: Torch, Google Colaboratory, Spider, Jupiter Notebook

Project work/Assignment:

Text Book

TextBook(s):

T1 Fan, J., Li, R., Zhang, C.-H., and Zou, H. (2020). Statistical Foundations of Data Science. CRC Press.

T2 Wainwright, M. J. (2019). *High-dimensional statistics: A non-asymptotic viewpoint.* Cambridge University Press.

References

R1. James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). *An Introduction to Statistical Learning with Applications in R* . Springer, New York.

R2. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). *The elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed). Springer, New York.

R3. Buehlmann, P. and van de Geer, S. (2011). *Statistics for High-Dimensional Data: Methods, Theory and Applications*. Springer, New York.

Book link **R1: Fan, J., Li, R., Zhang, C.-H., and Zou , Statistical Foundations of Data Science. CRC Press.** **E book link** **R2: W. N. Venables, D. M. Smith and the R Core Team, https://cran.r-roject.org/doc/manuals /R-intro.pdf, October,2022** **Web resources:** **W1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP** **https://presiuniv.knimbus.com/user#/**
Topics relevant to "EMPLOYABILITY SKILLS": - Asymptotic efficiency 345 7.3.1 Statistical efficiency and Fisher information, Linear regression with random design , Partial linear regression for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout..

Course Code: **CSD1705**	**Course Title: CSD1705 Cloud Computing for Data Science** **Type of Course: Program Core**	**L- P-C**	**2**	**0**	**2**
Version No.	**1**				
Course Pre-requisites					
Anti-requisites	**NIL**				
Course Description	**Cloud Computing for Data Science introduces learners to the integration of cloud platforms with data science workflows. The course covers cloud storage, data pipelines, machine learning deployment, and real-time analytics using AWS, Azure, and GCP. Students will gain hands-on experience with industry tools and scalable cloud services.**				
Course Objective	**The objective of the course is skill development of student by using Learning techniques**				
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1: Understand the core concepts of cloud computing.**				

	CO2: Learn to use cloud platforms for storing, processing, and analyzing data. **CO3:Implement data science workflows on cloud environments.** **CO4: Master scalable machine learning and big data tools on the cloud.**			
Course Content:				
Module 1	**Fundamentals of Cloud Computing**			**7 Sessions**
Overview of Cloud Computing, Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community,• Virtualization and Containers (Docker, Kubernetes basics); **Introduction to AWS, Azure, and Google Cloud Platform , Security and Compliance in the Cloud**				
Module 2	**Cloud Storage & Data Engineering**			**8 Sessions**
Cloud Storage Services (S3, Google Cloud Storage, Azure Blob);Data Lake vs. Data Warehouse; ETL Pipelines in the Cloud (AWS Glue, Dataflow, Azure Data Factory); Data Migration & Ingestion Tools;Distributed Computing with Hadoop and Spark on Cloud;Cost Optimization Techniques				
Module 3	**Machine Learning and Analytics on the Cloud**			**8 Sessions**
Cloud ML Tools (AWS SageMaker, Azure ML, Google Vertex AI); End-to-End ML Pipelines on the Cloud; Model Deployment and Monitoring; AutoML and MLOps; Integrating Notebooks (Jupyter, Colab) with Cloud Environments; Real-Time Analytics with BigQuery, Redshift				
Module 4	**Time Series Analysis**	**Discussion & Presentation**		**7 Sessions**

Introduction to Serverless Computing (AWS Lambda, Azure Functions) ; Cloud-Native Data Science Tools , Generative AI and LLMs in Cloud , Edge Computing and IoT Integration
Text Book **1."Cloud Computing: Concepts and Technology" by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini – 2nd Edition (2023)** **A foundational text covering updated cloud architectures, platforms, and security.**
Reference Book
1. "Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines" by Valliappa Lakshmanan (2023) ***Hands-on guide to building scalable data science projects on Google Cloud.*** **2. "Machine Learning Engineering with Python: Deploy and Scale ML Models on AWS, Azure, and GCP" by Andrew P. McMahon (2024)** ***Recent guide on using cloud platforms for production-level ML systems.***

Course Code: **CSD1706**	**Course Title: CSD1706 Cloud Computing for Data Science Lab** **Type of Course: Program Core**	**L- P-C**	**2**	**0**	**2**
Version No.	**1**				
Course Pre-requisites					
Anti-requisites	**NIL**				
Course Description	**Cloud Computing for Data Science Lab introduces learners to the integration of cloud platforms with data science workflows. The course covers cloud storage, data pipelines, machine learning deployment, and real-time analytics using AWS, Azure, and GCP. Students will gain hands-on experience with industry tools and scalable cloud services.**				
Course Objective	**The objective of the course is skill development of student by using Learning techniques**				
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1: Understand the core concepts of cloud computing.** **CO2: Learn to use cloud platforms for storing, processing, and analyzing data.** **CO3:Implement data science workflows on cloud environments.**				

	CO4: Master scalable machine learning and big data tools on the cloud.
Course Content:	

