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 ARTIFICIAL INTELLIGENCE AND ADVANCED COMPUTING

Program Regulations and Curriculum
2026-2030

BACHELOR OF TECHNOLOGY (B.Tech.) in
COMPUTER SCIENCE AND ENGINEERING (Data Science)

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

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PART A – PROGRAM REGULATIONS

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

1.1 Vision of the University

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

1.2 Mission of the University

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

1.3 Vision of Presidency School of 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 transforming Society.

1.4 Mission of Presidency School of Computer Science and Engineering

- Cultivate a practice-driven environment with a contemporary Learning-pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the field of Core Computer Science and Engineering.
- Establish state-of-the-art facilities for effective Teaching and Learning-experiences.
- Promote Interdisciplinary Studies to nurture talent and impart relevant skill-sets for global impact.
- 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 CreditSystem (CBCS) with focus on Industrial Based Project Learning, Industrial Training, and Internship toenable 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 2025-2029.

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 2025-2029 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 organizing 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, 2025-2029;*

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

gg. *"PSCSE" 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. *"SGPA" means the Semester Grade Point Average as defined in the Academic Regulations, 2021;*

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

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

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

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

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

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

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

5. Program Description

The Bachelor of Technology Degree Program Regulations and Curriculum 2025-2029 are subject to, and, pursuant to the Academic Regulations.These Program Regulations shall be applicable to the following ongoing Bachelor of Technology (B.Tech.) Degree Programs of 2025-2029 offered by the Presidency School of Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as CSE
2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as CBD
3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as CBC
4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as CDV
5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as CCS
6. Bachelor of Technology in Computer Science and Engineering (Internet of Things), abbreviated as CIT
7. Bachelor of Technology in Computer Science and Engineering (Data Science), abbreviated as CSD
8. Bachelor of Technology in Computer Science and Technology, abbreviated as CSG
9. Bachelor of Technology in Information Science and Technology, abbreviated as IST

10. Bachelor of Technology in Computer Science and Information Technology, abbreviated as CSI
11. Bachelor of Technology in Computer Science and Engineering (Networks), abbreviated as CSN
12. Bachelor of Technology in Computer Engineering, abbreviated as COM
13. Bachelor of Technology in Information Science and Engineering, abbreviated as ISE and
14. Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) abbreviated as CAI
15. Bachelor of Technology in Robotics and Artificial Intelligence Engineering, abbreviated as RAI
16. Bachelor of Technology in Artificial Intelligence and Data Science Engineering, abbreviated as AID

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 16.1**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 19.0 of Academic Regulations) in the prescribed maximum duration (Sub-Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

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

PEO 1: Demonstrate proficiency as a Computer Engineering professional, applying technical knowledge and skills effectively in various engineering fields.

PEO 2: Become a teaching and research professional in the areas of Computer Science and Engineering, engaging in lifelong learning to stay at the forefront of the field.

PEO 3: Contribute as a key member of a consultancy team in the Computer Science and Engineering industry, providing expert solutions to complex problems.

PEO 4: Emerge as an entrepreneur in the fields of Computer Science and related areas, creating innovative solutions and businesses.

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 knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3. **Design/Development of Solutions**:Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4. Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6.The Engineer and TheWorld: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7.Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8.Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9.Communication: Communicate effectively and inclusively within the engineering

community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10.Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11.Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking 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 1 Illustrate comprehensive knowledge of computer science to describe fundamental ideas, investigate computational issues, and apply theoretical understanding in the design of efficient and reliable systems.

PSO2 Employ software development skills, domain expertise in data science, and programming knowledge to create effective, real-life systems, preparing students for opportunities in technical careers, advanced studies, innovation, research or self-driven enterprises.

PSO3 Apply techniques of data engineering involving collecting, cleaning, storing, and managing structured and unstructured data using databases, data lakes, and cloud platforms to support efficient data-driven systems.

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 thecandidates 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, 2025-2029, 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. in Computer Science and Engineering for a student who joins the Program through the provision of the Lateral Entry, shall be "N – M" Credits.

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

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

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

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

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

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

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

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

11 Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the B.Tech. Program will normally

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

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

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

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

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

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

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

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

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

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

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

12.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 8.8 of Academic Regulations12.5)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 8.10 of Academic Regulations) 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

S. No	Credit Structure [L-T-P-C]	Percentage/ Marks	CA		Mid-Term		End-term		Project	Total	Exam Conducted by
			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 * Except for full stack courses
		Marks	25	25	25	25	50	50	-	200	
3	1-0-4-3	Percentage	-	25%	10%	40%	5%	20%	-	100%	Mid-Term & End Term by School
		Marks	-	25	10	40	5	25	-	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 at School level
		Marks	-	50	-	-	-	-	50	100	
6	0-0-2-1	Percentage	-	100%	-	-	-	-	-	100%	Only CA at School Level
		Marks	-	100	-	-	-	-	-	100	
7	3-0-	Perce	12.50	12.50%	15%	10%	30%	20%	-	100%	Mid-

	2-4	**ntage**	**%**									**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**		

*CSS3426-Front End Full stack development

CSS3427-Java Full Stack Development

CSS3428-.Net Full Stack development

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 5.2 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 Clauses12.6.1

and 8.9.2 of Academic Regulations) in the "Make-Up Examinations" of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

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

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

13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer ANNEXURE B 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 Clause13.3 (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 have 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 summarized in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the Academic Regulations.

Table 2: Durations and Credit Equivalence for Transfer of Creditsfrom 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 forthe award ofthe concernedDegree. 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 (13.0), shall not be included in the calculation of the CGPA.

13.5 Mandatory Non-Credit Course Completion Requirements: All mandatory non-credit courses shall be satisfactorily completed by the student as part of the degree requirements. These courses will be evaluated and awarded letter grades based on the following criteria:

S (Satisfactorily Completed): Awarded when the student successfully completes all prescribed course requirements.

NC (Not Completed): Awarded when the student fails to meet the prescribed course requirements.

A student receiving an NC grade must reappear for and complete the course in accordance with the guidelines prescribed by the University.

In the case of non-taught and non-credited mandatory courses—where students are advised to undertake learning through MOOC platforms—there shall be a clearly defined Course Catalogue and a corresponding Course Plan. The Course Plan shall outline the assessment components, which will form the basis for evaluation.

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 (2025-2029) totaling 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) 2025-2029: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	Humanities and Social Sciences including Management Courses (HSMC)	10
2	Basic Science Courses (BSC)	24
3	Engineering Science Courses (ESC)	22
4	Professional Core Courses (PCC)	64
5	Project Work (PRW)	16
6	Professional Elective Courses (PEC)	18
7	Open Elective Courses (OEC)	06
8	Mandatory Courses (MAC)*	0
	Total Credits	**160 (Minimum)**

* Please refer to Table 3.8, (where the number '8' corresponds to the serial number of the Mandatory course basket.)

In the entire Program, the practical and skill based course component contribute to an extent of approximately 61% out of the total credits of 160 for B.Tech. (Computer Science and Engineering-Data Science) program of four years' duration.

15. Minimum Total Credit Requirements of Award of Degree

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

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

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

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

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

b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause **Error! Reference source not found.** 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

17. 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).

Baskets
HSMC - Humanities and Social Sciences (including Management courses) (HSMC)
BSC - Basic Science Courses ESC - Engineering Science Courses
PCC - Professional Core Course
PEC - Professional Elective Courses
OEC - Open Elective Courses
EEC - Employment Enhancement Courses
MAC - Mandatory Course

Table 3.1:
List of Humanities and Social Sciences including Management Courses (HSMC)

Sl. No.	Course Code	Course Name	L	T	P	Credits	Contact Hours	Type of Skill	Pre-requisite
1	ENG1030	Fundamentals of Communication	1	0	2	2	3	S	Nil
2	ECE1512	Design Thinking in Practice	2	0	2	3	4	F	Nil
3	ENG2030	Communication in Practice	1	0	2	2	3	S	Nil
4	FIN1002	Essentials of Finance	3	0	0	3	3	S	Nil
5	APT4005	Aptitude for Employability	0	0	2	1	2	S	Nil
6	PPS3018	Preparedness for Interview	0	0	2	1	2	S	Nil
		Total	8	0	4	12	17		

Table 3.2: List of Basic Science Courses (BSC)

Sl. No.	Course Code	Course Name	L	T	P	Credits	Contact Hours	Type of Skill	Pre-requisite
1	MAT1211	Linear Algebra, Differential Equations and Statistical Methods	3	1	0	4	4	F	Nil
2	PHY2501	Optoelectronics and Quantum Physics	3	0	0	3	3	F	Nil
3	PHY2504	Optoelectronics and Quantum Physics Lab	0	0	2	1	2	F	Nil
4	MAT1212	Mathematical foundations for Machine Learning and Data Analysis	3	1	0	4	4	F	Nil
5	CHE2501	Chemistry of Smart Materials	3	0	0	3	3	S	Nil
6	CHE2502	Chemistry of Smart Materials Lab	0	0	2	1	2	S	Nil
7	MAT2311	Vector Calculus, Numerical Methods and Sampling Distributions	3	1	0	4	4	EM	Nil
8	MAT2321	Discrete Mathematical Structures	3	1	0	4	4	F	Nil
		Total	**18**	**4**	**4**	**24**	**26**		

Table 3.3: List of Engineering Science Courses (ESC)

Sl. No.	Course Code	Course Name	L	T	P	Credits	Contact Hours	Type of Skill	Pre-requisite
1	MEC1006	Engineering Graphics	2	0	0	2	2	**S**	Nil
2	CSS1500	Computational Thinking using Python	2	0	2	3	4	**S**	Nil
3	ECE2022	Digital Design	2	0	0	2	2	**F/S**	Nil
4	ECE2052	Digital Design Lab	0	0	2	1	2	**F/S**	Nil
5	CIV1200	Foundations of Integrated Engineering	2	0	0	2	2	**S**	Nil
6	EEE1200	Basics of Electrical and Electronics Engineering	3	0	0	3	3	**F/S**	Nil
7	EEE1251	Basics of Electrical and Electronics Engineering Laboratory	0	0	2	1	2	**F/S**	Nil
8	CSS2264	Essentials of AI	3	0	0	3	3	**S/EM**	Nil
9	CSS2265	Essentials of AI Lab	0	0	2	1	2	**S/EM**	Nil
10	CSS2274	Competitive Programming and Problem Solving	0	0	4	2	4	**S/EM**	Nil

Total	**15**	**0**	**14**	**22**	**29**		

Table 3.4: List of Professional Core Courses (PCC)

S.No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills/Focus	Pre-requisites/ Co-requisites
1	**CSS2200**	**Problem Solving using C**	**2**	**0**	**0**	**2**	**2**	**S**	**Nil**
2	**CSS2201**	**Problem Solving using C Lab**	**0**	**0**	**4**	**2**	**4**	**S**	**Nil**
3	CSS2251	**Data Communication and Computer Networks**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
4	CSS2252	**Data Communication and Computer Networks Lab**	**0**	**0**	**2**	**1**	**2**	**S**	**Nil**
5	CSS2253	**Data Structures**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
6	CSS2254	**Data Structures Lab**	**0**	**0**	**2**	**1**	**2**	**S**	**Nil**
7	CSS2255	**Object Oriented Programming Using Java**	**3**	**0**	**0**	**3**	**3**	**S/EM**	**Nil**
8	CSS2256	**Object Oriented Programming Using Java Lab**	**0**	**0**	**2**	**1**	**2**	**S/EM**	**Nil**
9	CSD1712	Statistical Foundations for Data Science	3	0	0	3	**3**	S	MAT2403
10	CSD1713	Statistical Foundations Lab for Data Science Lab	0	0	2	1	**2**	S	MAT2403
11	CSS2257	**Computer Organization and Architecture**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
12	CSS2258	**Web Technologies**	**3**	**0**	**0**	**3**	**3**	**S/EM**	**Nil**
13	CSS2259	**Web Technologies Lab**	**0**	**0**	**2**	**1**	**2**	**S/EM**	**Nil**
14	CSS2260	**Database Management Systems**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
15	CSS2261	**Database Management Systems Lab**	**0**	**0**	**2**	**1**	**2**	**S**	**Nil**
16	CSS2262	**Analysis of Algorithms**	**3**	**1**	**0**	**4**	**4**	**S**	**Nil**
17	CSS2263	**Analysis of Algorithms Lab**	**0**	**0**	**2**	**1**	**2**	**S**	**Nil**
18	**CSS2266**	**Theory of Computation**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
19	CSD2002	Introduction to Data Science	3	0	0	3	3	F	NIL
20	CSD2007	R programming for Data Science	3	0	0	3	**2**	S/EM	**Nil**

21	CSD2008	R programming Lab for Data Science	0	0	2	1	**2**	S/EM	**Nil**
22	CSS2269	**Operating Systems**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
23	CSS2270	**Operating Systems Lab**	**0**	**0**	**2**	**1**	**2**	**S/EM**	**Nil**
24	CSD2009	Data Handling and Visualization	2	0	0	2	2	S/EM	Nil
25	CSD2010	Data Handling and Visualization Lab	0	0	4	2	2	S/EM	Nil
26	**CSS2271**	**Software Design and Development**	**3**	**0**	**0**	**3**	**3**	**S**	**Nil**
27	CSD2021	Machine Learning for Intelligent data Science	3	0	0	3	3	S/EM	Nil
28	CSD2024	Machine Learning Lab for Intelligent data Science	0	0	2	1	2	S/EM	Nil
29	CSD2501	Predictive Analytics	2	0	0	2	2	S/EM	CSS1500
30	CSD2502	Predictive Analytics Lab	0	0	2	1	4	S/EM	CSS1500
Total No. of Credits						**64**			

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

Table 3.5 : List of course in Project Work basket (PRW)

S.No	Course Code	Course Name	L	T	P	C
1	CSS7000	Internship	0	0	0	2
2	CSS7100	Mini Project	0	0	0	4
3	CSS7300	Capstone Project	0	0	0	10
					Total No. of Credits	**16**

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

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

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

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

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

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

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

18.3 Capstone Project

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

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

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

18.3.3 The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Capstone Project, as stated in Sub-Clause 18.3.2 above.

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

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

18.4 Research Project / Dissertation

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

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

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 18.4.4). 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 Specializations / Stream Basket

Type of Skill
F - Foundation
S - Skill Development

Course Caters to
GS - Gender Sensitization
ES - Environment and sustainability

EM – Employability

EN – Entrepreneurship
SS-Soft Skills
AT-Aptitude Training

HP - Human values and Professional Ethics

Table 3.6 : 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	C.H	Type of Skill	Pre Requisite
PEC 1	Sem V	CSD3416	Probabilistic Modelling for Machine Learning	3	0	0	3	3	F	MAT1212
		CSD3405	Text Mining and Analytics	2	0	2	3	4	EM	CSE2064
PEC-II	SemVI	CSS3426	Front End Full Stack Development*	2	0	2	3	S/ EM		CSE2058
PEC III	Sem VI	CSS3427	Java Full Stack Development*	2	0	2	3	S/ EM		CSE2059
		CSS3428	.Net Full Stack Development*	2	0	2	3	S/ EM		CSE2058
PEC -IV	Sem VII	CSD3412	Graph Analytics	3	0	0	3	3	EM	MAT2311
PEC-IV		CSD3415	NextGen Predictive Analytics	2	0	2	3	4	EM	CSD2011
PEC -V		CSD3406	Business Intelligence and Analytics	3	0	0	3	3	EM	CSD2009
PEC -VI		CSD3411	Cybersecurity and Data Privacy	3	0	0	3	3	EM	-

Track 2 - Business Analytics and Data Visualization

S.No		Course Code	Course Name	L	T	P	C	C.H	Typeof Skill	Pre Requisite
PEC 1	Sem V	CSD3413	Data Visualization and Dashboards	3	0	0	3	3	S	CSD2009
		CSD3402	Web Data Analytics	2	0	2	3	4	EM	CSS1500
PEC-II	SemVI	CSS3426	Front End Full Stack Development*	2	0	2	3	S/ EM		CSE2058
PEC III	Sem VI	CSS3427	Java Full Stack Development*	2	0	2	3	S/ EM		CSE2059
		CSS3428	.Net Full Stack Development*	2	0	2	3	S/ EM		CSE2058
PEC -IV	Sem VII	CSD3404	E-Business and Marketing Analytics	2	0	2	3	4	EM	CSD2002
PEC-IV		CSD3410	IoT and Sensor Data Analysis	3	0	0	3	3	EM	CSE1014
PEC -V		CSD3409	Financial Data Analysis	2	0	2	3	4	EM	CSD2002
PEC -VI		CSD3401	Business Continuity and Risk Analysis for Data Science	3	0	0	3	3	EM	CSD2002

Track 3 –Computational Mathematics and Statistics											
S.No		Course Code	Course Name	L	T	P	C	C.H	Typeof Skill	Pre Requisite	
PEC 1	Sem V	CSD3407	Statistical Inference and Modelling	3	0	0	3	3	S/ EM	MAT1212	
		CSD3414	Statistics-Driven Data Science	2	0	2	3	4	S/ EM	MAT1212	
PEC-II	SemVI	CSS3426	Front End Full Stack Development*	2	0	2	3	4	S/ EM	CSE2058	
PEC III	Sem VI	CSS3427	Java Full Stack Development*	2	0	2	3	4	S/ EM	CSE2059	
		CSS3428	.Net Full Stack Development*	2	0	2	3	4	S/ EM	CSE2058	
PEC -IV	Sem VII	CSD3408	Data Mining and Warehousing	3	0	0	3	3	EM	CSE1510	
		CSD2006	Edge AI and IoT Analytics	3	0	0	3	3	EM		
PEC-IV		CSD3417	Scientific Computing for Intelligent Systems	3	0	0	3	3	EM	CSS1500	
PEC –V		CSD3403	Optimization for Data Science	2	0	2	3	4	F	MAT1003	
PEC –VI		CSD3418	Feature Engineering and Model Optimization	3	0	0	3	3	EM	CSS1500	