Module 1: Fundamentals of Cloud Computing

1. **Lab 1: Setting Up a Cloud Environment**
   - **Objective: Create and configure accounts on AWS, Azure, and GCP.**
   - **Tools: AWS Console, Azure Portal, Google Cloud Console**
2. **Lab 2: Launching and Managing Virtual Machines**
   - **Objective: Deploy and configure EC2 (AWS), Compute Engine (GCP), and Azure VMs.**
   - **Task: Install Jupyter and run a Python script for basic computation.**
3. **Lab 3: Using Docker and Kubernetes on the Cloud**
   - **Objective: Containerize a Python ML script and deploy it using Kubernetes on GCP.**
   - **Tools: Docker, Google Kubernetes Engine (GKE)**

Module 2: Cloud Storage & Data Engineering

4. **Lab 4: Working with Amazon S3 Buckets**
   - **Objective: Upload, retrieve, and manage structured/unstructured data using Boto3 SDK.**
   - **Language: Python**
5. **Lab 5: Building ETL Pipelines with AWS Glue**
   - **Objective: Clean and transform raw data using AWS Glue and store it in S3.**
6. **Lab 6: Google Cloud Dataflow for Batch Processing**
   - **Objective: Create and run a batch ETL pipeline for CSV data using Apache Beam.**
7. **Lab 7: Azure Data Factory for Data Migration**
   - **Objective: Build and schedule a pipeline to move data from blob storage to Azure SQL Database.**

Module 3: ML and Analytics on the Cloud

8. **Lab 8: Train a Machine Learning Model using AWS SageMaker**
   - **Objective: Use a built-in algorithm to train and evaluate a regression model on cloud.**
   - **Dataset: Boston Housing / Abalone dataset**

9. **Lab 9: AutoML on Google Vertex AI**
   - **Objective: Use Google Vertex AI AutoML to train a classification model.**
   - **Dataset: UCI ML dataset**
10. **Lab 10: Real-time Analytics using BigQuery**
   - **Objective: Query large datasets using SQL in BigQuery and generate insights.**
   - **Dataset: Public COVID-19 or NYC Taxi dataset**
11. **Lab 11: Azure Machine Learning Studio Workflow**
   - **Objective: Drag-and-drop ML experiment using Azure ML Studio.**
   - **Task: Classification model for diabetes prediction**
12. **Lab 12: Model Deployment using Flask and Docker on Cloud VM**
   - **Objective: Containerize a model using Flask + Docker and deploy to a VM instance.**
   - **Tools: Docker, Nginx, Python Flask**

Module 4: Capstone & Emerging Trends

13. **Lab 13: Serverless Model Deployment with AWS Lambda**
   - **Objective: Deploy a lightweight inference model as a serverless function.**
   - **Task: Classify text or image inputs via API Gateway**
14. **Lab 14: MLOps with MLflow on Google Cloud**
   - **Objective: Track, package, and deploy ML models using MLflow with GCS storage.**
   - **Tools: MLflow, GCS, GCP Notebooks**
15. **Lab 15: Capstone Project**
   - **Objective: Full data science pipeline (data ingestion → training → deployment) using a cloud platform of choice.**
   - **Example: Sentiment analysis API using Twitter data on AWS**

Text Book:

Thomas Erl et al. – *Cloud Computing: Concepts, Technology & Architecture* (2nd Edition, 2023)

Book Link:

Cloud Computing: Concepts, Technology & Architecture

Reference Book

1. **"Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines" by Valliappa Lakshmanan (2023)**
   Hands-on guide to building scalable data science projects on Google Cloud.
2. **"Machine Learning Engineering with Python: Deploy and Scale ML Models on AWS, Azure, and GCP" by Andrew P. McMahon (2024)**
   Recent guide on using cloud platforms for production-level ML systems.

Course Code: CSD1713	**Course Title: Statistical Foundations for Data Science** **Type of Course: Discipline elective Lab Integrated**	**L-T-P-C**	**0**	**0**	**2**	**1**
Version No.						
Course Pre-requisites						
Anti-requisites	**NIL**					
Course Description	**This course provides an in-depth introduction to statistics and machine learning theory, methods, and algorithms for data science. Topics include multiple regression, kernel learning, sparse regression, generalized linear models, supervised and unsupervised learning, deep learning, covariance learning, factor models, principal component analysis, and more. The course emphasizes the applicability and limitations of these methods using mathematical statistics and real-world data sets.**					
Course Objectives	**The objective of the course is to familiarize the learners with the concepts of Statistical Foundations for Data Science and attain Employability through Participative Learning techniques.**					
Course Out Comes	**On successful completion of this course, students can expect to achieve the following outcomes:** **CO1: Understand the rise and significance of Big Data in various fields such as Biological Sciences, Health Sciences, Computer and Information Sciences, Economics and Finance, Business and Program Evaluation, Earth Sciences, and Astronomy. [Understand]** **CO2: Develop a strong foundation in multiple linear regression and the Gauss-Markov theorem. [Apply]** **CO3: Apply linear regression with random design and partial linear regression. [Apply]** **CO4: Apply the power method and learn about factor models and structured covariance learning. [Apply]**					
Course Content: No. of Sessions: 15 (30 hours)						

List of Programs

Experiment 1: Use big data to predict patient outcomes.

Experiment 2: Predict stock market trends using big data.

Experiment 3: Segment customers based on purchasing behavior.

Experiment 4: Apply statistical learning techniques to high-dimensional data.