Track 04: Special Basket									
1	CAI3427	Language Models for Text Mining+	2	0	2	3	4	S/EM	CSS2264
2	CAI3428	Practical Deep Learning with TensorFlow+	2	0	2	3	4	S/EM	CSS2264
3	CAI3429	Deep Learning Techniques for Computer Vision+	2	0	2	3	4	S/EM	MAT1212

Track -5 Mandatory Non-Credited Course (** Offered for Lateral Entry students in higher semester wherever applicable in MOOC mode)									
1	LAW7601	Indian Constitution **	1	0	0	0	1	F	Nil
2	CHE7601	Environmental Studies **	1	0	0	0	1	F	Nil
3	CIV7601	Universal Human Values and Ethics **	1	0	0	0	1	F	Nil
4	PPS1025	Industry Readiness Program - I	0	0	2	0	2	SS	Nil
5	PPS1026	Industry Readiness Program - II	0	0	2	0	2	SS	Nil
6	APT4002	Introduction to Aptitude	0	0	2	0	2	AT	Nil
7	APT4004	Aptitude Training - Intermediate	0	0	2	0	2	AT	Nil
8	APT4006	Logical and Critical Thinking	0	0	2	0	2	AT	Nil
Track 06: PayTM_Curriculum Structure									
1	Sem V	Advanced Statistical Computing and Applied Inference Systems	2	0	2	3			Nil
2	Sem VI	Predictive Systems Engineering for Structured Data	2	0	2	3			Nil

3	Sem VI	Data Engineering Pipelines and Visual Analytics for Strategic Communication	2	0	2	3			Nil
4	Sem VII	Distributed Data Systems and High-Throughput Analytics	2	0	2	3			Nil
5	Sem VII	Multidimensional Data Modeling and Representation Learning	2	0	2	3			Nil
6	Sem VII	Operational Analytics and Computational Optimization Techniques	2	0	2	3			Nil
7	Sem VII	Mini Project/Hackathon - Data Innovation Challenge	0	0	0	4			Nil
8	Sem VIII	Capstone Project - Intelligent Data Product Design and Deployment	0	0	0	10			Nil
Track 07:Infosys Springboard courses									
CSD3500	Data Science:Complete Data Science & Machine Learning								
CSD3501	Python for Machine Learning & Data Science Masterclass								
Track 08:Nasscom Courses									
CSD4500	Data Science for Beginners								
CSD4501	Python for Data Science								

*Mandatory for Students selected for Tech Mahindra and Capgemini

** Offered for Lateral Entry students in higher semester wherever applicable in MOOC mode

+Mandatory for Students Selected for Samsung Innovation Campus

20. List of Open Electives to be offered by the School / Department (Separately for ODD and EVEN Semesters.

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

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

Baskets
HSMC - Humanities and Social Sciences (including Management courses) (HSMC)
BSC - Basic Science Courses ESC - Engineering Science Courses
PCC - Professional Core Course
PEC - Professional Elective Courses
OEC - Open Elective Courses
EEC - Employment Enhancement Courses

MAC - Mandatory Course

Table 3.7: Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 06										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites/ Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Prerequisite**
Chemistry Basket										
CHE1003	Fundamentals of Sensors	3	0	0	3	S	ES	-	-	-
CHE1004	Smart materials for IOT	3	0	0	3	S	ES	-	-	-
CHE1005	Computational Chemistry	2	0	0	2	S	ES	-	-	-
CHE1006	Introduction to Nano technology	3	0	0	3	S	ES	-	-	-
CHE1007	Biodegradable electronics	2	0	0	2	S	ES	-	-	-
CHE1008	Energy and Sustainability	2	0	0	2	S	ES	-	-	-
CHE1009	3D printing with Polymers	2	0	0	2	S	ES	-	-	-
CHE1010	Bioinformatics and Healthcare IT	2	0	0	2	S	ES	-	-	-
CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	S	ES	-	-	-
CHE1012	Introduction to Composite materials	2	0	0	2	S	ES	-	-	-
CHE1013	Chemistry for Engineers	3	0	0	3	S	ES	-	-	-
CHE1014	Surface and Coatings technology	3	0	0	3	S	ES	-	-	-
CHE1015	Waste to Fuels	2	0	0	2	S	ES	-	-	-
CHE1016	Forensic Science	3	0	0	3	S	ES	-	-	-
Civil Engineering Basket										
CIV1001	Disaster mitigation and management	3	0	0	3	S	-	-	-	-
CIV1002	Environment Science and Disaster Management	3	0	0	3	FC	-	-	-	-

CIV2001	Sustainability Concepts in Engineering	3	0	0	3	S	-	-	-	-
CIV2002	Occupational Health and Safety	3	0	0	3	S	-	-	-	-
CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	EM	-	-	-	-
CIV2004	Integrated Project Management	3	0	0	3	EN	-	-	-	-
CIV2005	Environmental Impact Assessment	3	0	0	3	EN	-	-	-	-
CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EN	-	-	-	-
CIV2044	Geospatial Applications for Engineers	2	0	2	3	EM	-	-	-	-
CIV2045	Environmental Meteorology	3	0	0	3	S	-	-	-	-
CIV3046	Project Problem Based Learning	3	0	0	3	S	-	-	-	-
CIV3059	Sustainability for Professional Practice	3	0	0	3	EN	-	-	-	-
Commerce Basket										
COM2001	Introduction to Human Resource Management	2	0	0	2	F	HP/GS	-	-	-
COM2002	Finance for Non Finance	2	0	0	2	S	-	-	-	-
COM2003	Contemporary Management	2	0	0	2	F	-	-	-	-
COM2004	Introduction to Banking	2	0	0	2	F	-	-	-	-
COM2005	Introduction to Insurance	2	0	0	2	F	-	-	-	-
COM2006	Fundamentals of Management	2	0	0	2	F	-	-	-	-
COM2007	Basics of Accounting	3	0	0	3	F	-	-	-	-
Computer Science Basket										
(not to be offered for Computer Science and Engineering students)										
CSS2002	Programming in Java	2	0	2	3	S/EM	-	-	-	-
CSS2003	Social Network Analytics	3	0	0	3	S	GS	-	-	-
CSS2004	Python Application Programming	2	0	2	3	S/ EM	-	-	-	-

CSS2005	Web design fundamentals	2	0	2	3	S/ EM/EN	-	-	-	-
Design Basket										
DES1001	Sketching and Painting	0	0	2	1	S	-	-	-	-
DES1002	Innovation and Creativity	2	0	0	2	F	-	-	-	-
DES1121	Introduction to UX design	1	0	2	2	S	-	-	-	-
DES1122	Introduction to Jewellery Making	1	0	2	2	S	-	-	-	-
DES1124	Spatial Stories	1	0	2	2	S	-	-	-	-
DES1125	Polymer Clay	1	0	2	2	S	-	-	-	-
DES2001	Design Thinking	3	0	0	3	S	-	-	-	-
DES1003	Servicability of Fashion Products	1	0	2	2	F	ES	-	-	-
DES1004	Choices in Virtual Fashion	1	0	2	2	F	ES, GS, HP	-	-	-
DES1005	Fashion Lifestyle and Product Diversity	1	0	2	2	F	ES, GS, HP	-	-	-
DES1006	Colour in Everyday Life	1	0	2	2	F	ES	-	-	-
DES2080	Art of Design Language	3	0	0	3	S	-	-	-	-
DES2081	Brand Building in Design	3	0	0	3	S	-	-	-	-
DES2085	Web Design Techniques	3	0	0	3	S	-	-	-	-
DES2089	3D Modeling for Professionals	1	0	4	3	S	-	-	-	-
DES2090	Creative Thinking for Professionals	3	0	0	3	S	-	-	-	-
DES2091	Idea Formulation	3	0	0	3	S	-	-	-	-
Electrical and Electronics Basket										
EEE1002	IoT based Smart Building Technology	3	0	0	3	S	-	-	-	-
EEE1003	Basic Circuit Analysis	3	0	0	3	S	-	-	-	-
EEE1004	Fundamentals of Industrial Automation	3	0	0	3	S	-	-	-	-
EEE1005	Electric Vehicles & Battery Technology	3	0	0	3	S	-	-	-	-
EEE1006	Smart Sensors for Engineering Applications	3	0	0	3	S	-	-	-	-

Electronics and Communication Basket										
ECE1003	Fundamentals of Electronics	3	0	0	3	F	-	-	-	-
ECE1004	Microprocessor based systems	3	0	0	3	F	-	-	-	-
ECE3089	Artificial Neural Networks	3	0	0	3	S	-	-	-	-
ECE3097	Smart Electronics in Agriculture	3	0	0	3	F/EM	-	-	-	-
ECE3098	Environment Monitoring Systems	3	0	0	3	F/EM	-	-	-	-
ECE3102	Consumer Electronics	3	0	0	3	F/EM	-	-	-	-
ECE3103	Product Design of Electronic Equipment	3	0	0	3	S/F/ EM / EN	-	-	-	-
ECE3106	Introduction to Data Analytics	3	0	0	3	F/EM	-	-	-	-
ECE3107	Machine Vision for Robotics	3	0	0	3	F/EM	-	-	-	-
English Basket										
ENG1008	Indian Literature	2	0	0	2	-	GS/ HP	-	-	-
ENG1009	Reading Advertisement	3	0	0	3	S	-	-	-	-
ENG1010	Verbal Aptitude for Placement	2	0	2	3	S	-	-	-	-
ENG1011	English for Career Development	3	0	0	3	S	-	-	-	-
ENG1012	Gender and Society in India	2	0	0	2	-	GS/ HP	-	-	-
ENG1013	Indian English Drama	3	0	0	3	-	-	-	-	-
ENG1014	Logic and Art of Negotiation	2	0	2	3	-	-	-	-	-
ENG1015	Professional Communication Skills for Engineers	1	0	0	1	-	-	-	-	-
DSA Basket										
DSA2001	Spirituality for Health	2	0	0	2	F	HP	-	-	-
DSA2002	Yoga for Health	2	0	0	2	S	HP	-	-	-
DSA2003	Stress Management and Well Being	2	0	0	2	F	-	-	-	-
Kannada Basket										
KAN1001	Kali Kannada	1	0	0	1	S	-	-	-	-
KAN1003	Kannada Kaipidi	3	0	0	3	S	-	-	-	-

KAN2001	Thili Kannada	1	0	0	1	S	-	-	-	-
KAN2003	Pradharshana Kale	1	0	2	2	S	-	-	-	-
KAN2004	Sahithya Vimarshe	2	0	0	2	S	-	-	-	-
KAN2005	Anuvadha Kala Sahithya	3	0	0	3	S	-	-	-	-
KAN2006	Vichara Manthana	3	0	0	3	S	-	-	-	-
KAN2007	Katha Sahithya Sampada	3	0	0	3	S	-	-	-	-
KAN2008	Ranga Pradarshana Kala	3	0	0	3	S	-	-	-	-
Foreign Language Basket										
FRL1004	Introduction of French Language	2	0	0	2	S	S	-	-	-
FRL1005	Fundamentals of French	2	0	0	2	S	S	-	-	-
FRL1009	Mandarin Chinese for Beginners	3	0	0	3	S	S	-	-	-
Law Basket										
LAW1001	Introduction to Sociology	2	0	0	2	F	HP		-	-
LAW2001	Indian Heritage and Culture	2	0	0	2	F	HP/GS		-	-
LAW2002	Introdcution to Law of Succession	2	0	0	2	F	HP/GS		-	-
LAW2003	Introduction to Company Law	2	0	0	2	F	HP		-	-
LAW2004	Introduction to Contracts	2	0	0	2	F	HP	-	-	-
LAW2005	Introduction to Copy Rights Law	2	0	0	2	F	HP	-	-	-
LAW2006	Introduction to Criminal Law	2	0	0	2	F	HP	-	-	-
LAW2007	Introduction to Insurance Law	2	0	0	2	F	HP	-	-	-
LAW2008	Introduction to Labour Law	2	0	0	2	F	HP	-	-	-
LAW2009	Introduction to Law of Marriages	2	0	0	2	F	HP/GS	-	-	-
LAW2010	Introduction to Patent Law	2	0	0	2	F	HP	-	-	-
LAW2011	Introduction to Personal Income Tax	2	0	0	2	F	HP	-	-	-
LAW2012	Introduction to Real Estate Law	2	0	0	2	F	HP	-	-	-

LAW2013	Introduction to Trademark Law	2	0	0	2	F	HP	-	-	-
LAW2014	Introduction to Competition Law	3	0	0	3	F	HP	-	-	-
LAW2015	Cyber Law	3	0	0	3	F	HP	-	-	-
LAW2016	Law on Sexual Harrassment	2	0	0	2	F	HP/GS	-	-	-
LAW2017	Media Laws and Ethics	2	0	0	2	F	HP/GS	-	-	-
Mathematics Basket										
MAT2008	Mathematical Reasoning	3	0	0	3	S	-	-	-	-
MAT2014	Advanced Business Mathematics	3	0	0	3	S	-	-	-	-
MAT2041	Functions of Complex Variables	3	0	0	3	S	-	-	-	-
MAT2042	Probability and Random Processes	3	0	0	3	S	-	-	-	-
MAT2043	Elements of Number Theory	3	0	0	3	S	-	-	-	-
MAT2044	Mathematical Modelling and Applications	3	0	0	3	S	-	-	-	-
Mechanical Basket										
MEC1001	Fundamentals of Automobile Engineering	3	0	0	3	F	-	-	-	-
MEC1002	Introduction to Matlab and Simulink	3	0	0	3	S/EM	-	-	-	-
MEC1003	Engineering Drawing	1	0	4	3	S	-	-	-	-
MEC2001	Renewable Energy Systems	3	0	0	3	F	ES	-	-	-
MEC2002	Operations Research & Management	3	0	0	3	F	-	-	-	-
MEC2003	Supply Chain Management	3	0	0	3	S/ EM/ EN	-	-	-	-
MEC2004	Six Sigma for Professionals	3	0	0	3	S/EM	-	-	MEC2008	-
MEC2005	Fundamentals of Aerospace Engineering	3	0	0	3	F	-	-	-	-
MEC2006	Safety Engineering	3	0	0	3	S/EM	ES	-	-	-
MEC2007	Additive Manufacturing	3	0	0	3	F/EM	-	-	-	-
MEC3069	Engineering Optimisation	3	0	0	3	S/EM	-	-	-	-

MEC3070	Electronics Waste Management	3	0	0	3	F/S	ES	-	-	-
MEC3071	Hybrid Electric Vehicle Design	3	0	0	3	S/EM	ES	-	-	-
MEC3072	Thermal Management of Electronic Appliances	3	0	0	3	S/EM	-	-	-	-
MEC3200	Sustainable Technologies and Practices	3	0	0	3	S/EM	-	-	-	-
MEC3201	Industry 4.0	3	0	0	3	S/EM	-	-	-	-
Petroleum Basket										
PET1011	Energy Industry Dynamics	3	0	0	3	FC	ES	-	NIL	-
PET1012	Energy Sustainability Practices	3	0	0	3	FC	ES	-	NIL	-
Physics Basket										
PHY1003	Mechanics and Physics of Materials	3	0	0	3	FC / SD				
PHY1004	Astronomy	3	0	0	3	FC				
PHY1005	Game Physics	2	0	2	3	FC / SD				
PHY1006	Statistical Mechanics	2	0	0	2	FC				
PHY1007	Physics of Nanomaterials	3	0	0	3	FC				
PHY1008	Adventures in nanoworld	2	0	0	2	FC				
PHY2001	Medical Physics	2	0	0	2	FC	ES			
PHY2002	Sensor Physics	1	0	2	2	FC / SD				
PHY2003	Computational Physics	1	0	2	2	FC				
PHY2004	Laser Physics	3	0	0	3	FC	ES			
PHY2005	Science and Technology of Energy	3	0	0	3	FC	ES			
PHY2009	Essentials of Physics	2	0	0	2	FC				
Management Basket- I										
MGT2007	Digital Entrepreneurship	3	0	0	3	S/EM/EN	-	-	-	-
MGT2015	Engineering Economics	3	0	0	3	S	-	-	-	-
MGT2023	People Management	3	0	0	3	S/EM/EN	HP	-	-	-
Management Basket- II										
MGT1001	Introduction to Psychology	3	0	0	3	F	HP	-	-	-

MGT1002	Business Intelligence	3	0	0	3	EN	-	-	-	-
MGT1003	NGO Management	3	0	0	3	S	-	-	-	-
MGT1004	Essentials of Leadership	3	0	0	3	EM/ EN	GS/ HP	-	-	-
MGT1005	Cross Cultural Communicatio n	3	0	0	3	S/EM/ EN	HP	-	-	-
MGT2001	Business Analytics	3	0	0	3	S/ EM/EN	-	-	-	-
MGT2002	Organizational Behaviour	3	0	0	3	F	HP	-	-	-
MGT2003	Competitive Intelligence	3	0	0	3	S	-	-	-	-
MGT2004	Development of Enterprises	3	0	0	3	S/EM/E N	-	-	-	-
MGT2005	Economics and Cost Estimation	3	0	0	3	S/EM	-	-	-	-
MGT2006	Decision Making Under Uncertainty	3	0	0	3	S	-	-	-	-
MGT2008	Econometrics for Managers	3	0	0	3	S	-	-	-	-
MGT2009	Management Consulting	3	0	0	3	S/EM/E N	-	-	-	-
MGT2010	Managing People and Performance	3	0	0	3	S/EM/E N	HP/GS	-	-	-
MGT2011	Personal Finance	3	0	0	3	F	-	-	-	-
MGT2012	E Business for Management	3	0	0	3	S/EM	-	-	-	-
MGT2013	Project Management	3	0	0	3	EN / EM	GS/HP/ ES	-	-	-
MGT2014	Project Finance	3	0	0	3	EN / EM	HP	-	-	-
MGT2016	Business of Entertainment	3	0	0	3	EM/ EN	-	-	-	-
MGT2017	Principles of Management	3	0	0	3	S/EM/ EN	-	-	-	-
MGT2018	Professional and Business Ethics	3	0	0	3	S/EM/ EN	HP	-	-	-
MGT2019	Sales Techniques	3	0	0	3	S/EM/ EN	HP	-	-	-
MGT2020	Marketing for Engineers	3	0	0	3	S/EM/ EN	HP	-	-	-
MGT2021	Finance for Engineers	3	0	0	3	S/EM/ EN	HP	-	-	-
MGT2022	Customer Relationship Management	3	0	0	3	S/EM/ EN	HP	-	-	-
Media Studies Basket										

BAJ3050	Corporate Filmmaking and Film Business	0	0	4	2	EM	HP	-	-	-
BAJ3051	Digital Photography	2	0	2	3	EM	HP	-	-	-
BAJ3055	Introduction to News Anchoring and News Management	0	0	2	1	EM	-	-	-	-

Table 3.8 : List of Mandatory Courses (MAC)

S.No	Course Code	Course Name	L	T	P	C
1	CHE7601	Environmental Studies	1	0	0	0
2	LAW7601	Indian Constitution	1	0	0	0
3	CIV7601	Universal Human Values and Ethics	1	0	0	0
4	PPS1025	Industry Readiness Program - I	0	0	2	0
5	PPS1026	Industry Readiness Program - II	0	0	2	0
6	APT4002	Introduction to Aptitude	0	0	2	0
7	APT4004	Aptitude Training - Intermediate	0	0	2	0
8	APT4006	Logical and Critical Thinking	0	0	2	0
				Total No. of Credits		**0**

21. List of MOOC Courses

21.1 Presidency University students are given the opportunity to study abroad in International Universities through a selection process coordinated by the Office of International Affairs (OIA). Such selected students need to complete their credits for the semester that they are abroad in the following way:

21.1.1. The student needs to study and complete School Core and Program Core Courses in offline mode only.

21.1.2. Massive Open Online Course (MOOC) courses maybe given for Open Elective and Discipline Elective Courses. These courses need to be approved by the concerned BOS and Academic Council from time to time.