Experiment 5: The Gauss-Markov Theorem

Experiment 6: Statistical Tests - Weighted Least-Squares

Experiment 7: Box-Cox Transformation

Experiment 8: Ridge Regression - Bias-Variance Tradeoff

Experiment 9: Ridge Regression Solution Path - Kernel Ridge Regression

Experiment 10: Debias of Regularized Regression Estimators

Experiment 11: Inference in Generalized Linear Models (GLMs)

Experiment 12: Partial Linear regression

Experiment 13: Power Method: To implement the Power Method for finding the largest eigenvalue and corresponding eigenvector.

Experiment 14: Factor model and high-dimensional PCA

Experiment 15: Hierarchical clustering

Targeted Application & Tools that can be used:

Torch, Google Colaboratory, Spider, Jupiter Notebook

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

Sentiment analysis of Facebook and Twitter data

Dataset resource link:

https://www.kaggle.com/datasets

REFERENCE MATERIALS:

Textbook(s):

T1 Fan, J., Li, R., Zhang, C.-H., and Zou, H. (2020). Statistical Foundations of Data Science. CRC Press.

T2 Wainwright, M. J. (2019). ***High-dimensional statistics: A non-asymptotic viewpoint.*** **Cambridge University Press.**

Reference Book(s):

R1. James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). ***An Introduction to Statistical Learning with Applications in R*** **. Springer, New York.**

R2. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). ***The elements of Statistical Learning: Data Mining, Inference, and Prediction*** **(2nd ed). Springer, New York.**

R3. Buehlmann, P. and van de Geer, S. (2011). ***Statistics for High-Dimensional Data: Methods, Theory and Applications*** **. Springer, New York.**

R1: Fan, J., Li, R., Zhang, C.-H., and Zou , Statistical Foundations of Data Science. CRC Press.

E book link

R2: W. N. Venables, D. M. Smith and the R Core Team, https://cran.r-roject.org/doc/manuals /R-intro.pdf, October,2022

Web resources:

W1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP

https://presiuniv.knimbus.com/user#/

Course Code: CSE1716	**Course Title: Fundamentals of Data Analytics** **Type of Course: Theory only -Program Core**	**L- P- C**	**3**	**0**	**3**
Version No.	**1.0**				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	**Fundamentals of data analysis is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decision- making. The course begins by covering types of data, data acceptance, input, processing, and transformation. It delivers a foundation in basic statistics, taught in an intuitive, accessible way that simplifies the learning experience. This course will help the**				

	students to input, process, and analyze data and apply their knowledge to a wide range of applications.			
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Describe different types of data and variables.[Remember]** **2. Interpret data using appropriate statistical methods.[Apply]** **3. Demonstrate the collection, processing and analysis of data for any given application.[Apply]** **4. Illustrate various charts using visualization methods.[Apply]** **5. Apply Regression models for data and analysis of data.[Apply]**			
Course Content:				
Module 1	**Introduction to Data Analysis**	**Assignment**	**Data Collection , data analysis**	**9 Hours**
Topics: Introducing Data, overview of data analysis: Data in the Real World, Data vs. Information, The Many "Vs" of Data, Structured Data and Unstructured Data, Types of Data, Data Analysis Defined, Types of Variables, Central Tendency of Data, Scales of Data, Sources of Data, Data preparation: Cleaning the data, Removing variables, Data Transformations.				
Module 2	**Statistical functions**	**Assignment**	**Data analysis**	**9 Hours**
Topics: Sampling Techniques: Fundamental Definitions, Important sampling distributions concept of standard error, Descriptive Statistics, Inferential Statistics (T test, Z test,), Probability Application In Business and Calculating Probability from a Contingency Tables.				
Module 3	**Data Collection, Processing and Analysis**	**Project based assignment**	**Data Collection, data analysis**	**9 Hours**
Topics: Collection of Primary Data(Observation Method, Interview Method, Collection of Data through Questionnaires ,Collection of Data through Schedule) Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data ,Difference between Survey and Experiment, Processing Operations, correlation Analysis.				
Module 4	**Data Visualization and Charting**	**Project based assignment**	**Data Collection,visulaization and data analysis**	**9 Hours**

Topics: Types of charts and their significance, Organize data interactively with tables , Visualizing data with charts, Analyzing data with pivot tables, Build presentation ready dashboards and turn real world data into business insights, Tracking trends and making forecasts, Interpretation and report writing

Module 5	**Prediction**	**Project based assignment**	**Data analysis with optimization**	**9 Hours**

Topics: Introduction: Overview, Classification, Regression, Building a prediction model, Applying a prediction Model, Simple Linear Regression, Simple Non Linear Regression, Data Analysis with Optimization techniques.

Targeted Application & Tools that can be used:

Application Area are

Decision making in business, health care, financial sector, Medical diagnosis etc...

Microsoft excel, r studio, SaaS, python, Graphana, Dashbuilder.

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

1. **Collect student marks of test1 and apply inferential and descriptive statistics.**
2. **Identify the problem in any of the buisness and make one objective, collect the relevant data and analyse using visualization.**
3. **Collect the data related to agriculture production and sales and predict the values with linear regression.**
4. **Taking the KPI data create the interactive dashboards for different companies.**

Text Book

1."Business Analytics: Data Analysis and Decision Making",Authors: S. Christian Albright, Wayne L. Winston, Edition: 8th Edition (2023),Publisher: *Cengage Learning,(*Use for: Modules 1, 2, 4, and 5)

2.Making sense of data: A practical guide to exploratory data analysis and data mining, Wiley, Glenn J.Myatt, Wayne P. Johnson, Second Edition, 2014.

References

1. **"Statistics for Business and Economics",Authors: Paul Newbold, William Carlson, Betty Thorne**

Edition: 10th or 11th Edition (latest: 2022),Publisher: *Pearson Education,*Use for: Module 2 and 3

2. **Excel Data Analysis-visual blue print –Paul McFedries –Wiley 4th Edition September 2019**
3. **Analyzing Business Data with Excel - Gerald Knight - O'Reilly; 1st Edition,13 January 2006**
4. **Data Analysis and business modelling using Microsoft Excel – Hansa Lysander-PHI,2017**
5. **Research Methodology- Methods and Techniques, 4th Edition, C R Kothari and Gaurav Garg, New Age International(P) limited, Publishers,2020**

Course Code: CSE7000	**Course Title: Internship** **Type of Course:**	**L- T-P- C**	**-**	**-**	**-**	**2**
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**					
Anti-requisites	**NIL**					
Course Description	**Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems.**					
Course Objectives	**The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** **1. Identify the engineering problems related to local, regional, national or global needs. (Understand)** **2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply)** **3. Design the experiments as per the standards and specifications. (Analyze)**					

	4. Interpret the events and results for meaningful conclusions. (Evaluate)

Course Code: CSE2021	Course Title: Data Mining Type of Course: Discipline Elective/ Theory Only Course	L- P-C	3	0	3
Version No.	2.0				
Course Pre-requisites	Students are expected to be familiar with the basics of Linear Algebra, Probability and Statistics and should have a knowledge on DBMS.				
Anti-requisites	NIL				
Course Description	Introduction, Applications, issues in data mining, data pre-processing techniques, data mining tasks, association rules, advanced association rules, classification, different approaches for classification, clustering, outlier detection. Recent trends in data mining.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Mining and attain Employability through Problem Solving Methodologies				
Course Out Comes	On successful completion of the course the students shall be able to: Apply the various pre-processing techniques needed for a data mining task. Understand the functionality of the various data mining algorithms. Appreciate the strengths and limitations of various data mining models. Understand the advances in data mining for real life applications.				
Course Content:					
Module 1	Introduction to Data Mining	Assignment	Data Collection	5 Sessions	
Topics: Introduction to Data mining – Data Mining Goals– Stages of the Data Mining Process–Data Mining Techniques– Merits and Demerits.					
Module 2	Data preprocessing	Quiz	Problem Solving	9 Sessions	
Topics: Types of data – Pre Processing steps – Data Preprocessing Techniques – Similarity and Dissimilarity measures.					

Module 3	Data Mining – Frequent Patterns	Assignment	Problem Solving	7 Sessions
Topics: Market Basket Analysis, item sets – Generating frequent item sets and rules efficiently – Apriori Algorithm– FPGrowth.				
Module 4	Classification and clustering	Assignment	Problem Solving	11 Sessions
Classification and Clustering Decision tree Induction – Bayesian classification –Classification by Back Propagation - Lazy learners – Modern evaluation and selection techniques to improve classification accuracy. Clustering Analysis – portioning method – Hierarchical methods – Density based method				
Module 5	Outlier detection & Data mining trends	Assignment	Problem Solving	5 Sessions
Anomaly detection preliminaries - Different Outlier detection techniques-Web mining- Text mining- Demonstration of Weka tool.				
Project work/Assignment:				
Assignments From the dataset given, find the Entropy, Gain value of the attributes and also draw the decision tree using entropy for the given dataset. Transactional Data Base, D given below which contains set of items find the frequent item set using the Apriori Algorithm and generate the Association Rules. Minimum Support count is 2%. Minimum confidence is 60%.				
Text Book T1 T1. Tan P. N., Steinbach M & Kumar V. “Introduction to Data Mining” ,Pearson Education, 2016.				
References				

Tid	Items
10	1, 3, 4
20	2, 3, 5
30	1, 2, 3, 5
40	2, 5

R1 Han J & Kamber M, “Data Mining: Concepts and Techniques”, Elsevier, Second Edition, 2006

R2 G K Gupta, “Introduction to Data Mining with Case Studies”, PHI, Third Edition, 2014.

R3 Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, Tata McGraw – Hill

Additional web-based resources

W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012.

W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk

https://nptel.ac.in/courses/105105157

Topics relevant to “EMPLOYABILITY SKILLS”: Data Mining Techniques, FP Growth for developing Employability Skills through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: UG COURSE: CSD 1701	**Course Title: Social Media Analytics** **Type of Course: Theory**	**L-T-P-C**	**3**	**0**	**0**	**3**
Version No.	**1.0**					
Course Pre-requisites						
Anti-requisites	**NIL**					
Course Description	**This course provides a comprehensive overview of social media analytics, focusing on the techniques and tools used to analyze social media data. Students will learn how to collect, process, and analyze data from various social media platforms to extract valuable insights. The course covers topics such as big data collection, demographic analysis, web analytics, and the use of analytics tools to understand online customer behavior and make data-driven decisions.**					
Course Objective	**The objective of the course is to familiarize the learners with the concepts Social Media Analytics and attain Skill Development through Experiential Learning techniques.**					