21.1.3. SWAYAM/NPTEL/ other approved MOOCs shall be approved by the concerned Board of Studies and placed in the concerned PRC.

21.1.4. Student shall register for these courses in the ERP of Presidency University.

21.1.5. For these MOOC courses faculty coordinators are identified. These faculty should have undergone similar MOOC courses and therefore should be familiar with the mode of class conduction, types of assessments and evaluation procedures.

21.1.6. Study materials shall be provided to the students as video lectures shared by the MOOCs Coordinator(s), or the students may access the approved MOOCs Portal directly. The mode of class conduction is determined by the MOOCs coordinator(s) as detailed in the Course Catalogue and Course Plan.

21.1.7. The question paper shall be prepared by the MOOCs coordinator(s).

21.1.8. Students write the exams in online mode. These exams are scheduled and conducted by the School.

21.1.9. Results are evaluated by School and given to the Office of the Controller of Examinations (CoE).

21.1.10. The details of the duration, credits and evaluation are given below:

Sl#	Duration	Credits	Evaluation

1.	12 weeks	3	Continuous Assessment –50 Marks Mid Term –50 Marks End Term-100 Marks
2.	8 weeks	2	Mid Term-50 Marks End Term-100 Marks
3	4 weeks	1	End Term-100 Marks

21.2 List of MOOC – B.Tech. Computer Science and Engineering Program (Data Science).

Table 3.9: MOOC Professional Elective Courses for B.Tech. Computer Science and Engineering Program (Data Science) Duration is 4 weeks (01 credit) / 8 weeks (02 credits) / 12 weeks (03 credits)

Sl.	Course Code	Course Name	L	T	P	C	Contact Hours
1	CSE3111	Artificial Intelligence: Search Methods for Problem Solving	3	0	0	3	3
2	CSE3112	Privacy and Security in Online social media	3	0	0	3	3
3	CSE3113	Computational Complexity	3	0	0	3	3
4	CSE3114	Deep Learning for Computer Vision	3	0	0	3	3
5	CSE3115	Learning Analytics Tools	3	0	0	3	3
6	CSE502	Technical Skills in JAVA	0	0	6	3	6
7	CSE503	Technical Skills in Python	0	0	6	3	6
8	CSE504	Comprehensive Technical Skills	0	0	1	5	1
9	CSE505	The Joy of Computing Using Python	3	0	0	3	3
10	CSE3119	Coding Skills in Python	3	0	0	3	3
11	CSE3121	Parallel Computer Architecture	3	0	0	3	3
12	CSE3124	Games and Information	3	0	0	3	3
13	CSE3140	Introduction to Industry 4.0 and Industrial Internet of Things	3	0	0	3	3
14	CSE3142	Affective Computing	3	0	0	3	3
15	CSE3196	Foundations of Cyber Physical Systems	3	0	0	3	3
16	CSE3197	Getting Started with Competitive Programming	3	0	0	3	3
17	CSE3198	GPU Architectures and Programming	3	0	0	3	3
18	CSE3199	Artificial Intelligence: Knowledge Representation and Reasoning	3	0	0	3	3
19	CSE3200	Programming in Modern C++	3	0	0	3	3
20	CSE3201	Circuit Complexity Theory	3	0	0	3	3
21	CSE3202	Basics of Computational Complexity	3	0	0	3	3
22	CSE3212	Introduction to Computer and Network Performance Analysis using Queuing	1	0	0	1	1
23	CSE3213	C Programming and Assembly Language	1	0	0	1	1
24	CSE3214	Python for Data Science	1	0	0	1	1
25	CSE3215	Software Conceptual Design	1	0	0	1	1
26	CSE3117	Industrial Digital Transformation	3	0	0	3	3
27	CSE3118	Blockchain for Decision Makers	3	0	0	3	3
28	CSE3349	Technology for Lawyers	3	0	0	3	3
29	CSE3430	Deep Learning for Natural Language Processing	3	0	0	3	3
30	CSE3431	Machine Learning for Engineering and Science Applications	3	0	0	3	3

31	CSE3432	Algorithms in Computational Biology and Sequence Analysis	3	0	0	3	3
32	CSE3433	Introduction to Large Language Models (LLMs)	3	0	0	3	3
33	CSE3434	Quantum Algorithms and Cryptography	3	0	0	3	3

21.3MOOC - Open Elective Courses for B. Tech. (Computer Science and Engineering-Data Science)

Table 3.10: MOOC Open Elective Courses

Open Elective Courses Duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)

Sl. No.	Course code	Course Name	L	T	P	C
1	BBA2022	Supply Chain digitization	3	0	0	3
2	BBA2021	E Business	3	0	0	3
3	BBB2016	Business Analytics for Management Decisions	3	0	0	3
4	BBB2015	Artificial Intelligence for Investments	3	0	0	3
5	MEC3001 *	Design and Development of Product	1	0	0	1
6	ENG3004 **	Perspectives of Neurolinguistics	1	0	0	1
7	PPS4009 ***	Working in Contemporary Teams	1	0	0	1
8	MGT3001	Data Analysis and Decision Making	3	0	0	3

Note :

** MEC3001 is offered to the students who had 1 credit shortage because of implementation of CBCS system during their 1st year.*

*** ENG3004 is offered to the students who had 2 credits shortage along with the MEC3001 because of implementation of CBCS System during their 1st year.*

**** PPS4009 is offered to only International students in place of Interview Preparedness course of their batch mates.*

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

Sl. No.		Course Name	L	T	P	Credits	Contact Hours	Type of Skill	Pre-requisite	Basket
Semester 1 - PHY Cycle			**15**	**1**	**8**	**21**	**28**			
1	MAT1211	Linear Algebra, Differential Equations and Statistical Methods	3	1	0	4	4	F	Nil	BSC
2	PHY2501	Optoelectronics and Quantum Physics	3	0	0	3	3	F	Nil	BSC
3	MEC1006	Engineering Graphics	2	0	0	2	2	S	Nil	ESC
4	ENG1030	Fundamentals of Communication	1	0	2	2	3	S	Nil	HSMC
5	CSS1500	Computational Thinking using Python	2	0	2	3	4	S	Nil	ESC
6	ECE20	Digital Design	2	0	0	2	2	F/S	Nil	ESC

	22									
7	ECE1512	Design Thinking in Practice	2	0	2	3	4	F	Nil	HSMC
8	PHY2504	Optoelectronics and Quantum Physics Lab	0	0	2	1	2	F	Nil	BSC
9	PPS1025	Industry Readiness Program – I	0	0	2	0	2	S	Nil	MAC
10	ECE2052	Digital Design Lab	0	0	2	1	2	F/S	Nil	ESC
Semester 2 - CHE Cycle			**14**	**1**	**10**	**20**	**27**			
1	MAT1212	Mathematical foundations for Machine Learning and Data Analysis	3	1	0	4	4	F	Nil	BSC
2	CIV1200	Foundations of Integrated Engineering	2	0	0	2	2	S	Nil	ESC
3	CHE2501	Chemistry of Smart Materials	3	0	0	3	3	S	Nil	BSC
4	CSS2200	Problem Solving using C	2	0	0	2	2	S	Nil	PCC
5	ENG2030	Communication in Practice	1	0	2	2	3	S	Nil	HSMC
6	EEE1200	Basics of Electrical and Electronics Engineering	3	0	0	3	3	F/S	Nil	ESC
7	CSS2201	Problem Solving using C Lab	0	0	4	2	4	S	Nil	PCC
8	CHE2502	Chemistry of Smart Materials Lab	0	0	2	1	2	S	Nil	BSC
9	PPS1026	Industry Readiness Program – II	0	0	2	0	2	S	Nil	MAC
10	EEE1251	Basics of Electrical and Electronics Engineering Laboratory	0	0	2	1	2	F/S	Nil	ESC
Semester 3			**19**	**1**	**10**	**23**	**30**			
1	MAT2311	Vector Calculus, Numerical Methods and Sampling Distributions	3	1	0	4	4	EM	Nil	BSC
2	CSS2251	Data Communication and Computer Networks	3	0	0	3	3	S	Nil	PCC
3	CSS2252	Data Communication and Computer Networks Lab	0	0	2	1	2	S	Nil	PCC
4	CSS2253	Data Structures	3	0	0	3	3	S	Nil	PCC
5	CSS2254	Data Structures Lab	0	0	2	1	2	S	Nil	PCC
6	CSS2255	Object Oriented Programming Using Java	3	0	0	3	3	S/EM	Nil	PCC
7	CSS2256	Object Oriented Programming Using Java Lab	0	0	2	1	2	S/EM	Nil	PCC
8	CSD1712	Statistical Foundations of Data Science	3	0	0	3	3	S	Nil	PCC
9	CSD1713	Statistical Foundations of Data Science Lab	0	0	2	1	2	S	Nil	PCC
10	CSS2257	Computer Organization and Architecture	3	0	0	3	3	S	Nil	PCC

11	APT4002	Introduction to Aptitude	0	0	2	0	2	S	Nil	MAC
12	CIV7601	Universal Human Values and Ethics	1	0	0	0	1	S	Nil	MAC
Semester 4			**19**	**2**	**10**	**24**	**31**			
1	MAT2321	Discrete Mathematical Structures	3	1	0	4	4	F	Nil	BSC
2	CHE7601	Environmental Studies	1	0	0	0	1	F	Nil	MAC
3	CSS2258	Web Technologies	3	0	0	3	3	S/EM	Nil	PCC
4	CSS2259	Web Technologies Lab	0	0	2	1	2	S/EM	Nil	PCC
5	CSS2260	Database Management Systems	3	0	0	3	3	S	Nil	PCC
6	CSS2261	Database Management Systems Lab	0	0	2	1	2	S	Nil	PCC
7	CSS2262	Analysis of Algorithms	3	1	0	4	4	S	Nil	PCC
8	CSS2263	Analysis of Algorithms Lab	0	0	2	1	2	S	Nil	PCC
9	CSS2264	Essentials of AI	3	0	0	3	3	S/EM	Nil	ESC
10	CSS2265	Essentials of AI Lab	0	0	2	1	2	S/EM	Nil	ESC
11	FIN1002	Essentials of Finance	3	0	0	3	3	S	Nil	HSMC
12	APT4004	Aptitude Training – Intermediate	0	0	2	0	2	S	Nil	MAC
Semester 5			**17**	**0**	**10**	**23**	**27**			
1	CSS2266	Theory of Computation	3	0	0	3	3	S	Nil	PCC
2	CSD2002	Introduction to Data Science	3	0	0	3	3	F	NIL	PCC
3	CSD2007	R programming for Data Science	3	0	0	3	3	S/EM	Nil	PCC
4	CSD2008	R programming for Data Science Lab	0	0	2	1	2	S/EM	Nil	PCC
5	CSS2269	Operating Systems	3	0	0	3	3	S	Nil	PCC
6	CSS2070	Operating Systems Lab	0	0	2	1	2	S/EM	Nil	PCC
7	CSD2009	Data Handling and Visualization	2	0	0	2	2	S/EM	Nil	PCC
8	CSD2010	Data Handling and Visualization Lab	0	0	4	2	4	S/EM	Nil	PCC
9	CSSXXXX	Professional Elective – I	3	0	0	3	3	S/EM	Nil	PEC
10	CSS7000	Internship	0	0	0	2	0	S/EM	Nil	PRW
11	APT4006	Logical and Critical Thinking	0	0	2	0	2	S	Nil	MAC
Semester 6			**18**	**0**	**10**	**22**	**28**			

1	CSS2271	Software Design and Development	3	0	0	3	3	S	Nil	PCC
2	CSD2021	Machine Learning for Intelligent data Science	3	0	0	3	3	S/EM	Nil	PCC
3	CSD2024	Machine Learning for Intelligent data Science Lab	0	0	2	1	2	S/EM	Nil	PCC
4	CSD2501	Predictive Analytics	2	0	0	2	2	S/EM	CSS1500	PCC
5	CSD2502	Predictive Analytics Lab	0	0	2	1	2	S/EM	CSS1500	PCC
6	CSS2274	Competitive Programming and Problem Solving	0	0	4	2	4	S/EM	Nil	ESC
7	LAW7601	Indian Constitution	1	0	0	0	1	F	Nil	MAC
8	CSSXXXX	Professional Elective – II	3	0	0	3	3	S	Nil	PEC
9	CSSXXXX	Professional Elective – III	3	0	0	3	3	S	Nil	PEC
10	XXXXXXX	Open Elective – I	3	0	0	3	3	S	Nil	OEC
11	APT4005	Aptitude for Employability	0	0	2	1	2	S	Nil	HSMC
Semester 7			**12**	**0**	**2**	**17**	**14**			
1	CSSXXXX	Professional Elective – IV	3	0	0	3	3	S	Nil	PEC
2	CSSXXXX	Professional Elective – V	3	0	0	3	3	S	Nil	PEC
3	CSSXXXX	Professional Elective – VI	3	0	0	3	3	S	Nil	PEC
4	XXXXXXX	Open Elective – II	3	0	0	3	3	S	Nil	OEC
5	CSS7100	Mini Project	0	0	0	4	0	S	Nil	PRW
6	PPS3018	Preparedness for Interview	0	0	2	1	2	S	Nil	HSMC
Semester 8			**0**	**0**	**0**	**10**	**0**			
1	CSS7300	Capstone Project	0	0	0	10	0	S/EM	Nil	PRW
			115	**3**	**60**	**160**	**182**			

Course Catalogue

Course Code: MAT1211	**Course Title: Linear Algebra, Differential Equations and Statistical Methods** **Type of Course:1] School Core**	**- P- C**	**3**	**1**	**0**	**4**
Version No.						
Course Pre-requisites						
Anti-requisites						

Course Description	This course introduces fundamental mathematical concepts from linear algebra, differential calculus, ordinary differential equations and statistics. The content includes matrices, systems of linear equations, eigenvalues and eigenvectors, functions of several variables, differential equations, correlation and regression analysis, and curve fitting techniques. The course combines theoretical developments with illustrative applications drawn from scientific and engineering settings. The course emphasizes the application of these mathematical tools in solving problems in science and engineering. It extends student's problem-solving abilities through analytical and computational approaches, with focus on both theoretical understanding and applications.	
Course Objective	The objective of this course is to provide students with a strong mathematical foundation required for engineering and scientific studies. The course introduces fundamental concepts from linear algebra, differential calculus, ordinary differential equations, and statistical methods that are widely used in modeling, analysis and problem solving. It aims to familiarize students with mathematical techniques for representing engineering systems, studying relationships among variables, describing dynamic processes and interpreting data. The course serves as a foundation to prepare students for advanced engineering subjects that rely on mathematical modeling, computation and analytical methods.	
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Use linear algebra concepts to evaluate properties of matrices and quadratic forms. (L3) **CO2:** Apply matrix-based methods to solve systems of linear equations. (L3) **CO3:** Use fundamental theorems and analytical techniques of differential calculus to single variable functions. (L3) **CO4:** Apply the concepts of partial derivatives to multivariable functions. (L3) **CO5:** Solve first order ordinary differential equations using analytical methods. (L3) **CO6:** Employ statistical techniques for data analysis and to interpret relationships between variables. (L3)	
Course Content:		
Module 1	**Fundamentals of Linear Algebra**	**(15L+5T=20 Sessions)**
Matrices, echelon forms, rank of matrix, Systems of linear equations: Consistency, solution to system of linear homogeneous and non-homogeneous equations- Gauss elimination method, Gauss-Jordan method (Self-study), LU decomposition method, Network analysis using linear systems, Design of traffic patterns, Electrical circuits. Eigenvalue and eigenvector, diagonalization of symmetric matrices, quadratic forms.		
Module 2	**Differential Calculus**	**(15L+5T=20 Sessions)**
Introduction, limit, continuity, Rolle's theorem, mean value theorems, Indeterminate forms and L'Hôpital's rule. Partial derivatives, Euler's theorem, total derivative, Jacobians, Taylor's and Maclaurin's theorems, maxima, minima and saddle points, method of Lagrange multipliers, Current Growth in an RL Circuit, Velocity Estimation, Fuel consumption optimization, Cost function optimization.		
Module 3	**Ordinary Differential Equations**	**(6L+2T=8 Sessions)**
Definition, types of differential equations-variable separable, homogeneous, exact, linear and Bernoulli's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, Newton's law of cooling, Current in RL circuit.		
Module 4	**Statistical Methods and Curve Fitting**	**(9L+3T=12 Sessions)**
Measures of central tendency, moments, skewness, and kurtosis. Correlation - Karl Pearson's coefficient of correlation, rank correlation, multiple correlation. Regression analysis - lines of regression, multiple regression. Principle of least square, curve fitting- straight line, parabola and exponential curves, Stress and strain curve fitting, Feature selection and Prediction models.		
Targeted Applications & Tools that can be used:		

- Linear Algebra is applied to solve systems of equations in circuits, traffic flow, and network analysis, with eigenvalues and quadratic forms aiding stability and optimization studies.
- Differential Calculus supports process speed analysis, velocity estimation, and optimization techniques such as minimizing fuel consumption and cost functions.
- Differential Equations model dynamic behaviours like current in RL circuits, heat transfer in materials, and growth or decay in environmental and nuclear engineering.
- Statistical Methods and Curve Fitting enable effective data analysis through correlation, regression, and curve fitting, supporting predictive modeling and interpretation of experimental data such as stress-strain relationships.

Software: MATLAB, Python, R Programming, Mathematica, Scilab, Octave

Assignment:

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. B. S. Grewal, *Higher Engineering Mathematics*, 44th ed. New Delhi, India: Khanna Publishers, 2017.
2. D. C. Montgomery and G. C. Runger, *Applied Statistics and Probability for Engineers*, 7th ed. Hoboken, NJ, USA: Wiley, 2018.

References:

1. P. V. O'Neil, *Advanced Engineering Mathematics*, 8th ed. Boston, MA, USA: Cengage Learning, 2018.
2. R. I. Miller and J. E. Freund, *Probability and Statistics for Engineers*, 9th ed. Noida, India: Pearson Education Ltd., 2017.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2011.
4. V. Henner, T. Belozerova, and M. Khenner, *Ordinary and Partial Differential Equations*. Boca Raton, FL, USA: CRC Press, 2013.

E-resources/ Web links:

1. https://nptel.ac.in/courses/111105121
2. https://nptel.ac.in/courses/111106146
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_106839
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_61605
5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_134719
6. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TEXTBOOK_LIBRARY01_06082022_174

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

Catalogue prepared by	**Dr. Kavita Permi, Dr. Rahul M. P. and Dr. Athmakoori Prashant**
Recommended by the Board of Studies on	
Date of Approval by the	

Academic Council	

Course Code: PHY2501	Course Title: Optoelectronics and Quantum Physics Type of Course: School Core	L-T-P-C	3-0-0-3
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 and analytical skills.		
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Understand the concepts of electrical conducting properties of metal, semiconductor, and superconductivity. — Level 2 – Understand **CO2:** Understand the principles of quantum mechanics. — Level 2 – Understand **CO3:** Discuss the quantum concepts used in quantum computers. — Level 2 – Understand **CO4:** Explain the applications of lasers and optical fibers in various technological fields. — Level 2 – Understand		
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Applied Physics for Computer Science Cluster "and to attain the basic knowledge related to quantum mechanics and computation.		
Course Content:			
Module 1	Electrical Conductivity Of Solids And Semiconducting Devices	Assignment	11 Sessions
Topics: Classification of materials based on bandgap, Fermi energy and Fermi level, Fermi level in semiconductors, Law of mass action, Electrical conductivity of a semiconductor, Hall effect, Superconductivity, p-n junctions, Zener diode, Solar cells, I-V characteristics, and LEDs			
Module 2	Quantum Mechanics	Assignment	11 Sessions
Topics: Introduction, de-Broglie hypothesis, Heisenberg's uncertainty principle- statement and physical significance. Wave function-properties and physical significance. Schrodindger's time independent wave equation, Probability density and normalization of wave function. Wave Function in Ket Notation: Matrix form of wave function, Identity operator, Determination of I|0> and I|1>, Pauli Matrices and its operations on 0 and 1 states, Mention of Conjugate and Transpose, Unitary Matrix U, Examples: 2x2 Matrices and their multiplication (Inner Product), Probability, Orthogonality			
Module 3	Quantum Computing	Term paper	12 Sessions
Topics: Introduction to quantum computing, Moore's law & its end, Differences between classical and quantum computing, Concept of Qubit and its properties, . Representation of qubit by Bloch sphere, Quantum Gates: Single Qubit Gates: Quantum Not Gate, Pauli Z Gate, Hadamard Gate, Phase Gate (or S Gate), T Gate. Multiple Qubit Gates: Controlled gate - CNOT Gate, (Discussion for 4 different input states). Representation of Swap gate, Controlled - Z gate, Toffoli gate. Problems.			
Module 4	Lasers And Optical Fibers	Term paper	11 Sessions
Topics: Interactions of radiations with matter, expression for energy density of a system under thermal			

equilibrium in terms of Einstein's coefficients, conditions for LASER action using Einstein's coefficients, Characteristics of laser, conditions and requisites of laser, 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.
Targeted Application & Tools that can be used: 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. 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 Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications,2024. Quantum Computation and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, Cambridge Universities Press, 2010 Edition
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: https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live 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 Code:MEC1006	Course Name: Engineering Graphics Type of Course: School Core & Theory Only	L- T- P- C	2-0-0-2
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: CO1: Demonstrate competency in Engineering Graphics as per BIS conventions and standards. — Level 3 – Apply CO2: Comprehend the theory of projection for drawing projections of points, lines, and planes under different conditions. — Level 2 – Understand CO3: Prepare multiview orthographic projections of solids by visualizing them in different positions. — Level 3 – Apply CO4: Prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions. — Level 3 – Apply

Course Content:

Module 1	Introduction to Drawing	Assignment	Standard technical drawing	7 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 Lines and Plane Surfaces	Assignment	Projection methods Analysis	7 Sessions

Topics:
Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points in all 4 quadrants.Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only.

[10 Hours: Application Level]

Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	8 Sessions

Topics:
Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron in different positions (Problems resting on HP only and First angle projection).
[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: K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall. 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: **ENG1030**	**urse Title: Fundamentals of Communication** **Type of Course: Integrated**	**L-T-P-C**	1	0	2	2
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Fundamentals of Communication is a lab intensive, practice first integrated course designed to introduce first-year undergraduate engineering and computer science students to the foundational principles and advanced applications of effective communication across interpersonal, spoken, written, and digital contexts. Anchored in real world scenarios directly relevant to college life, cross-functional technical teams, and digital workplaces, the curriculum develops students' abilities to navigate cultural differences, speak with clarity, read texts critically, and write with precise					

	audience awareness. The course explicitly relies on scenario-based learning, interactive case studies, and hands-on lab applications to ensure that theoretical communication frameworks are immediately actionable. By guiding students from reflective self-awareness to complex digital and AI-mediated content creation, the course builds an enduring communicative foundation optimized for performance-oriented professional practice.
Course Objective	The course aims to explain the key principles of interpersonal, intercultural, and professional communication and apply them to real-world scenarios. It also focuses on developing spoken communication strategies, including structured delivery and impromptu responses, for academic and group contexts. Furthermore, it aims to develop effective writing skills to produce clear, coherent, and audience-appropriate texts across formal and professional contexts.
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. **Understand** the principles of interpersonal, intercultural, and professional communication in academic, social, and technical team contexts. 2. **Demonstrate** audience-centered spoken communication in individual presentations, group discussions, and simulated professional scenarios through vocal control, adaptive register, and collaborative engagement. 3. **Interpret** written, multimodal, and AI-generated texts to identify underlying assumptions, rhetorical strategies, logical errors, and credibility markers across diverse media and professional contexts. 4. **Utilize** plain-language principles and professional conventions to produce clear, purposeful, and appropriately formatted written and multimodal communication, including technical content adapted for non-specialist audiences. 5. **Employ** responsible and critical practices in AI-assisted communication by designing iterative prompts, evaluating generated outputs, and applying ethical frameworks in academic and professional contexts.

Course Content: Fundamentals of Communication

Module 1	**Communication in a New World**	**CA1 + Project Milestone**	**Deep Listening and Contextual Response Lab**	**06 Sessions**
The topics will be discussed through case studies: • The Communication Process: How Messages Are Sent, Received, and Misread • Verbal, Non-Verbal, and Vocal Communication in Everyday Contexts • Communication Breakdown: Recognising Barriers Across Psychological, Cultural, and Semantic Dimensions • Active Listening: Attention, Paraphrasing, and Purposeful Response; asking for clarification • Interpersonal Communication and Self-Awareness *(including cross-cultural dimensions)*				
Module 2	**Contemporary Speaking Practices**	**CA2, CA3, CA4**	**Narrative and Adaptive Oral Delivery** **Facilitated Stakeholder Group Discussion** **Simulated Workplace Crisis Briefing**	**15 Sessions**

The topics will be discussed through structured, individual presentations and group discussions:

- Elements of Spoken Communication: Voice, Clarity, and Presence
- Storytelling and Narrative in Spoken Contexts
- Structuring Spoken Messages: From Idea to Delivery
- Speaking with Confidence: Managing Anxiety and Building Presence
- Communicating in Groups: Participation, Productive Disagreement, and Turn-Taking
- Giving and Receiving Feedback Effectively
- Presentation Design and Delivery: Structure, Evidence, and Audience Engagement; eliciting responses
- Speaking for Technical and Non-Technical Audiences

Module 3	**Critical Reading**	**Project Milestone**	**Source Audit and Fallacy Brief**	**09 Sessions**

The topics will be discussed through case studies and real-world scenarios:

- Critical Reading: Purpose, Context, and Analytical Approach
- Perspective and Persuasion: Identifying Tone, Bias, and the Fact-Opinion Distinction
- Understanding Flawed Reasoning *(patterns of weak argumentation in everyday contexts)*
- Evaluating Sources: Credibility, Reliability, and AI-Generated Content; accuracy of the content
- Reading Multimodal Texts: Images, Infographics, and Digital Media

Module 4	**Writing with Purpose**	**CA 5 + Project Milestone**	**Technical Translation and Annotated Script**	**09 Sessions**

The topics will be discussed through case studies:

- Principles of Effective Writing: Clarity, Coherence, Precision and Concise; audience analysis
- Plain Language and Technical Communication: Making Complex Ideas Accessible
- Writing for Professional Contexts: Email, Formal Reports, and Correspondence
- Argumentative Writing: Claim, Evidence, and Logical Progression
- Summary Writing and Short-Form Academic Response

Module 5	**Communication in the Age of AI**	**CA 6 – Project Milestone**	**CA 6: Cross-Disciplinary Case Analysis and Defence**	**06 Sessions**

The topics will be discussed through case studies featuring real-world examples:

- AI as a Communication Tool: Capabilities, Limitations, and the Hallucination Problem
- Prompt Engineering: Communicating Effectively with AI Systems
- AI-Assisted Writing: Drafting, Refining, and Maintaining Your Voice
- Ethical and Legal Dimensions of AI in Communication *(includes India's Digital Personal Data Protection Act, 2023)*
- AI, Bias, and Critical Evaluation: Reading AI Outputs Responsibly

Targeted Application & Tools that can be used: Otter.ai, Microsoft Word/PowerPoint/Teams/Clipchamp/Whiteboard/OneNote/Forms/Copilot, Miro, Padlet, Canva, Mentimeter, AllSides Media Bias Ratings, Ad Fontes Media Bias Chart, Snopes/factcheck.rog, Zotero, NotebookLM, Canva, Adobe Express, CapCut, OBS Studio, Claude, ChatGPT, Gemini, DeepSeek, Google Docs

Project Work / Assignment:

1. **Multimodal Communication Portfolio** (Project) with multiple milestones: Continuous, milestone based. Developed across all five modules. Final consolidated submission at the end of the course. Develop a progressive, publicly shareable communication portfolio that demonstrates the student's ability to move a technical concept across multiple audiences, formats, and media.
2. **Active Listening and Contextual Response Lab** (Individual): Students listen to an unedited, multi-speaker audio recording of a real or simulated professional scenario. Under timed conditions, students produce a structured written brief consisting of four parts. Assessed on comprehension accuracy, analytical precision, quality of questioning, and practicality of the proposed strategy.
3. **Narrative and Adaptive Oral Delivery** (Individual): Each student delivers a 4-minute structured presentation. At the 3-minute mark, the faculty assessor introduces a counter-perspective or an unexpected constraint, and the student must adapt their argument in real time for the remaining minute. The assessment evaluates: the quality of the prepared 3 minutes; the quality of the improvised adaptation; and the degree to which the full 4 minutes function as a coherent whole.
4. **Facilitated Stakeholder Group Discussion** (Group): Groups of 5–6 students are each assigned a distinct stakeholder position within a shared scenario. and must engage in a live, facilitated discussion to resolve a stated policy impasse. No prepared scripts are permitted; students receive their role brief 15 minutes before the discussion begins. Assessment is individual, not group-level.
5. **Simulated Workplace Crisis Briefing** (Group)**:** Groups of 4–5 students receive an unexpected corporate or institutional emergency brief. Teams have exactly 30 minutes to read the brief, distil the critical information, assign speaking roles, and prepare a 5-minute status update for a simulated leadership panel.
6. **Technical Translation and Annotated Script** (Individual)**:** Students receive a dense, jargon-heavy technical document. Students must: (a) read and fully comprehend the document; (b) identify the core idea that a non-specialist audience needs to understand; and (c) produce an annotated script for a 90-second public explainer.
7. **Cross-Disciplinary Case Analysis and Defence** (Group)**:** Groups of 3–4 students select one case from a faculty-curated shortlist of five to six approved cases.The group delivers a 10-minute structured presentation that goes beyond narrative description - identify the specific communication failures, explain the ethical or regulatory dimensions of those failures, and propose what a communication-competent response would have looked like. This is followed immediately by a 5-minute live Q&A in which individual group members must defend their analytical assertions against probing questions from both faculty and peers.

Text Book(s):

1. Markel, M., & Selber, S. A. (2021). *Technical Communication* (13th ed.). Bedford/St. Martin's.

Reference Book(s):

R1. Carnegie, D. (1936/1998). *How to Win Friends and Influence People*. Simon & Schuster.
R2. Orwell, G. (1946). *Politics and the English Language*.
R3. Strunk, W., & White, E. B. (1999). *The Elements of Style* (4th ed.). Longman.
R4. Kahneman, D. (2011). *Thinking, Fast and Slow*. Farrar, Straus and Giroux.
R5. O'Neil, C. (2016). *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. Crown Publishers.
R6. Adler, R. B., Rodman, G., & DuPré, A. (2019). *Understanding Human Communication* (14th ed.). Oxford University Press.

Web Sources:
• owl.purdue.edu • plainlanguage.gov • allsides.com • adfontesmedia.com • ted.com • economist.com/styleguide • factcheck.org • ailiteracy.org • learnprompting.org • unesco.org/en/artificial-intelligence/ethics
Topics relevant to "SKILL DEVELOPMENT": Active listening, verbal and non-verbal communication, interpersonal communication and self-awareness, elements of spoken communication — voice, clarity, and presence, storytelling and narrative in spoken contexts, structuring spoken messages, speaking with confidence, group communication and productive disagreement, giving and receiving feedback, presentation design and delivery, speaking for technical and non-technical audiences, critical reading, identifying tone and bias, understanding flawed reasoning, source credibility and information evaluation, reading multimodal texts, principles of effective writing, plain language and technical communication, professional writing — email, reports, and correspondence, argumentative writing, summary writing, prompt engineering, AI-assisted writing, ethical AI use in academic and professional communication, AI bias and critical evaluation.

Catalogue prepared by	Dr Ajith K and Dr Shahanas Punnilath Shanavas
Recommended by the Board of Studies on **Date of Approval by the Academic Council**	

Course Code: CSS1500	Course Title: Computational Thinking using Python Type of Course: Lab Integrated Course (ESC)	L-T-P-C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	Nil		
Anti-requisites	NIL		
Course Description	This course efficiently introduces fundamental programming concepts including conditionals, loops, functions, lists, strings, tuples, and dictionaries through practical examples and problem-solving techniques. It also covers advanced programming concepts such as exception handling, file processing, modules, and packages using Python. The course emphasizes computational thinking, algorithm development, and implementation of searching and sorting techniques using Python data structures. Additionally, it introduces secure file handling, intelligent input validation, and AI-		

	assisted data processing concepts for real-world applications.	
Course Objective	To develop computational thinking and problem-solving skills using Python by enabling students to design algorithms, implement programs using core programming constructs, apply data structures and file handling techniques, and develop secure and intelligent solutions for real-world applications.	
Course Outcomes	On successful completion of this course, students will be able to: CO1: Apply computational thinking principles to design algorithms for solving basic and intermediate computing problems. — Understand CO2: Implement Python programs using data types, operators, and expressions to perform computational tasks. — Apply CO3: Develop programs using control structures, functions, and recursion to solve structured problems. — Apply CO4: Utilize data structures such as lists, tuples, and dictionaries for efficient data representation and manipulation. — Apply CO5: Design and implement Python programs for secure file handling, exception management, and intelligent data validation for real-world applications. — Apply	
Course Content:		
Module 1	Computational Thinking And Problem Solving	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	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	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	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	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), Secure File Handling, Intelligent Error Detection using AI Concepts, Smart Input Validation Techniques, Automated Data Validation Applications.		

List of Practical Tasks 30 Sessions

WEEK 1: Computational Thinking & Algorithms

Lab Sheet 1: Problem Solving & Algorithm Design

Level 1: Write an algorithm and Python program to find the minimum element in a list of numbers.