Course Out Comes	**On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:** **CO1: Understand the fundamental concepts and importance of social media analytics in modern business contexts. [Remember]** **CO2: Effectively collect data from various social media platforms, ensuring they can gather relevant and accurate information. [Apply]** **CO3: Develop the ability to process and analyze social media data, transforming raw data into meaningful insights. [Apply]** **CO4: Acquire skills in visualizing data, enabling them to present findings in a clear and impactful manner. [Apply]**			
Course Content:				
Module 1	**Introduction to Social Media Analytics**	**Assignment**	**Practical**	**11 Sessions Remember**
The foundation for analytics, Social media data sources, Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics., Dealing with Unstructured Data, Challenges, Social media Mining Techniques, Social media data, Types of data, Text data formats, Text cleaning, tagging and storing. API: RESTful API, Stream API, OAuth Parsing API.				
Module 2	**Text Mining in Social Networks**	**Assignment**	**Practical**	**11 Sessions Apply**
Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.				
Module 3	**Network Measures and Behavior Analytics**	**Assignment**	**Practical**	**12 Sessions Apply**
Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Between ness Centrality, Closeness Centrality , Similarity: Structural Equivalence, Regular Equivalence, Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction				

Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction				
Module 4	**Analyzing the Social Media Data**	**Assignment**	**Practical**	**11 Sessions Apply**
Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections. Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters				

REFERENCE MATERIALS:

(i) Textbooks

T1. Mining the Social Web – Mathew A. Rusell, 3rd Edition, O'Reilly, 2019.

T2 : Python Social Media Analytics – Michal Krystyanczuk and Siddhartha Chatterjee, PacktPub, 2017.

(ii) Reference Book(s)

R1. Charu C. Aggarwal, Social Network Data Analytics, Springer, 2011

R2:Mastering Social Media Mining with Python – Macro Bonzanini, PacktPub, 2016.

R3; Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, 2014

W1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_cs28

W2. Coursera: https://www.coursera.org/learn/social-media-data-analytics

W3.Udemy:https://www.udemy.com/course/introduction-to-social-analytHYPERLINK "https://www.udemy.com/course/introduction-to-social-analytics/"ics/

W4. Others : https://research.facebook.com/publications/realtime-data-processing-at-facebook/

Topics relevant to Entrepreneurial Skills: Extract and Analyze Social media Data for Entrepreneurship Development through Problem Solving methodologies/Participative Learning Techniques/ Experiential Learning Techniques.

Course Code:	**Course Title: Edge AI and IoT Analytics**	**L-T- P- C**	**3**		**0**	**3**

CSD1709	**Type of Course: Theory**			**0**		
Version No.	**1.0**					
Course Pre-requisites	**Basics of Machine Learning, IoT fundamentals, and Python programming**					
Anti-requisites	**NIL**					
Course Description	**This course provides a comprehensive overview of the convergence between Edge Computing, Artificial Intelligence (AI), and the Internet of Things (IoT). Learners will explore how intelligent analytics can be performed on-device at the edge of the network, reducing latency and enabling real-time decision-making in resource-constrained environments. The course covers core concepts of edge architecture, IoT protocols, AI model optimization, and deployment on edge hardware such as Raspberry Pi, Jetson Nano, and Google Coral. . Real-world use cases from domains such as healthcare, smart cities, and Industry 4.0 are discussed along with emerging trends in DataOps, ModelOps, and Edge-to-Cloud integration. By the end of the course, students will be able to design, build, and deploy secure and efficient edge-AI-powered IoT systems.**					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Edge AI and IoT Analytics and attain Employability through Participative Learning techniques.**					
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Understand and analyze the architecture of IoT systems and Edge AI platforms.** **2. Select and apply appropriate hardware, tools, and optimization techniques for deploying AI models on edge devices.** **3. Perform real-time analytics on IoT data streams using lightweight ML models and appropriate platforms.** **4. Design and develop secure, scalable, and intelligent Edge-IoT solutions for real-world applications.**					
Course Content:						
Module 1: Fundamentals of Edge AI and IoT Systems						**11 Sessions**
	Introduction to IoT and Edge Computing- Edge vs Cloud vs Fog Computing-Architectures of IoT & Edge Devices-Key Communication Protocols: MQTT, CoAP, BLE, LoRaWAN. **Overview of Edge AI: Concepts and Industry Trends-Introduction to TinyML and Embedded AI.**					
Module 2: Edge Hardware, Platforms, and AI Model Deployment						**12 Sessions**
	Edge AI Hardware Platforms: Raspberry Pi, NVIDIA Jetson, Google Coral, Arduino Nano 33 BLE- Model Optimization Techniques for Edge: Quantization, Pruning, Knowledge Distillation-AI Frameworks for Edge: TensorFlow Lite, ONNX, PyTorch Mobile, Edge					