Level 2: Write an algorithm and Python program to insert an element into a sorted list at the correct position.

Lab Sheet 2: Algorithm Strategies (Iteration & Recursion)

Level 1: Write a Python program to guess a number within a given range using iteration.

Level 2: Write a Python program to solve the Tower of Hanoi problem using recursion.

WEEK 2: Data Types & Expressions

Lab Sheet 3: Data Types & Variables

Level 1: Write a Python program to demonstrate different data types (int, float, boolean, string, list).

Level 2: Write a Python program to perform type conversions and display results.

Lab Sheet 4: Expressions & Operators

Level 1: Write a Python program to swap two variables using tuple assignment.

Level 2: Write a Python program to circulate the values of n variables.

WEEK 3: Expressions & Problem Solving

Lab Sheet 5: Mathematical Expressions

Level 1: Write a Python program to calculate the distance between two points.

Level 2: Write a Python program to evaluate complex arithmetic expressions with operator precedence.

Lab Sheet 6: Debugging & Interactive Mode

Level 1: Write a Python program with intentional errors and debug it.

Level 2: Write a Python program to demonstrate interactive mode operations.

WEEK 4: Conditional Statements

Lab Sheet 7: Decision Making

Level 1: Write a Python program to check whether a number is positive, negative, or zero.

Level 2: Write a Python program to find the largest of three numbers using if-elif-else.

Lab Sheet 8: Advanced Conditions

Level 1: Write a Python program to check whether a number is even or odd.

Level 2: Write a Python program to implement a grading system using chained conditions.

WEEK 5: Iteration (Loops)

Lab Sheet 9: Looping Basics

Level 1: Write a Python program to print numbers from 1 to N using a loop.

Level 2: Write a Python program to compute factorial using loops.

Lab Sheet 10: Loop Control

Level 1: Write a Python program demonstrating break and continue.

Level 2: Write a Python program to generate number patterns using nested loops.

WEEK 6: Functions

Lab Sheet 11: Functions Basics

Level 1: Write a Python function to calculate square root of a number.

Level 2: Write a Python function to find GCD of two numbers.

Lab Sheet 12: Recursion & Scope

Level 1: Write a recursive function to calculate exponentiation.

Level 2: Write a Python program demonstrating local and global variables.

WEEK 7: Strings

Lab Sheet 13: String Operations

Level 1: Write a Python program to demonstrate string slicing.

Level 2: Write a Python program to check whether a string is a palindrome.

Lab Sheet 14: String Methods

Level 1: Write a Python program using string functions (upper, lower, replace).

Level 2: Write a Python program to count vowels and consonants in a string.

WEEK 8: Lists

Lab Sheet 15: List Basics

Level 1: Write a Python program to create and display a list.

Level 2: Write a Python program to find the sum of elements in a list.

Lab Sheet 16: List Operations

Level 1: Write a Python program to demonstrate list slicing.

Level 2: Write a Python program to perform linear search on a list.

WEEK 9: Advanced Lists

Lab Sheet 17: List Methods

Level 1: Write a Python program to demonstrate list methods (append, remove).

Level 2: Write a Python program to sort a list.

Lab Sheet 18: List Comprehension

Level 1: Write a Python program using list comprehension to generate squares.

Level 2: Write a Python program to create a histogram of list values.

WEEK 10: Tuples

Lab Sheet 19: Tuple Basics

Level 1: Write a Python program to create and access tuple elements.

Level 2: Write a Python program to demonstrate tuple assignment.

Lab Sheet 20: Tuples as Return Values

Level 1: Write a Python function returning multiple values using tuple.

Level 2: Write a Python program to swap values using tuples.

WEEK 11: Dictionaries

Lab Sheet 21: Dictionary Basics

Level 1: Write a Python program to create and access dictionary elements.

Level 2: Write a Python program to count frequency of elements using dictionary.

Lab Sheet 22: Dictionary Applications

Level 1: Write a Python program to store student marks using dictionary.

Level 2: Write a Python program to generate a retail bill using dictionary.

WEEK 12: Advanced List Processing

Lab Sheet 23: Sorting & Searching

Level 1: Write a Python program to implement simple sorting.

Level 2: Write a Python program to implement binary search.

Lab Sheet 24: Data Processing

Level 1: Write a Python program to generate student marks statement.

Level 2: Write a Python program to analyze list data (min, max, average).

WEEK 13: File Handling Basics

Lab Sheet 25: File Operations

Level 1: Write a Python program to create and write to a text file.

Level 2: Write a Python program to read and display file contents.

Lab Sheet 26: File Processing

Level 1: Write a Python program to count words in a file.

Level 2: Write a Python program to copy contents from one file to another.

WEEK 14: Exceptions & Validation

Lab Sheet 27: Exception Handling

Level 1: Write a Python program using try-except.

Level 2: Write a Python program to handle multiple exceptions.

Lab Sheet 28: Validation Programs

Level 1: Write a Python program to validate voter's age.

Level 2: Write a Python program to validate marks range (0–100).

WEEK 15: Modules & Advanced Concepts

Lab Sheet 29: Modules & Packages

Level 1: Write a Python program to create and use a module.

Level 2: Write a Python program to use built-in modules.

Lab Sheet 30: Command Line Arguments

Level 1: Write a Python program to accept command-line arguments.

Level 2: Write a Python program to perform operations using command-line inputs

WEEK 15.1: Secure and Intelligent Python Applications

Lab Sheet 31: Secure File Handling and Validation

Level 1: Write a Python program for secure file reading and writing with exception handling.
Level 2: Implement intelligent input validation for user data using exception handling techniques.

Lab Sheet 32: AI-based Python Applications

Level 1: Develop a Python program for automated data validation or log analysis.
Level 2: Implement a simple intelligent application using Python modules and file processing concepts.

Project work/Assignment:

1. Assignment 1 on (Module 1 and Module 2)
2. 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

W1. https://onlinecourses.nptel.ac.in/noc20_cs70/preview

1. Topics relevant to development of "Employability": Data structures using python.
2. Topics relevant to "PROFESSIONAL ETHICS": Naming and coding convention for simple programs using python.

Course Code: ECE2022	Course Name: Digital Design Type of Course: Theory Course	L- T-P- C	2-0-0-2
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	ECE2052		
Anti-requisites	NIL		

<table>
<tr><td>Course Description</td><td colspan="3">The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra. Further to focusing on combinational and sequential digital logic circuits. This course is analytical in nature and needs a fundamental knowledge on logical computation with Boolean algebra. The focus of the course will be to discuss the minimization techniques for making low-cost canonical digital circuit implementations. In this course, we emphasize design procedures of digital electronic circuits.
Additionally, this course will create a foundation for future courses that includes Computer Architecture, Microprocessors, Microcontrollers and Embedded Systems etc.</td></tr>
<tr><td>Course Objective</td><td colspan="3">The objective of the course is to familiarize the learners with Design and Analysis of Digital Logic Circuits concepts and to improve the learner's SKILL DEVELOPMENT by using PARTICIPATIVE LEARNING TECHNIQUES through Assessments.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">On successful completion of this course the students shall be able to:
CO1. Explain the fundamental concepts of Number system, Boolean algebra and Logic gates
CO2. Determine the minimum literal Boolean Expression using K-Map minimization techniques
CO3. Make use of relevant logic gates for constructing the combinational circuit.
CO4. Produce standard and real world combinational logic circuits using minimum number of logic gates
CO5. Demonstrate the working principles of flip-flops and latches within the context of sequential logic circuits.
CO6. Design synchronous and asynchronous logic circuit using Flip-flops</td></tr>
<tr><td colspan="4">Course Content:</td></tr>
<tr><td>Module 1</td><td>Number System, Logic Gates & Boolean function simplification (Comprehension Level)</td><td>Assessment</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics:
Review of Number systems -Overview of Boolean Algebra- Boolean Laws, Rules & Theorems. Boolean function Standard form and Canonical form. Review of logic gates -Basic gates, Universal gates & Special Gates- Boolean functions simplifications using Algebraic functions & Karnaugh-map. SOP and POS simplifications & Implementations.</td></tr>
<tr><td>Module 2</td><td>Combinational Logic circuits:
(Application Level)</td><td>Assessment</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics:
Digital logic circuit Introduction –Classification of circuit- Analysis and Design procedure of Combinational Logic circuits - Binary Adder and Subtractor- Magnitude comparator- , Multiplexers - DeMultiplexers, Decoders, Encoders and Priority Encoders-Real world scenario based application design using logic gates.</td></tr>
<tr><td>Module 3</td><td>Sequential logic circuits (Application Level)</td><td>Quiz</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics:
Introduction to sequential circuits- Storage elements: latches and flip flops- Characteristic tables and equations, excitation table- Analysis of clocked sequential circuits- state diagram-state table and design of finite state machines - Registers & Counters.</td></tr>
<tr><td colspan="4">Text Book
T1: Thomas L Flyod, "Digital Fundamentals", Eleventh Edition, Pearson Education. ISBN-10: 132737965. (2014).eBook-[PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org</td></tr>
</table>

T2: Mano, M. Morris and Ciletti Michael D., "Digital Design", Pearson Education, 6th edition
., [PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download (studymaterialz.in)

References

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

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

E-Resources/Web Resources

1. https://openFullText.html?DP=https://nptel.ac.in/courses/108105132
2. https://openFullText.html?DP=https://ocw.mit.edu/courses/6-111-introductory-digital-systems-laboratory-fall-2006/
3. https://openFullText.html?DP=https://www.javatpoint.com/digital-electronics
4. https://openFullText.html?DP=https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
5. https://openFullText.html?DP=https://circuitverse.org

Course Code: ECE1512	**Course Title: Design Thinking in Practice**	**L-T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces students to Design Thinking frameworks for identifying real-world user needs and transforming them into innovative technology solutions using embedded systems, sensors, IoT platforms, and AI-enabled computing devices. The course blends human-centered innovation methodologies with hands-on development using Arduino, Aries, ESP32, Raspberry Pi, NVIDIA Jetson, and GPU-based embedded platforms. Students will develop problem-solving skills while learning problem identification, ideation, rapid prototyping,sensor integration,edgeAI,and intelligent system development for applications in smart automation,healthcare,agriculture,robotics,andIndustry5.0.The course emphasizes experiential and project-based learning to build future-ready innovators capable of developing scalable, intelligent,andsocially impactful products.						
Course Objective	The objective of the course is to enhance students'**employability skills**through**participative learning techniques** by integrating Design Thinking, embedded systems, IoT, and AI technologies to develop innovative, intelligent, and socially impactful real-world solutions.					

Course Outcomes	**On successful completion of the course,the students shall be ableto** 1. **Explain**the principles, framework,andprocess of design thinking 2. **Formulate**Engineering Problem from user challenges,customer expectations,and market opportunities using design thinking process. 3. **Analyze**the Engineering Problem using the basic concepts of microcontroller and sensory devices. 4. **Find** alternate methods to solve the engineering problem by working with embedded computing platforms. 5. **Develop**functional prototypes using embedded boards,sensors,and an intelligent system for the chosen method 6. **Validate**prototype performance through testing,userfeedback,anditerative improvements.	
Course Content		
Module 1	**Introduction to Design Thinking**	**6 Sessions**
Introduction to Design Thinking –Importance of Design ThinkingHistory of Design Thinking- Design Thinking Framework-Design Thinking process-Empathise Define Understanding Purpose-Ideate-What isCreativity?-Thinking Differently Basic Rules of Design Thinking The Creativity Heart Set Everyone is a Designer - Activity-based with case studies		
Module 2	**Basic Concepts of Microcontrollers and Sensory Devices**	**8 Sessions**
Introduction to Arduino, ESP and NodeMCU - Pin Configuration and Architecture - Device and Platform Features-Concept of Digital and Analog Ports-Familiarizing with Arduino Interfacing Board Programming using Arduino IDE and Embedded C - Datatypes and Variables - I/O Functions Sensors, types and its applications-HumiditySensor-Temperature Sensor-WaterDetector/Sensor -PIRSensor - Ultrasonic Sensor -Connecting Switches and Actuators-Sensor Interface with ESP Microcontroller-VariousCloudPlatforms		
Module 3	**Working with Embedded Computing Platforms and 3D printing technology**	**8 Sessions**
Introduction to Raspberry Pi boards,pindiagram,different types of Raspberry Pi boards and their applications, Configuration of Raspberry Pi boards-LED and switch control Exploring various libraries and their functions. GPU fundamentals Configuration of Jetson Nano board,WorkingwithH200GPUServers.Introductionto3D Printer:3DPrintertechnologyanditsworkingPrinciples,Applications.Introduction to online Simulators: Working with Tinker CAD Simulator.		
Module 4	**Prototype Development and Validation Techniques**	**8 Sessions**

Importance of Prototyping in Design Thinking – Concept Refinement Using Prototypes – From Ideato Functional Prototype – User Testing and Validation – Iteration and Design Optimization – Prototype Readiness for Product Development (DFM & Market Feasibility – overview) – Activity-based with case studies.

Prototype Development Tasks:
Total Sessions: 30

1. Smart illumination system using Arduino
2. Intelligent Plant Health Monitoring System.
3. Aries Rover Drive and Control System Development
4. IoT-Based Environmental Intelligence System using ESP32
5. Edge Computing Platform Setup using RaspberryPi
6. RaspberryPi-based smart lighting Controller
7. VoiceX: AI-Powered Smart Home Automation System
8. VisionAI: Intelligent Object Recognition System.
9. Smart Traffic Management System using NVIDEA Jetson Nano
10. High-Performance AI Vision Analytics using H200-GPU Computing.
11. Rapid Prototype Development using 3D Design and printing

Topics: Types of embedded boards, Thonny Python, Python IDLE, sensors, 3D Printer, Jetson Nano board, GPUs

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, Aries, ESP32, RaspberryPi, and sensors can be applied. The flexibility and affordability of all embedded boards, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: Students can use open-source software, such as Arduino IDE, Blynk console, Tinker CAD, Thonny Python, Python IDLE, etc.

Project work/Assignment:

- **Projects:** At the end of the course, students will be completing the project work on solving many real-time problem statements on different domains, such as women-centric, agritech, medtech, climatecell, robotics, drones, and smart cities etc.
- **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 to the library resources and

write a report on their understanding of the assigned article in an appropriate format.Presidency University Library Link**Presentation:** There will be a review presentation (Phase 1, Phase 2, and Phase 3) from among the students'groups,where the students will be given a project, and they have to demonstrate the working and discuss the applications for the same

Textbook(s):

1. Thinking Design by S Balaram.NewDelhi[India]:Sage Publications Pvt.Ltd.2010.eBook. Database: eBook Collection (EBSCOhost)
2. MonkSimon,"Programming ArduinoGettingStarted withSketches",McGraw-HillPublications, SecondEdition
3. Monk Simon "Raspberry Pi Cookbook: Software and Hardware Problems and Solutions", Publisher O'ReillyMedia,Inc.,ISBN:9781098130923,FourthEdition.
4. CUDAbyExample: An Introduction to General-Purpose GPU Programming. *CUDAbyExample:An Introduction to General-Purpose GPU Programming*. Addison-Wesley Professional, 2010.

References:

1. Design Thinking by Clarke,RachelIvy.Series:LibraryFutures,Vol.4.Chicago:ALANeal-Schuman. 2020. eBook., Database: eBook Collection (EBSCOhost)
2. NeerparajRai, "Arduino Projects for Engineers," BPB Publishers, firstedition,2016.
3. Stewart Watkiss "Learn Electronics with Raspberry Pi" Apress Berkeley,CA.Secondedition,2020 . ISBN978-1-4842-6348-8
4. Jo Prusa, "Basics of 3D printing", Prusa Research, 3rdedition.
5. VolkerZiemann , "AHands-On Course in Sensors Using the Arduino and Raspberry Pi(Seriesin Sensors)", CRC Press, 1st Edition.2018.
6. Professional CUDA C Programming.*Professional CUDA C Programming*.WroxPress,2014.

OnlineResources(e-books,notes,PPTs,videolectures,etc.):

1. Arduinotrending 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
4. Raspberry Pi Projects-https://magpi.raspberrypi.com/articles/category/tutorials/
5. Introduction to internet ofthingshttps://nptel.ac.in/courses/106105166>

Getting Started with Jetson Nano-https://www.youtube.com/watch?v=DVfmw3Ftu3I

E-content:

1. Tim Brown, "Design Thinking," Harvard Business Review, vol. 86, no. 6, pp. 84–92, Jun. 2008.
2. Rolf Faste, "Ambidextrous Thinking," in Innovations in Mechanical Engineering Curricula for the 1990s, American Society of Mechanical Engineers, 1994, pp. 1–6.
3. M. H. Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, and Pragya Singh, "IoT Based Smart Security System Using Arduino," Journal of Emerging Technologies and

Innovative Research (JETIR), vol. 8, no. 8, Aug. 2021.

4. Basil and Eliza Sawant, S. D., "IoT-Based Traffic Light Control System Using Raspberry Pi," in Proceedings of ICECDS 2017, 2017. DOI: 10.1109/ICECDS.2017.8389604.

5. Espressif Systems, "ESP32 Series Datasheet," 2024.

6. Josef Průša, "Open-Source 3D Printers and the RepRap Project," RepRap Magazine, 2018.

Topics relevant to the development of "SKILL": System design for achieving Sustainable Development Goals.

Catalogue prepared by	Dr.DivyaraniMS, Dr.MManikandan
Recommended by the Board of Studies on	BoS Number:
Date of Approval by the Academic Council	Academic Council Meeting No.___dated on _____

Course Code: PHY2504	Course Title: Optoelectronics and Quantum Physics Lab Type of Course: 1] School Core	L-T-P-C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The 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:** Understand electrical and optical properties of materials. Level 2 – Understand **CO2:** Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. Level 2 – Understand		
Course Objective	The objective of the course is to familiarize the learners with the concepts of " Applied Physics for Computer Science Cluster "and attain Skill Development through Experiential Learning techniques		

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 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. 8: 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. 9: 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. 10: 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.

Experiment No. 11: : Dielectric constant
Level 1: Determination of Dielectric constant of given material

Level 2: compare the obtain results with other materials

Experiment No. 12: determine the wavelength of monochromatic light, such as sodium light, using Newton's rings.
Level 1: Determination of wavelength
Level 2: determine the radius of curvature of the Plano-convex lens.

Targeted Application & Tools that can be used:

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. 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.

Course Code: PPS1025		Course Title: Industry Readiness Program – I (Audited Course) Type of Course: HSMC	L- T - P- C	0-0-2-0
Version No.		1.0		
Course Pre- requisites		NIL		
Anti-requisites		NIL		
Course Description		This course is designed to enable students to set SMART goals, form Professional & personal ethics for success and learn various email writing techniques. 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"Employability for Young Professionals"and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.		
CourseOut Comes		On successful completion of this course the students shall be ableto: CO1Define their career goals CO2Practice ethical habitsforbetter career success CO3Demonstrate effective email writing techniques		
Course Content				
Module1	**Goal Setting & Grooming**	Classroomactivities	**10 Sessions**	
Topics:SMART Goals, formal grooming through self-introduction activity **Activity:**Realworld scenarios				
Module2	**Habit Formation**	Roleplays	**10 Sessions**	

Topics: Professional and Personal ethics for success and activity-based practice **Activity:**Students to present 2 min video on building professional ethics			
Module3	**Email Etiquettes**	Individual and group presentation	**10Sessions**
Topics: Types of prompts to generate effective or desired results for email etiquettes **Activity:**Individual student presenting various search prompts			
Faculty: L&D			
Targeted Application&Toolsthatcanbe used: 1. TED Talks 2. YouTube Links 3. Activities			
Assignment proposed for this course Assignment 1: SMART Goal Assignment 2: AI tools for prompt search			
Continuous IndividualAssessment Module 1: Presentation Module 2: Activity based assessment Module 3: Class assessment			
The topics related to skill development: Students acquire knowledge on SMART goals, implement grooming standards, practice ethical behavior in class and campus, acquire hands-on experience to use AI tools to get search prompts for desired email etiquettes.			

Course Code: ECE2052	Course Name: Digital Design Lab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	ECE2022		
Anti-requisites	NIL		
Course Description	This course gives knowledge through the simulation software for design and implementation of various digital logic circuit. The theoretical concepts and working principles of combinational and sequential logic circuits are verified through implementation using openCV. This course provides necessary learning for fundamental concepts of computer and communication engineering. The purpose of this course is to support the students to exhibit the design and analysis skills. The course enhances the Design and Implementation abilities through laboratory tasks. Additionally, it provides an opportunity to verify the theoretical knowledge.		
Course Objective	The objective of the course is to familiarize the learners with the design concepts of digital logic circuit and attain Skill Development through Experiential Learning by simulation-based laboratory Assessments.		
Course Outcomes	On successful completion of the course the students shall be able to CO1. Interpret Boolean laws and the logic gates functionality using available circuit elements in simulator platforms.		

	CO2. Apply the fundamental laws and rules of Boolean algebra for simplified circuit simulation using any simulator tool. CO3. Develop combinational logic circuits by connecting offered gates for basic arithmetic operation CO4. Make use of circuit elements for ensuring the digital logic circuit's truth table perfection. CO5. Examine the performance of sequential logic circuit simulation using flip-flop and latch elements CO6. Demonstrate the operation of clocked and edge-triggered sequential components in an open-source simulation environment

Course Content:

List of Laboratory Tasks:

- **Experiment 1: Logic Gates**.

  Study and verify the operation of basic logic gates such as AND, OR, NOT, NAND, NOR, XOR, and XNOR.

- **Experiment 2: Boolean Algebra**

  Implement and verify Boolean algebra laws and simplification techniques using logic circuits.

- **Experiment 3: Adder**

  Design and analyze half adder and full adder circuits for binary addition.

- **Experiment 4: Subtractor**

  Design and verify half subtractor and full subtractor circuits for binary subtraction.

- **Experiment 5: Magnitude Comparator**

  Design a circuit to compare two binary numbers and determine equality or greater/less conditions.

- **Experiment 6: Design of Combinational Circuits**

  Design and implement combinational logic circuits using Boolean expressions and K-maps.

- **Experiment 7: Multiplexer, Demultiplexer & Applications of MUX**

  Study the working of multiplexers and demultiplexers and implement logic functions using MUX.

- **Experiment 8: Flip-Flops**

  Implement and verify the operation of SR, JK, D, and T flip-flops.

- **Experiment 9: Shift Registers**

  Design and analyze serial and parallel shift registers for data storage and transfer.

- **Experiment 10: Counter Design**

  Design and implement synchronous and asynchronous counters using flip-flops.

Targeted Applications & Tools:	
CIRCUIT VERSE	An online digital circuit simulation platform used for designing and testing logic circuits and combinational/sequential circuits.
HDL	Hardware Description Language used to model, design, and simulate digital electronic systems and circuits.
VHDL	Very High-Speed Integrated Circuit Hardware Description Language used for designing, simulating, and implementing digital systems in FPGA and ASIC design.

Skill-Building Activities through Experiential Learning:

- Design and simulation of digital circuits using CircuitVerse/HDL tools.
- Hands-on implementation of combinational and sequential circuits.
- Mini exercises on logic simplification and circuit optimization.
- Team-based circuit design and debugging activities.
- Real-time verification of flip-flops, counters, and shift registers.

Text Book

T1: Mano, M. Morris and Ciletti Michael D., "Digital Design", Pearson Education, 6th edition

T2: Thomas L. Floyd "DIGITAL LOGIC DESIGN" , Pearson Education, fourth edition.

References

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

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

E-Resources/Web Resources

1. https://circuitverse.org/
2. https://ocw.mit.edu/courses/6-111-introductory-digital-systems-laboratory-fall-2006/
3. https://nptel.ac.in/courses/108105132
4. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
5. https://www.tutorialspoint.com/digital_electronics/index.htm
6. https://github.com/logisim-evolution/logisim-evolution
7. https://www.javatpoint.com/digital-electronics

Course Code: MAT1212	**Course Title:Mathematical foundations for Machine Learning and Data Analysis Type of Course:1] School Core**	**L-T- P- C**	**3**	**1**	**0**	**4**
Version No.	1.0					

Course Pre-requisites	NIL	
Anti-requisites	NIL	
Course Description	This course provides a comprehensive foundation in advanced mathematical concepts essential for engineering and scientific applications. It covers integral calculus and special functions, linear transformations and matrix decompositions, vector spaces and inner product spaces, and probability theory with random variables and standard probability distributions. The course emphasizes mathematical modeling, analytical problem-solving, data analysis techniques, and engineering applications, enabling students to apply mathematical tools to solve real-world engineering problems.	
Course Objective	The course aims to develop a strong conceptual understanding of vector spaces, linear algebra, and vector calculus. It introduces mathematical techniques used in engineering analysis and modelling, enabling students to apply these concepts effectively in solving engineering problems. The course also enables students to apply probability distributions and statistical methods in practical situations involving uncertainty and data analysis. Further, it strengthens analytical and problem-solving skills through applications of differential equations and statistical inference. In addition, the course familiarizes students with computational tools for solving engineering mathematics problems, thereby enhancing their ability to address real-world engineering challenges.	
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Apply integral calculus and special functions to solve engineering problems. (L3) **CO2:** Solve problems involving linear transformations and matrix techniques. (L3) **CO3:** Apply concepts of vector spaces, basis, dimension, and orthogonality in mathematical applications. (L3) **CO4:** Apply probability concepts and random variable distributions to solve problems involving uncertainty and stochastic phenomena (L3) **CO5:** Examine discrete and continuous random variables using probability distributions such as Binomial, Poisson, Uniform, Exponential, and Normal distributions. (L3) **CO6:**Utilize computational tools such as MATLAB, Python, or similar software for mathematical computation, data analysis, and engineering applications. (L3)	
Course Content:		
Module 1	**Integral Calculus and Special Functions**	**(8L+3T=11 Sessions)**
Definite and indefinite integrals, Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Surface areas, volumes, Sterlin approximation theorem.		
Module 2	**Vector Spaces and Inner Product Spaces**	**(12L+4T=16 Sessions)**
Vector Space, Examples, Properties, Subspaces, Linear Combinations, Spanning Set of a Vector Space, Linear Dependence and Independence, Basis and Dimension, Change of Basis; Normed Linear Spaces, Inner Products Spaces, Orthogonality, Orthogonal and Orthonormal Bases, Gram-Schmidt Orthogonalization Process, Orthogonal Complements, Orthogonal Projections. Applications to Difference Equations, Markov Chains.		
Module 3	**Linear Transformations and Matrix Decompositions**	**(10L+3T=13 Sessions)**
Linear Transformations, Algebra of Transformations, Singular and Nonsingular Linear Mappings, Isomorphisms, Matrix Representation of Linear Transformations, The Range and Null Space, Rank-Nullity Theorem. Least Squares Approximation, Singular Value Decomposition: Singular Values, Computing Singular Value Decomposition, Data Compression Using Singular Value Decomposition and Introduction to Principal Component Analysis.		
Module 4	**Probability and Random Variables for machine learning**	**(15L+5T =20 Sessions)**

Introduction to Probability, Conditional Probability, Bayes' Theorem and Problems. Random Variables (discrete and continuous), Probability Mass/Density Functions, Mathematical Expectations, discrete probability distributions - Binomial distribution, Poisson distribution, Continuous uniform distribution - Exponential distribution, Normal distribution.
Machine learning: large language models

Targeted Applications & Tools that can be used:

- Evaluation of definite and improper integrals for computing areas, volumes, surface areas, engineering design calculations, and scientific modeling using Beta and Gamma functions.
- Representation and analysis of high-dimensional vector spaces, feature extraction, orthogonal projections, signal processing, computer graphics, pattern recognition, and machine learning.
- Least-squares regression, image compression, recommendation systems, dimensionality reduction, Principal Component Analysis (PCA), data mining, and machine learning applications.
- Probabilistic modeling, Bayesian inference, uncertainty quantification, predictive analytics, classification algorithms, statistical learning, and foundations of large language models (LLMs).

Software: MATLAB, Mathematica, Maple, Python, GeoGebra, Octave, R, Scilab.

Text Book

1. E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2015.
2. B. S. Grewal, *Higher Engineering Mathematics*, 45th ed. New Delhi, India: Khanna Publishers, 2017.sley Publishing Company.

Assignment:

Assignments will involve theoretical problem-solving and computational implementation using suitable programming tools. The assignments may be undertaken individually or in groups, as decided by the instructor.

References:

1. G. Strang, *Introduction to Linear Algebra*, 6th ed. Wellesley, MA, USA: Wellesley-Cambridge Press, 2023.
2. D. C. Lay, S. R. Lay, and J. J. McDonald, *Linear Algebra and Its Applications*, 6th ed. Harlow, U.K.: Pearson, 2021.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2015.
4. B. S. Grewal, *Higher Engineering Mathematics*, 45th ed. New Delhi, India: Khanna Publishers, 2017.
5. C. D. Meyer, *Matrix Analysis and Applied Linear Algebra*, 2nd ed. Philadelphia, PA, USA: SIAM, 2023.

E-resources/ Web links:

1. https://open.umn.edu/opentextbooks/textbooks/24
2. https://open.umn.edu/opentextbooks/textbooks/introduction-to-probability
3. https://open.umn.edu/opentextbooks/textbooks/linear-transformations-on-vector-spaces

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

Catalogue prepared by	**Dr. Pavithra Sivaprakasam**
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CIV1200	Course Name: Foundations of Integrated Engineering Type of Course: Theory Course	L- T-P- C	2-0-0-2

Version No.	1.0
NCrF Level-	5.0
Course Pre-requisites	NIL
Co-requisites	
Anti-requisites	CSSXXXX
Course Description	This interdisciplinary course introduces first-year engineering students to foundational principles and practices across key engineering domains, emphasizing real-world problem-solving, sustainability, and ethical innovation. Students explore how civil, mechanical, electrical, and IT systems intersect with emerging technologies like IoT, AI, and geomatics to address global challenges. Through case studies, learners gain deeper understanding of smart infrastructure, prototyping mechanical/electronic systems, and securing IT solutions. Topics include bioinformatics for environmental monitoring, GIS-enabled urban planning, renewable energy integration, and cybersecurity fundamentals. The course cultivates a holistic understanding of engineering's role in sustainable development, safety, and ethical decision-making, preparing students to contribute meaningfully to multidisciplinary projects in a technology-driven world.
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Recall key principles of Agile, DevOps, and bioinformatics used in interdisciplinary engineering contexts. **L1**– Remember CO2: Explain the role of GIS, LiDAR, and sustainable materials in designing smart infrastructure and disaster management systems. **L2**– Understand CO3: Describe core components of mechanical systems and their real-world applications. **L3** – Apply CO4: Describe the functionality of IoT-enabled wearable devices, embedded systems, and renewable energy integration in smart grids. **L4** – Analyze CO5: List foundational IT concepts such as cloud computing architectures, cybersecurity threats, and blockchain applications. **L5** – Evaluate

Course Content:				
Module 1	Foundations of Engineering Practice	Assignment	Case studies	6 Sessions
Real-world problem-solving using data logic and practical applications, Collaboration and Innovation through multi-domain project, Engineering Ethics & Environmental Impact Emerging Fields: Automation, and Introduction to bioinformatics and its application Sustainability & Safety: Circular economy principles, carbon footprint analysis.				
Module 2	Civil Engineering & Geomatics	Assignment	Article Review	6 Sessions
Smart Infrastructure & Geomatics: GIS mapping, LiDAR, drone surveys for urban planning, Geospatial data analysis for disaster management. Sustainable Construction: 3D-printed structures, self-healing concrete, Digital twins for infrastructure monitoring. Green Innovations: Net-zero energy buildings, rainwater harvesting systems.				
Module 3	Mechanical Engineering in Action	Assignment & Quiz	Data Collection	6 Sessions
Advanced Manufacturing: Collaborative robots (cobots), additive manufacturing and 3D printing, Reverse engineering and prototyping. Energy Systems: Solar/wind energy harvesting, piezoelectric applications. Biomechanics: Prosthetics design, ergonomic product lifecycle.				

Module 4	Electrical & Electronics Engineering	Assignment & Quiz	Data Collection and visualization	6 Sessions
Smart Devices & Systems: Embedded systems, Wearable technology, Edge computing and hardware platforms Energy Innovations: EV charging infrastructure, wireless power transfer, Smart grid integration with renewables.				
Module 5	Fundamentals of IT	Assignment & Quiz	Case studies	6 Sessions
Core IT Topics: Networking basics, Cloud computing Cybersecurity & Data: Encryption, phishing prevention, zero-trust models, Database management. Emerging Tech: Blockchain for supply chains, AI/ML basics, IoT integration with cloud platforms				
Targeted Application & Tools that can be used: Application Areas include Interdisciplinary problem-solving, Smart city planning, disaster management, Robotics prototyping, renewable energy systems, Wearable health tech, smart grids, Secure cloud systems. Tools: 3D Printers, Autocad, Tinkercad, ArcGIS / QGIS, Arduino/Raspberry Pi				
Text Book: 1. William Oakes & Les Leone, "Engineering Your Future: An Introduction to Engineering", Oxford University Press, 9th Edition, 2021 2. Barry F. Kavanagh, "Introduction to Geomatics", Pearson, 5th Edition, 2021 3. Ian Gibson, David Rosen, & Brent Stucker, "Additive Manufacturing Technologies", Springer, 3rd Edition, 2021 4. Sudip Misra, "The Internet of Things: Enabling Technologies, Protocols, and Use Cases", Wiley, 2nd Edition, 2022 5. James Kurose & Keith Ross, "Computer Networking: A Top-Down Approach", Pearson, 8th Edition, 2020				
References 1. Supratim Choudhuri, "Bioinformatics for Beginners: Genes, Genomes, and Molecular Evolution", Academic Press, 1st Edition, 2023, 2. Robert McGinn, "The Ethical Engineer: Contemporary Concepts and Cases", Princeton University Press, 1st Edition, 2020 3. Charles J. Kibert, "Sustainable Construction: Green Building Design and Delivery", Wiley, 5th Edition, 2022 4. Anthony M. Townsend, "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia", W.W. Norton & Company, 1st Edition, 2020 5. David Buchla, "Renewable Energy Systems: A Smart Energy Systems Approach", Pearson, 2nd Edition, 2023 6. Charles Platt, "Make: Electronics: Learning Through Discovery", Make Community, 3rd Edition, 2021 7. Charles J. Brooks, Christopher Grow, & Philip Craig, "Cybersecurity Essentials", Wiley, 2nd Edition, 2021 Web-resources: 1. Post-parametric Automation in Design and Construction https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live 2. Smart Cities : Introducing Digital Innovation to Cities https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live 3. 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 4. Additive Manufacturing: Opportunities, Challenges, Implications https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live				

Course Code: CHE2501	Course Name: Chemistry of Smart Materials Type of Course: Theory Course	L- T-P- C	3-0-0-3

Version No.	1.0
NCrF Level-	5.0
Course Pre-requisites	NIL
Co-requisites	CHE2501
Anti-requisites	CSSXXXX
Course Description	Theobjective of the course is to introduce the students to concepts and applications of chemistry of smart materials. The course also aims to enhance the knowledge of smart materials associated with memory system, display devices, , sensors, energy devices and environment. It will also cultivate an ability to identify chemistry in each of smart engineered materialsand interpret solutions for the challenges connected to memory, display, energy, smart, green and sustainable technologies. It targets to strengthen the fundamental concepts behind chemistry of smart materials and then builds an interface with their industrial applications. **This course is designed to cater to Environment and Sustainability**
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using Participative learning techniques.
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:**Relate the knowledge of chemistry to computational approaches to identify materials functionalities and properties – **L1**– Remember **CO2**:Recognizeand interpret solutions for the challenges connected to memory, display, smart, green and sustainable technologies. – **L2**– Understand **CO3:**Explain the quality parameters of engineering materials associated with environment and sensors. – **L3** – Apply **CO4:**Interpret the knowledge of sustainable chemistry for E- waste management. – **L4** – Analyze **CO5:**Analyse the importance of various electrochemical sources in energy systems. – **L5** – Evaluate

Course Content:

Module 1	Computational Chemistry	Assignment	Data Collection and analysis	**09 Sessions**
Topics: Fundamental particles of atom – their mass, charge and location – atomic number and mass number, Stabilizing interactions: Bonded and non-bonded interactions. Chemistry of weak interactions – van der Waals force and hydrogen bonding, Density functional theory. 3D co-ordinate generation for small molecules, geometry optimization by Molview. Chemical Databases: Chemoinformatics, MSDS ***Self- learning topics:***Scope, cost and efficiency of computational modeling.				
Module 2	Materials for Memory and Display Systems	Assignment	Data Collection and analysis	**09 Sessions**
Topics: Memory Systems : Introduction, classification of electronic memory devices- Transistor, capacitor, charge -transfer and Resistor, types of materials - organic, polymeric and hybrid materials, and applications, manufacturing of semiconductor chips. **Display Systems:** photo and electroactive materials , materials for display -Principle, Properties and applications: Liquid crystals for LCD-Liquid crystals display, Basics of LED: OLED-organic light emitting diode and light emitting electrochemical cells. ***Self- learning topics:***Green computing: Biocomposite based memory devices				
Module 3	Nanomaterials based Smart Sensors and Devices	Assignment	Data Collection and analysis	**09 Sessions**
Topics: Nanomaterials- Introduction, classification based on dimensionality,quantum confinement. Size				

dependent properties,Synthesis, Properties of CNT and Graphene and their application as **Materials for data analysis and packaging** -RFID and IONT.
Sensors: Introduction, types, Principle and applications- electrochemical sensor: nanomaterials for sensing applications - Glucose, VOC sensing.
Self-learning topics: Fullerene,biomolecules in sensing, Strain sensors

Module 4	Sustainable Materials and Development	Quiz/Seminar	Data Collection and analysis	**09 Sessions**

Topics: E waste: Introduction, E waste Hazards, E- waste management,Recovery of precious metal- Cu by Hydrometallurgy.
Green Chemistry: Fundamentals and 12 principles with examples, Carbon footprint and sequestration
Sustainable Chemistry: -Introduction to Biomaterials- PLA , polymers in bio-compatible and bio-degradable materials - Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) PHBV, synthesis and applications in drug delivery.
Self-learning topics:circular economy- case studies.