	Impulse-Deployment Workflows: From Training to On-Device Inference-Power, Memory, and Latency Constraints in Edge Devices	
Module 3 IoT Data Analytics and Real-Time Processing		**12 Sessions**
	IoT Data Acquisition, Streaming, and Preprocessing -Time-Series Analysis for IoT Sensors -Lightweight ML Models for Edge: Decision Trees, k-NN, Naïve Bayes, SVMs -Anomaly Detection and Predictive Maintenance -Tools and Platforms: Azure IoT Hub, AWS Greengrass, Google IoT Core-Data Visualization for Edge Analytics (Grafana, ThingsBoard)	
Module 4 Applications, Security, and Project Implementation		**10 Sessions**
	Smart Home, Smart Agriculture, Industrial IoT (IIoT), Smart Cities-Case Studies: Edge AI in Surveillance, Energy Monitoring, Healthcare-Security in Edge AI and IoT (Device Authentication, Secure Boot, Data Privacy)-Edge-to-Cloud Integration	
	Text Book **1. Xiaofei Wang, Yi Pan "Edge AI: Machine Learning for Embedded Applications" Publisher: Springer- 1st Edition (2022)** **2. Yunchuan Sun et al " Learning Edge AI: Algorithms and Applications". Publisher: Springer Edition: 1st Edition (2022)** **3. Arshdeep Bahga, Vijay Madisetti "Internet of Things: A Hands-On Approach" Publisher: Universities Press Edition: 2nd Edition (2023)** **4. William Lawless et al. "Artificial Intelligence for the Internet of Everything" Publisher: Academic Press (Elsevier) Edition: 1st Edition (2022)**	
	References **1. Colin Dow "Hands-On Edge Analytics with Azure IoT: Stream Data Processing from Devices to Cloud" Publisher: Packt Publishing Edition: 1st Edition (2022).** **Web resources:** **1. NPTEL – Introduction to Internet of Things** **https://nptel.ac.in/courses/106/105/106105166/** **2. Google Developers – Edge AI Overview** **https://developers.google.com/edge-tpu** **3. Google Cloud IoT Core (Edge to Cloud Integration)** **https://cloud.google.com/iot-core**	
	Topics relevant to "EMPLOYABILITY SKILLS": Edge computing vs. cloud computing: trade-offs and applications- Use of analytics platforms (Grafana, AWS IoT, Azure IoT) for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	

Course Code: CSD1702	**Course Title: Social Media Analytics** **Type of Course: Discipline elective Lab Integrated**	**L-T-P-C**	**0**	**0**	**2**	**1**
Version No.	**1.0**					
Course Pre-requisites						
Anti-requisites	**NIL**					
Course Description	**This course provides a comprehensive overview of social media analytics, focusing on the techniques and tools used to analyze social media data. Students will learn how to collect, process, and analyze data from various social media platforms to extract valuable insights. The course covers topics such as big data collection, demographic analysis, web analytics, and the use of analytics tools to understand online customer behavior and make data-driven decisions.**					
Course Objectives	**The objective of the course is to familiarize the learners with the concepts Social Media Analytics and attain Skill Development through Experiential Learning techniques.**					
Course Out Comes	**On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:** **CO1: Understand the fundamental concepts and importance of social media analytics in modern business contexts. [Remember]** **CO2: Effectively collect data from various social media platforms, ensuring they can gather relevant and accurate information. [Apply]** **CO3: Develop the ability to process and analyze social media data, transforming raw data into meaningful insights. [Apply]** **CO4: Acquire skills in visualizing data, enabling them to present findings in a clear and impactful manner. [Apply]**					
Course Content: No. of Sessions: 15 (30 hours)						
List of Programs **Experiment 1:** **LO1: Python Programs Dealing with structured Data** **LO2: Python Programs Dealing with Unstructured Data**						

Experiment 2:

LO1: Python Programs for Data Integration

LO2: Python Programs for Outlier detection

Experiment 3:

LO1: Python Programs for Data transformation

LO2: Python Programs for Text cleaning

Experiment 4:

LO1: Python Programs Obtaining tokens

LO2: Programs for OAuth Authentication

Experiment 5:

LO1: Text classification using different

Classification Algorithms

LO2: Performance analysis of different classification algorithms

Experiment 5:

LO1: Text clustering using different Algorithms

LO2: Performance analysis of different clustering algorithms

Experiment 8:

LO1: Python program of individual behavior classification

LO2: Python program of individual Analysis

.Experiment 9:

LO1: Python program of collective behavior classification

LO2: Python program of collective behavior Analysis

Experiment 10:

LO1: Extracting my Facebook profile

LO2: Extracting friends' information from Facebook.

Experiment 11:

LO1: Perform a time frequency analysis of the posts extracted from Facebook page

LO2: Visualize the posts of Facebook page using word cloud

Experiment 12:

LO1: Python Programs for Extract Tweets from Home Timeline.