Module 5	Energy Science	Quiz/Seminar	Data Collection and analysis	**09 Sessions**

Topics:Battery technology: Fundamentals of electrochemistry, Introduction to electrochemical storage devices: battery (Lithium-ion battery- $LiMnO_2$, $LiCoO_2$, metal air batteries- LiO_2) and supercapacitors- Introduction, Principle, Types - EDLC, pseudo and asymmetric capacitor.
Photovoltaics: Solar cells - Construction and working principle; types- Inorganic, Organic and quantum dot sensitized (QDSSC's).
Self -learning topics:Battery technology for e-mobility, Green hydrogen

Targeted Application & Tools that can be used:
Application areas are Data storage and analysis, logistics, Biomedicine, Energy, Environment and sustainability
Tools: Molview, chemdraw, excel etc

Project work/Assignment:

Assessment Type

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

Text Book

1. Wiley, "Engineering Chemistry", Wiley.
2. G.A. Ozin and A.C. Arsenault, Nanochemistry: A chemical approach to nanomaterials, Royal Society of Chemistry, 2009

Reference Books

1. Functional and smart materials, Chander Prakash, Sunpreet Singh, J. Paulo Davim, 2020, CRC Press,
2. ISBN: 978-036-727-510-5.
3. E-waste recycling and management: present scenarios and environmental issues, Khan, Anish, and
4. Abdullah M. Asiri. 2019, Springer, Vol. 33. ISBN: 978-3-030-14186-8.
5. Essentials of computational chemistry: theories and models, Christopher J Cramer, 2013, John Wiley &
6. Sons. ISBN: 978-0-470-09182-1.
7. Energy storage and conversion devices: Supercapacitors, batteries and hydroelectric cells, Anurag Gaur,
8. L. Sharma, Anil Arya. 2021, CRC press, 1st edition, ISBN: 978-1-003-14176-1.
9. Fundamentals of analytical chemistry: An introduction, Douglas A. Skooget etal., 2004 Thomson Asia pte
10. Ltd., 8th, ISBN: 978-0-495-55828-6
11. Functional and smart materials, Chander Prakash, Sunpreet Singh, J. Paulo Davim, 2020, CRC Press,
12. ISBN: 978-036-727-510-5.
13. Electrical and electronic devices, circuits and materials: Technological challenges and solutions.

Tripathi,
14. L., Alvi, P. A., & Subramaniam, U, 2021, John Wiley & Sons, ISBN: 978-0367564261.
15. F. Jensen, Introduction to Computational Chemistry, 3rd edition, Wiley, 2017.

E resources

1. https://presiuniv.knimbus.com/user#/searchresult?searchId=computational%20chemistry&_t=1738054970142
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_48504
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_147967
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_130301
5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_87297
6. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_67006
7. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_137261
8. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_86712

Skill Sets

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

Course Code: CSS2200	Course Title: Program Solving Using C Type of Course: Theory Course	L- T-P-C	2-0-0-2
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The course is designed to provide a strong foundation in the C programming language and problem-solving techniques. It enables students to develop logical thinking and programming skills required to design and implement applications using C. By understanding fundamental programming concepts such as algorithms, control structures, arrays, functions, pointers, and data handling, students will be prepared to learn and adapt to other programming languages and advanced computing technologies in the future.		
Course Objective	The objective of the courseis 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: CO1: Explain problem-solving techniques using algorithms, pseudo code, and flowcharts for developing programs [Level 2 – Understand] CO2: Apply fundamental C programming constructs such as data types, operators, decision-making, and looping statements to develop simple programs. [Level 3 – Apply] CO3: Develop programs using arrays and strings to solve computational problems effectively [Level 3 – Apply] CO4: Implement modular and reusable programs using functions, recursion, and pointers. [Level 3 – Apply] CO5: Design applications using structures, unions, file handling concepts, and demonstrate the role of C programming in emerging technologies. [Level 3 – Apply]		
Course Content:			
Module 1	Introduction to C Language	Assignment (Algorithms,	6 Sessions

		Flowcharts, and Basic C Programs)	
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 andExpressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making andLooping.			
Module 2	Introduction to Arrays andStrings	Programming Assignment (Arrays, Sorting, Searching, and String Handling in C)	6 Sessions
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.ExamplePrograms– Matrix operations.Strings:Introduction-Declaring and Initializing String Variables–Reading Strings from Terminal–Writing StringtoScreen– String Handling Functions.			
Module 3	Functions and Pointers	Programming Assignment (Functions, Recursion, and Pointer Implementation in C)	6 Sessions
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:PassbyValue,PassbyReference.			
Module 4	Structures and Union and File Handling	Assignment (Structures, Unions, and File Operations in C)	6 Sessions
Topics: Structures:Introduction–Defining a Structure–DeclaringStructure Variable–Accessing Structure Members-Union:Introduction–Defining and Declaring Union–Difference Between Unionand Structure.- Filehandling: Defining and Opening a File –ClosingaFile–Input/Output Operations on File.			
Module 5	Application of C Programming in Emerging CSE Specializations	Mini Project (C Programming Applications in Cyber Security, Blockchain, and AI)	6 Sessions
Topics: Applications of C Programming in modern technologies – Cyber Security: Simple password checking programs and basic security concepts – Blockchain: Secure data storage and transaction concepts – Artificial Intelligence and Machine Learning: Basic data processing programs.			
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. Reema Thareja, “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. NPTEL – Programming in C 2. NPTEL – Problem Solving Through Programming in C 3. GeeksforGeeks – C Programming Language			

Course Code: ENG xxxx	**Course Title: Communication in Practice** **Type of Course: Integrated**	**L-T-P-C**	1	0	2	2
Version No.	1.0					
Course Pre-requisites	ENG XXXX – Fundamentals of Communication (Semester I)					
Anti-requisites	NIL					
Course Description	*Communication in Practice* is the second-semester course in sequence designed for first-year undergraduate students in engineering and computer science programmes. This course puts those foundations under professional pressure. The question is no longer *what* communication is, but *how* to deploy it when it counts: in a job interview, a pitch to a client, a negotiation with a colleague, a professional report directed at a real reader, or a leadership communication challenge that affects a team. The course is organised around four modules, each of which explicitly upgrades the work done in semester one. Assessment is 100% Continuous Assessment. There is no end-semester examination. The centrepiece is a capstone Professional Communication Portfolio that the student could realistically share with an employer.					
Course Objective	The course aims to articulate the foundational tenets of professional communicative identity, discourse ethics, and analytical text evaluation and apply them to high-stakes institutional scenarios and complex professional ecosystems. It also focuses on cultivating advanced oral communication strategies and persuasive vocal mechanics, including structured rhetorical delivery and spontaneous adaptive responses, for collaborative, hierarchical, and leadership contexts. Furthermore, it aims to refine technical authorship capabilities and artificial intelligence-mediated workflows to produce precise, highly structured, and audience-centric professional artifacts across formal engineering, computational, and cross-functional corporate domains.					
Course Outcomes	**On successful completion of this course the students shall be able to:** 6. **Explain** the principles governing professional communication identity, communicator ethics, and context-sensitive self-presentation across workplace, hierarchical, and digital contexts. 7. **Demonstrate** advanced vocal, rhetorical, and adaptive strategies across high-stakes spoken communication genres, including interviews, pitches, negotiations, and leadership scenarios. 8. **Demonstrate** advanced vocal, rhetorical, and adaptive strategies across high-stakes spoken communication genres, including interviews, pitches, negotiations, and leadership scenarios. 9. **Execute** the production of professional-grade written artifacts across high-demand genres—including formal reports, business proposals, data communications, and advocacy briefs—meeting real-world standards of clarity, structure, and audience appropriateness. 10. **Implement** AI-assisted communication workflows in professional contexts, including systematic prompt design for high-stakes outputs, validation protocols for synthetic materials, and the application of ethical frameworks at individual and organizational levels.					
Course Content: Communication in Practice						
Module 1	**Words that Work: Vocabulary,**	**CA1**	**Register Switching**		**09 Sessions**	

	Register, and Precision		**Activity**	
The topics will be explored through vocabulary games, role-play activities, communication challenges, case-based tasks, and workplace simulations: • Why Words Matter in Professional and Technical Communication • Choosing the Right Words for Different Situations • Understanding Meaning: Positive, Negative, and Neutral Word Choices • Commonly Confused Words and Miscommunication in Professional Contexts • Using Clear, Precise, and Concise Language • Explaining Technical Terms to Non-Technical Audiences • Building and Using Personal/Professional Vocabulary				
Module 2	**Listening, Processing, and Structured Response Writing**	**CA2**	**Rapid Listening and Response**	**12 Sessions**
The topics will be explored through podcasts, interviews, workplace recordings, collaborative listening tasks, discussions, and real-time writing activities: • Identifying Key Information from Spoken Inputs • Organizing Information from Discussions and Conversations • Converting Spoken Communication into Clear and Structured Written Responses • Writing Summaries from Audio and Discussion Inputs • Writing Follow-Up Responses Based on Spoken Communication • Writing Action Notes, Instructions, and Task Updates from Listening Inputs • Converting Meetings and Discussions into Structured Written Outputs				
Module 3	**High-Stakes Spoken Communication**	**CA**	**Mock Professional Interview, Pitching an Idea Pitch**	**12 Sessions**
• Speaking as a professional: identity, presence, and the first impression • Vocal authority, physical presence, and communication across hierarchies • Interview communication: structure, composure, and the STAR framework • Pitching ideas: the 3-minute and 10-minute pitch architecture • Negotiation and principled disagreement • Communicating in leadership positions: chairing, facilitating, and giving direction • Managing communication under pressure: hostile questions, silence, and contradiction				
Module 4	**Adaptive Communication**	**CA**	**Communication Strategy Plan**	**12 Sessions**
The topics will be explored through leadership simulations, AI-assisted scenario practice, ethical debate exercises, case analysis, peer feedback sessions, and reflective portfolio activities: • Communication Strategy: Audiences, Channels, Timing, and Feedback Loops • What Emotional Intelligence Actually Does in High-Stakes Conversations • Reading the Room: Adapting Style Across Personalities, Contexts, and Power Gaps • Giving and Receiving Developmental Feedback as a Professional Practice • Navigating Difficult Conversations: Disagreement, Criticism, and Bad News • Repairing Communication Breakdowns: Apology, Accountability, and Recovery • AI as a Strategic Communication Tool: Capabilities, Limits, and What Professionals Must Decide				
Targeted Application & Tools that can be used: Otter.ai, Microsoft Word/PowerPoint/Teams/Clipchamp/Whiteboard/OneNote/Forms/Copilot, Miro, Padlet, Canva, Mentimeter, AllSides Media Bias Ratings, Ad Fontes Media Bias Chart, Snopes/factcheck.rog, Zotero, NotebookLM, Canva, Adobe Express, CapCut, OBS Studio, Claude, ChatGPT, Gemini, DeepSeek, Google Docs				
Project Work / Assignment:				

1. Register Switching Activity (Individual): Students receive a single professional scenario and must communicate the same core message to three different audiences — a peer, a manager, and a non-specialist outsider — switching register, vocabulary, and tone appropriately for each. Delivered live in class. Graded on accuracy of register shift, vocabulary choices, and adaptability under in-the-moment feedback from the assessor.
2. Word in the Wild Log (Individual): Over four weeks, students maintain a running log of 25 words or phrases encountered in professional contexts — podcasts, workplace conversations, news, interviews — that they did not fully understand or could not have used confidently themselves. For each entry, students record the source, the meaning in context, an alternative they might have used, and one original sentence demonstrating precise use. Submitted as a structured document at the end of Module 1. Graded on range, contextual accuracy, and quality of reflection.
3. Rapid Listening and Response (Individual): Students listen to an unedited workplace audio recording — a meeting excerpt, a briefing, or a professional conversation — played once, without transcripts. Under timed conditions, they produce a structured written response that captures key information, identifies the communication purpose, and drafts an appropriate follow-up action note. Graded on accuracy, organisation, and quality of written response.
4. Mock Professional Interview (Individual): Each student undergoes a 10-minute mock professional interview conducted by faculty or a peer panel. No prepared scripts permitted. Graded on composure, structure, vocal authority, and use of the STAR framework. Written self-evaluation of 200 words submitted within 48 hours.
5. Idea Pitch (Individual): Students deliver a 3-minute pitch of a solution to a real or simulated professional problem, to a panel that includes at least one hostile or sceptical questioner. Immediately after the pitch, the panel asks two minutes of unscripted questions. Graded on clarity of argument, persuasive structure, handling of pressure, and vocal presence.
6. Difficult Conversation Simulation (Pair): Pairs of students are assigned roles in a scripted conflict scenario — a performance issue, a missed deadline, a broken professional agreement. Each student must navigate the conversation toward a constructive resolution without a script. Immediately after, both students complete a structured individual debrief identifying what communication choices they made, what they would change, and what they observed in their partner. Graded individually on communication behaviour during the simulation and quality of the debrief.
7. Communication Strategy Plan — Presentation and Portfolio Submission (Group): Students select a real or realistic professional scenario — a team conflict, a stakeholder disagreement, a leadership announcement, or a crisis communication moment. They develop a communication strategy plan that maps the audience, chooses appropriate channels and timing, anticipates likely responses, and identifies where AI tools could assist and where they must not. The plan is delivered as a 5-minute structured presentation to a simulated panel, followed by two minutes of unscripted Q&A. The portfolio submission includes the written plan, a one-page reflection on their communication growth across all four modules, and one piece of evidence from each module that demonstrates that growth. Graded on strategic thinking, clarity of presentation, quality of reflection, and coherence of the portfolio as a whole.

Text Book(s):

T1. Treasure, J. (2017). *How to be Heard: Secrets for Powerful Speaking and Listening.* Mango Publishing.
T2. Beebe, S. A., Beebe, S. J., & Ivy, D. K. (2019). *Communication: Principles for a Lifetime* (7th ed.). Pearson.

Reference Book(s):

R1. Goleman, D. (1995). *Emotional Intelligence: Why It Can Matter More Than IQ.* Bantam Books.
R2. Patterson, K., Grenny, J., McMillan, R., & Switzler, A. (2011). *Crucial Conversations: Tools for Talking When Stakes Are High* (2nd ed.). McGraw-Hill.
R3. Cuddy, A. (2015). *Presence: Bringing Your Boldest Self to Your Biggest Challenges.* Little, Brown and Company.
R4. Fisher, R., Ury, W., & Patton, B. (2011). *Getting to Yes: Negotiating Agreement Without Giving In* (3rd ed.). Penguin Books.
R5. Stone, D., Patton, B., & Heen, S. (2010). *Difficult Conversations: How to Discuss What Matters Most* (2nd ed.). Penguin Books.

Web Sources:
• ted.com/topics/communication • ted.com/topics/leadership • hbr.org (Harvard Business Review — communication and leadership articles) • psychologytoday.com/us/basics/emotional-intelligence • learnprompting.org • unesco.org/en/artificial-intelligence/ethics • yoodli.ai (AI speech coaching) • themuse.com (professional communication and career resources) • mindtools.com (communication skills and workplace tools)
Topics relevant to "SKILL DEVELOPMENT": Vocabulary building and register awareness; precise and concise language use; explaining technical terms to non-specialist audiences; active listening and information processing; converting spoken inputs into structured written responses; writing action notes and follow-up communications; professional presence and vocal authority; interview communication and the STAR framework; idea pitching and persuasive speaking; negotiation and principled disagreement; chairing and facilitating discussions; managing communication under pressure; communication strategy and audience mapping; emotional intelligence in professional contexts; adapting communication style across personalities and power gaps; giving and receiving developmental feedback; navigating difficult conversations; repairing communication breakdowns; AI as a strategic communication tool; ethics of AI in professional communication.