LO2: Retrieve tweets from a specific user timeline

Targeted Application & Tools that can be used: **Python Programming Language**
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course **Sentiment analysis of Facebook and Twitter data** **Dataset resource link:** **https://www.kaggle.com/datasets**
REFERENCE MATERIALS: **i. Textbooks** **T1. Mining the Social Web – Mathew A. Rusell, 3rd Edition, O'Reilly, 2019.** **T2 : Python Social Media Analytics – Michal Krystyanczuk and Siddhartha Chatterjee, PacktPub, 2017.** **ii. Reference Book(s)** **R1. Charu C. Aggarwal, Social Network Data Analytics, Springer, 2011** **R2:Mastering Social Media Mining with Python – Macro Bonzanini, PacktPub, 2016.** **R3; Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, 2014** **W1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_cs28** **W2. Coursera: https://www.coursera.org/learn/social-media-data-analytics** **W3.Udemy:https://www.udemy.com/course/introduction-to-social-analytHYPERLINK "https://www.udemy.com/course/introduction-to-social-analytics/"ics/** **W4. Others : https://research.facebook.com/publications/realtime-data-processing-at-facebook/**

Course Code: CSE 7100	**Course Title: Mini Project** **Type of Course:**	**L- T-P- C**	**0**	**0**	**0**	**4**
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**					
Anti-requisites	**NIL**					
Course Description	**Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get**					

	an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company.
Course Objectives	**The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques.**
Course Outcomes	**On successful completion of this course the students shall be able to:** **1. Identify the engineering problems related to local, regional, national or global needs. (Understand)** **2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply)** **3. Design the experiments as per the standards and specifications.** **(Analyze)** **4. Interpret the events and results for meaningful conclusions. (Evaluate)** **5. Appraise project findings and communicate effectively through scholarly publications. (Create)**

Course Code: CSE 7300	**Course Title: Capstone Project** **Type of Course:**	**L- T-P- C**	**0**	**0**	**0**	**10**
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**					
Anti-requisites	**NIL**					

Course Description	**Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company.**
Course Objectives	**The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques.**
Course Outcomes	**On successful completion of this course the students shall be able to:** **1. Identify problems based on societal /research needs. (Understand)** **2. Apply Knowledge and skill to solve societal problems in a group. (Apply)** **3. Develop interpersonal skills to work as member of a group or leader. (Apply)** **4. Analyze the inferences from available results through theoretical /** **Experimental / Simulations. (Analyze)** **5. Analyze the impact of solutions in societal and environmental context for sustainable development. (Analyze)** **6. Improve in written and oral communication. (Create)** **7. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. (Understand)**

Course Code: **CSE1500**	**Course Title:** **Computational Thinking Using Python**	**L- T- P- C**	2	0	2	3

	Type of Course: Integrated					
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces students to the essential skills of **computational thinking** and their practical application through the **Python programming language**. By combining problem-solving strategies with coding, students will learn to decompose complex challenges, identify patterns, abstract general principles, and design algorithms to build functional programs					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computational Thinking and use the Computational Thinking Principles to solve the computational Problems using Python Language					

Course Outcomes	Upon successful completion of this course, students will be able to:
	• Explain and apply the core principles of **computational thinking**:
	  ○ Decomposition
	  ○ Pattern Recognition
	  ○ Abstraction
	  ○ Algorithm Design
	• Use **Python** to implement solutions to real-world problems.
	• Write and debug Python code using functions, loops and conditions
	• Design simple programs and algorithms to automate repetitive or complex tasks.
	• Collaborate effectively and communicate problem-solving approaches using pseudocode and Python.					

Course Content:						
Module 1	**Pillars of Computational Thinking**	Comprehension		**9 Sessions**		
What is computational thinking? Why is it important? Pillars of computational thinking: decomposition; pattern recognition; data representation and abstraction; algorithms Applying computational thinking to case studies						
Module 2	**Algorithm Design & Problem-Solving Strategies**	Application		**9 Sessions**		

Introduction to Algorithms, Introduction to Problem Solving techniques: Brute Force, Divide and conquer, Common algorithms: find-max, linear search, binary search and other simple Algorithms				
Module 3	**Applied Computational Thinking using Python**	Application		**12 Sessions**
Introduction to Python, Data representation: variables, lists, Conditionals, Loops and Iteration Basic Example programs to illustrate the programming constructs				
Targeted Application & Tools that can be used: **Google Colab, Python**				
Text Book 1. "Computational Thinking for the Modern Problem Solver" – David D. Riley & Kenny A. Hunt 2. "Mastering Python 3 Programming: Ultimate Guide to Learn Python Coding Fundamentals and Real-World Applications" Subburaj Ramaswamy, BPB publications				
References 1. • **Sweigart, Al.** *Automate the Boring Stuff with Python: Practical Programming for Total Beginners.* No Starch Press, 2015. https://automatetheboringstuff.com • **Severance, Charles.** *Python for Everybody: Exploring Data Using Python 3.* CreateSpace Independent Publishing, 2016. https://www.py4e.com • **Wing, Jeannette M.** "Computational Thinking." *Communications of the ACM*, vol. 49, no. 3, 2006, pp. 33–35. https://doi.org/10.1145/1118178.1118215 • **Downey, Allen B.** *Think Python: How to Think Like a Computer Scientist.* Green Tea Press, 2015. http://greenteapress.com/wp/think-python-2e/ . **E-Resources** https://edu.google.com/resources/programs/exploring-computational-thinking				

Topics relevant to "SKILL DEVELOPMENT": Decomposition, Abstraction, Pattern recognition, Data Representation ,Algorithms

Course Code: CSE2514	**Course Title: Operating Systems Lab** **Type of Course: Lab Only**	**L-T- P- C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	CSE2009- Computer Organization Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended.					
Anti-requisites	**NIL**					
Course Description	This laboratory course provides hands-on experience with the core concepts of operating systems through practical assignments, simulations, and case studies. It covers foundational aspects such as system calls, process and thread management, inter-process communication, synchronization, deadlocks, memory management, and file systems. Students will implement and simulate real-time OS components and scheduling algorithms, fostering deeper understanding of OS architecture and design. The lab also introduces modern OS tools, programming interfaces, and the basics of open-source OS environments.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Demonstrate system-level programming using system calls and OS structures. [**Apply**] 2] Simulate process scheduling and multithreading techniques. [**Apply**] 3] Apply various tools to handle synchronization problems using semaphores and shared memory. [**Apply**] 4] Demonstrate memory management and file system concepts using simulation or scripting. **[Apply]**					
Course Content:						
Targeted Application:						

Application area is traffic management system, banking system, health care and many more systems where in there are resources and entities that use and manage the resources.

Software Tools:

Oracle Virtual Box/VMWare Virtualization software [Virtual Machine Managers]. Used to install and work on multiple guest Operating Systems on top of a host OS.

Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.

List of Laboratory Tasks:

Lab sheet -1

L1: Write a program to demonstrate the use of fork() and exec() system calls in process creation.
L2: A system has limited memory and high-priority real-time processes. Design a scheduling algorithm that ensures responsiveness while preventing starvation.

Lab sheet -2

L1: Implement First-Come-First-Serve (FCFS) process scheduling using C or Python.
L2: You are designing a server that handles thousands of client connections. Compare multithreading and multiprocessing for this task and implement a basic server model.

Lab sheet -3

L1: Implement Round Robin Scheduling with a fixed time quantum.
L2: In a banking system, concurrent access to accounts leads to data corruption. Design a synchronization solution to avoid race conditions.

Lab sheet -4

L1: Write a program to create threads using Pthreads or Python's threading module.
L2: You're tasked with building a file access tracker in an OS. Implement a system to log file access patterns and identify frequent accesses.

Lab sheet -5

L1: Demonstrate inter-process communication (IPC) using pipes.
L2: A simulation tool needs to emulate process suspension and resumption. Design and implement such a mechanism using signals or condition variables.

Lab sheet -6

L1: Simulate the Producer-Consumer problem using semaphores.
L2: You're developing a system where sensor devices (producers) generate temperature readings, and data processors (consumers) store and process these readings. To prevent race conditions and ensure buffer safety, implement a synchronization mechanism using semaphores.

Lab sheet -7

L1: Implement Dining Philosophers Problem using threads and synchronization.
L2: In a multi-threaded cafeteria simulation, five philosophers sit around a circular table, each alternating between thinking and eating. To eat, a philosopher must hold two forks (represented by shared resources). Your task is to avoid deadlock and ensure no philosopher starves using thread synchronization techniques.

Lab sheet -8

L1: Write a program to simulate First Fit, Best Fit, and Worst Fit memory allocation strategies.
L2: A system with limited memory blocks needs to allocate memory to processes arriving with various size requests. Your task is to implement three classic memory allocation strategies—First Fit, Best Fit, and Worst Fit—to allocate memory to each process efficiently. Simulate and compare how memory gets allocated in each strateg

Lab sheet -9

L1: Demonstrate paging using a simple page table simulation.
L2: A program has a logical address space divided into pages. The system's memory is divided into equal-sized frames. When a program executes, its pages are loaded into available frames in main memory. Simulate the address translation process using a page table and demonstrate how a logical address is converted to a physical address.

Lab sheet -10

L1: Write a program to simulate page replacement algorithms like FIFO and LRU.
L2: In a virtual memory system, a process accesses pages in a specific order. The memory can only hold a limited number of pages (frames). When a page is needed and the memory is full, a page replacement algorithm is used to decide which page to evict. Simulate and compare FIFO and LRU algorithms for a given page reference string.

Lab sheet -11

L1: Simulate file directory structure (single level/two level).
L2: A university campus computer lab has limited memory space available for each student login session. When students open files or run programs, memory pages are loaded into available memory frames. Due to the limited number of frames, some pages must be replaced when new ones are needed.

The lab system uses page replacement algorithms to decide which pages to evict when memory is full..

Lab sheet -12

L1: Write a shell script to demonstrate file handling commands in Linux.
L2: Design a command-line mini shell that can run background and foreground processes and handle basic built-in commands like cd, pwd, exit.

Project work/Assignment

Demonstrate process concepts in LINUX OS.

Simulation of CPU scheduling algorithms.

Develop program to demonstrate use of Semaphores in threads.

Develop program to demonstrate use of deadlock avoidance algorithms.

Develop program to demonstrate use of page replacement algorithms.

Simulation of memory allocation strategies [first fit, best fit and worst fit].

Text Book

Silberschatz A, Galvin P B and Gagne G , "Silberschatz's Operating System Concepts", Paperback, Global Edition Wiley, 2019

References

Silberschatz A, Galvin P B and Gagne G, "Operating System Concepts", 10th edition Wiley, 2018.

William Stallings, "Operating Systems",Ninth Edition, By Pearson Paperback ,1 March 2018.

Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, " Cracking the Operating System skills", Dreamtech, paperback, 2020

Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , "Operating Systems: Three Easy Pieces, Amazon digital Services", September 2018.

E-resources/Weblinks

https://www.os-book.com/OS9/

https://pages.cs.wisc.edu/~remzi/OSTEP/

https://codex.cs.yale.edu/avi/os-book/OS10/index.html

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