Catalogue prepared by	Dr Ajith K and Dr Shahanas Punnilath Shanavas
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: EEE1200	Course Name: Basics of Electrical and Electronics Engineering. Type of Course: Theory Course	L- T-P-C	3-0-0-3
Version No.	2.0		
Course Pre-requisites	NIL		
Co-requisites	EEE1250		
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 emphasises on the characteristics and applications of electrical and electronic devices. The course also emphasizes on the working, analysis and design of electrical circuits using both active & passive components. Additionally, this course creates a foundation for the future courses such as Electrical machines, power system, power electronics Linear Integrated Circuits, Analog Communication and Digital		

	Communication etc.		
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 Participative Learning techniques		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Apply basic laws of Electrical Engineering to compute voltage, currents and other parameters in the circuits. [Level 3 - Apply] CO2: Discuss various fundamental parameters appearing in the characteristics of semiconductor devices and their applications. [Level2– Understand] CO3: Summarize the operations of different biasing configurations of BJTs and amplifiers. [Level2– Understand] CO4 :Discuss the performance characteristics and applications of various electrical Machines. [Level2– Understand]] CO5: Apply basic laws of Electrical Engineering to compute voltage, currents and other parameters in the circuits. [Level 3 – Apply]		
Course Content:			
Module 1	Introduction to Electrical Circuits	Assignment/ Quiz	10 Sessions
Topics: DC Circuits: Concept of Circuit and Network, Types of elements, Network Reduction Techniques- Series and parallel connections of resistive networks, Star–to-Delta Transformations, Mesh Analysis, Nodal Analysis, Numerical examples. AC Circuits: Fundamentals of single phase circuits - Series RL, RC and R-L-C Circuits, Concept of active power, reactive power and Power factor, Numerical examples. Introduction to three phase system and relation between line and phase values in Star & Delta connection, Numerical examples.			
Module 2	Semiconductor and Diode applications	Assessment : Quiz + Assignment	10 Sessions
Topics: Mass Action Law, Charge densities in a semiconductor, Types of SC, Junction diodes -Ideal and practical behaviour, Modelling the Diode Forward Characteristic, and Diode applications like rectifiers, Clipping and clamping circuits. Zener diode, characteristics and its applications like voltage regulator.			
Module 3	Transistors and its Applications	Assessment : Assignment/ Quiz	10 Sessions
Topics: 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.			
Module 4	Fundamentals of Electrical Machines	Assessment : Assignment/ Quiz	10 Sessions
Topics: 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.			
Targeted Applications & Tools:			

Multisim	An electronic circuit simulation software used for designing, testing, and analyzing analog and digital circuits.
PSpice	A simulation tool used to analyze the behavior and performance of electronic circuits.
Multimeter	An electronic measuring instrument used to measure voltage, current, and resistance in circuits.
Function Generator	A device used to generate different electrical waveforms for circuit testing and analysis.
Power Supplies	Equipment used to provide regulated electrical power to electronic circuits and devices.

Skill-Building Activities through Experiential Learning:

- Hands-on experiments on electrical circuits and electronic components.
- Measurement and analysis of voltage, current, resistance, and waveform characteristics using electrical instruments.
- Simulation and testing of electronic circuits using software tools such as Multisim and PSpice.
- Practical study of semiconductor devices, BJTs, amplifiers, and electrical machines.
- Team-based troubleshooting and circuit debugging activities to enhance problem-solving skills.

Text Book

T1: Kothari D. P. & Nagrath I. J., "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education

T2: 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.

T3: J. Millman, C. C. Halkias and C. D. Parikh, "Millman's Integrated Electronics", McGraw Hill Education, 2nd Edition.

Basics of Electrical & Electronics Laboratory Manual.

R1: Re John Hiley, Keith Brown and Ian McKenzie Smith, "HUGHES Electrical and Electronic Technology", 10th Edition (Indian Edition published by Dorling Kindersley), Pearson,2011

R2: Samarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, Prentice Hall India, 2007.

R3: K Uma Rao, A Jaya Lakshmi, "Basic Electrical engineering" IK International publishing house Pvt. Ltd

R4:R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education India 7th Edition.

E-Resources/Web Resources

1. https://www.digimat.in/nptel/courses/video/108105112/L01
2. https://nptel.ac.in/courses/108/105/108105153/
3. https://nptel.ac.in/courses/108/102/108102095

Course Code: CSS2201	Course Title: Program Solving Using C Lab Type of Course: Laboratory Course	L- T-P-C	0-0-4-2
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		

Course Description	The course is designed to provide a strong foundation in the C programming language and problem-solving techniques. It enables students to develop logical thinking and programming skills required to design and implement applications using C. By understanding fundamental programming concepts such as algorithms, control structures, arrays, functions, pointers, and data handling, students will be prepared to learn and adapt to other programming languages and advanced computing technologies in the future.
Course Objective	The objective of the courseis 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: CO1: Explain algorithms, flowcharts, and basic programming concepts used in C programming. [Level 2 – Understand] CO2: Implement C programs using decision-making, looping statements, arrays, and strings to solve computational problems. [Level 3 – Apply] CO3: Construct modular programs using functions, recursion, and pointers for effective problem solving.. [Level 3 – Apply] CO4: Develop applications using structures, unions, and file handling concepts in C programming. [Level 3 – Apply] CO5: Design and implement simple real-world applications in areas such as Cyber Security and Artificial Intelligence using C programming concepts. [Level 3 – Apply]
Course Content:	

List of Practicals: 60 Sessions

Lab Sheet 1: 10 Sessions

Program 1: Sum of Two Numbers
Program 2: Find the Greatest of Three Numbers
Program 3: Check Even or Odd using Conditional Operator
Program 4: Print Multiplication Table using Loop
Program 5: Count Digits in a Number using While Loop
Program 6: Demonstration of Preprocessor Directives
Program 7: Simple Calculator using Switch Case

Lab Sheet 2: 10 Sessions
Program 1: Check Whether a Number is Positive, Negative or Zero
Program 2: Find the Sum of First N Natural Numbers
Program 3: Check Whether a Number is Prime or Not
Program 4: Find Factorial of a Number
Program 5: Reverse a Number
Program 6: Simple Number Guessing Game

Lab Sheet 3: 10 Sessions
Program 1: Linear Search in a One-Dimensional Array
Program 2: Bubble Sort on an Integer Array
Program 3: Matrix Addition (2D Arrays)
Program 4: Count Vowels in a String
Program 6: Selection Sort on an Array

Lab Sheet 4: 10 Sessions
Program 1: Sum of Two Numbers Using User-Defined Function

Program 2: Factorial Using Recursion
Program 3: Swap Two Numbers Using Call by Value (No Swap)
Program 4: Swap Two Numbers Using Call by Reference (With Swap)
Program 5: Pointer Basics - Access and Modify Variable via Pointer
Program 6: Accessing Array Elements Using Pointers

Lab Sheet 5: 10 Sessions
Program 1: Basic Structure Usage
Program 2: Structure with Nested Structures (Date of Birth)
Program 3: Union Example and Member Access
Program 4: Write to a File (Text Mode)
Program 5: Read from a File (Text Mode)
Program 6: Append Data to a File

Lab Sheet 6: 10 Sessions
Program 1:Write a C program to check whether a password is strong or weak based on its length. If the password contains more than 8 characters, display "Strong Password"; otherwise display "Weak Password".
Program 2: Develop a simple login system using C. Store a predefined username and password in the program and verify the user input. Display "Login Successful" or "Invalid Credentials".
Program 3: Write a C program to input marks of 5 students and calculate the average marks. Display whether the class performance is "Good" or "Needs Improvement".
Program 4: Develop a C program to find the largest number in an array. This simulates basic data analysis used in AI systems.

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. NPTEL – Programming in C
2. NPTEL – Problem Solving Through Programming in C
3. GeeksforGeeks – C Programming Language
4. Programiz – Learn C Programming

Course Code: CHE2502	Course Name: Chemistry of Smart Materials Lab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
NCrF Level-	5.0		
Course Pre-requisites	NIL		
Co-requisites			
Anti-requisites			
Course Description	The laboratory course aims to develop experimental skills and apply fundamental chemical principles to address chemistry-related problems in engineering. The experiments are carefully designed to complement the theoretical concepts covered		

	in lectures, providing hands-on experience to deepen understanding and reinforce learning. 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 "Chemistry of Smart Materials Lab" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.
Course Outcomes	On successful completion of the course, students shall be able to: CO1: recognize the basic techniques and instrumentation used in chemistry laboratories for quantitative analysis. CO2: estimate the presence of acids and metal ions in domestic and industrial waste using laboratory techniques. CO3: review the experimental results and demonstrate improved experimental skills through hands-on laboratory experience. CO4: classify laboratory techniques such as experimental setups for synthesis, purification, recovery and analysis.

Course Content:			
eriment 1	Experimental	Data Collection	alysis and erpretation
Determination of strength of strong acid in battery electrolyte using conductometric sensors.			
eriment 2	Experimental	Data Collection	alysis and Interpretation
Estimation of iron from e-waste using Electrochemical sensors.			
eriment 3	Experimental	Data Collection	alysis and Interpretation
Determination of pKa of organic acid of battery electrolyte using pH sensor.			
eriment 4	erimental	a Collection	alysis and Interpretation
Estimation of copper from PCBs by using colorimeter (Optical Sensor).			

Course Code: PPS1026	Course Title:Industry Readiness Program – II (Audited Course) Type of Course:PracticalOnlyCourse	L- T- P-C	0-0-2-0
Version No.	1.0		
Course Pre-requisites			
Anti-requisites	NIL		
Course Description	This course is designed to enable students learn styles of communication, team building and use empathy in leadership. The course will benefit learners in preparing themselves effectively through various activities and learning methodologies.		
Course Objective		The objective of the course is to familiarize the learners with the concepts of"Industry Readiness for Young Professionals"andattain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.	

Course Out Comes	On successful completion of this course the students shall be ableto: CO1Apply different communication skills for success in workplace CO2Practice team building skillsforcareer success CO3Demonstrate ethical leadership skills in workplace		
Course Content			
Module1	**Effective Communication**	Classroomactivities	**10 Sessions**
Topics: Practice effective communication skills (Verbal, Non-verbal, Written and Visual) **Activity:**Use social media prompts to prepare self-introduction videos			
Module2	**Team Building**	Group Activity	**10 Sessions**
Topics: Skills of an effective team player **Activity:**Student group activity to build class networking			
Module3	**Leadership**	Case study	**10Sessions**
Topics: Types of leadership, using empathy in leadership **Activity:**Individual presentation by students on corporate leaders.			
Faculty : L&D			
Targeted Application&Toolsthatcanbe used: 1. TED Talks 2. YouTube Links 3. Activities			
Assignment proposed for this course Assignment 1: One minute reel Assignment 2: Team building assignment			
Continuous IndividualAssessment Module 1: L-S-R-W class assessment Module 2: Team Presentation Module 3: Individual Assessment			
The topics related to skill development: Students acquire knowledge on effective communication skills, team building skills and how to prepare themselves to be leaders in workplace using empathy and implement various skill sets during the course of their time in the university.			

Course Code: EEE1251	**ırse Title: Basics of Electrical and Electronics Engineering Laboratory**	**L-T-P-C**	0	0	2	1

	Type of Course: ESC - Laboratory					
Version No.	**1.0**					
Course Pre-requisites	**Nil**					
Anti-requisites	**Nil**					
Course Description	This fundamental laboratory provides an opportunity to validate the concepts taught in the basics of electrical and electronics engineering and enhances the ability to visualize 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.					
Basic skill sets required for the laboratory	**The students shall be able to develop:** 1) An attitude of enquiry. 2) Confidence and ability to tackle new problems. 3) Ability to interpret events and results. 4) Ability to work as a leader and as a member of team. 5) Assess errors and eliminate them. 6) Observe and measure physical phenomenon. 7) Write Reports. 8) Select suitable equipment, instruments and materials. 9) Locate faults in systems. 10) Skills for setting and handling equipment. 11) The ability to follow standard test procedures. 12) An awareness of the need to observe safety precautions. 13) To judge magnitudes without actual measurement.					
Course Outcomes	On successful completion of the course, the students shall be able to: 1. **Demonstrate** the behavior of passive elements and fundamental electrical circuit laws 2. **Determine** the power factor, impedance, and phase relationship of R and RL loads under AC supply conditions. 3. **Develop** electrical circuits and three-phase supply systems using MATLAB/Simulink to study resistance, voltage, and current characteristics. 4. **Analyze** the performance characteristics of electrical machines, including single-phase transformers and three-phase induction motors, under different operating conditions. 5. **Examine** the output characteristics and performance parameters of half-wave and full-wave rectifiers. 6. **Illustrate** the performance characteristics of Zener diode and MOSFET under different operating conditions.					
Course Content:	List of Laboratory Tasks: **Experiment No 1:**Familiarization of passive elements. Level 1: Identify and understand the function and ratings of basic passive elements. Level 2: Study the behavior of passive elements in simple electrical circuits by measuring voltage, current, and impedance. **Experiment No 2:**Experimental Verification of Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL). Level 1: Study and Verify KVL and KCL for the given electrical Circuit.					

	Experiment No 3: Determination of Power Factor, and Impedance for R and RL Loads. Level 1: Determine the power factor and impedance of R and RL loads under steady-state AC supply conditions. Level 2: Analyze the effect of inductance on power factor, impedance, and phase angle for RL loads under varying load conditions. **Experiment No 4:**Modeling and Simulation of effective resistances in different circuit connections Using Simulink. Level 1: Model and simulate series and parallel resistor circuits in Simulink and determine their effective resistance. Level 2: Analyze the effect of different resistor combinations on total resistance, current distribution, and voltage drop. **Experiment No 5:**Simulation and analysis of line and phase voltages in Star-connected and Delta- connected supply systems. Level 1: Model and simulate star-connected and delta-connected three-phase supply systems and observe line and phase voltages. Level 2: Analyze and compare the relationship between line and phase voltages in star and delta connections. **Experiment6:** Determination of transformation ratio of a Single-Phase Transformer Under different tapping conditions. Level 1: Determine the transformation ratio of a single-phase transformer under no-load condition for various tap settings. Level 2: Analyze the effect of different tapping conditions on secondary voltage, regulation, and transformer performance. **Experiment No. 7:** Study of the speed-torque characteristics of a Three-Phase Induction Motor. Level 1: Study and analyze the speed–torque characteristics of a three-phase induction motor. Level 2: Evaluate the effect of supply voltage and current on motor performance parameters such as slip, and torque. **Experiment 8:** Performance Analysis of Half-Wave and Full-Wave Rectifier Circuits Using Simulink. Level 1: Model and simulate half-wave and full-wave rectifier circuits in Simulink and analyze their output waveforms. Level 2: Evaluate and compare rectifier performance parameters such as ripple factor, efficiency, and output voltage. **Experiment 9:** Study of the characteristics of a Zener Diode. Level 1: Study the forward and reverse V–I characteristics of a Zener diode using DC analysis. Level 2: Analyze the Zener breakdown characteristics and determine the Zener voltage and regulation behavior. **Experiment 10:** Study of the Output and Transfer Characteristics of a MOSFET. Level 1: Study, analyze and implement the output characteristics of a MOSFET under different gate-source voltage conditions and observe their results. Level 2: Analyze the transfer characteristics of a MOSFET and evaluate key parameters such as threshold voltage and transconductance.

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 SIMULINK

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.

ırse Material

1. Basics of Electrical and Electronics Engineering Laboratory Manual, Presidency University, Bengaluru.

Text Book:

1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, 4th Edition, McGraw Hill Education, New Delhi, 2019.
2. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology, Volume-I: Basic Electrical Engineering in SI Units, 24th Edition, S. Chand Publishing, New Delhi, 2024.

References

1. John Hiley, Keith Brown and Ian McKenzie-Smith, Hughes Electrical and Electronic Technology, 12th Edition, Pearson Education, 2016.
2. S. K. Bhattacharya and D. Devaraj, Basic Electrical and Electronics Engineering, 2nd Edition, Pearson Education India, 2017.
3. T. K. Nagsarkar and M. S. Sukhija, Principles of Basic Electrical Engineering, 1st Edition, Oxford University Press, 2018.
4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 12th Edition, Pearson Education, 2019.
5. A. K. Maini and Varsha Agrawal, Electronic Devices and Circuits, 2nd Edition, Wiley India, 2019.
6. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, 8th Edition, Oxford University Press, 2019.

Online Resources:

1. https://presidency university.linways.com
2. https://www.digimat.in/nptel/courses/video/108105112/L01 "Fundamentals of Electrical Engineering - Basic Concepts, Examples"
3. 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
4. NPTEL lectures on "Rectifiers", by Prof. G. Bhuvaneswari, IIT Delhi https://nptel.ac.in/courses/108102145
5. NPTEL Lectures on "Electrical Machines II", by Prof. G. Sridhara Rao, IIT Madras. https://nptel.ac.in/courses/108106072

Topics relevant to "EMPLOYABILITY SKILLS": All the experiments which are listed are for **Skill Development** through **Experiential Learning Techniques**. This is attained through the assessment component mentioned in course handout.

Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS": Standard test methods, safety procedure.

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

Course Code: MAT2311	**Course Title: Vector Calculus, Numerical Methods and Sampling Distributions [Type of Course:1] School Core**	**L-T- P- C**	**3**	**1**	**0**	**4**
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts and methods of ordinary differential equations, numerical techniques, and statistical inference used in engineering and scientific applications. The course covers analytical methods for solving differential equations, numerical methods for solving linear and nonlinear equations, interpolation, numerical differentiation and integration, and numerical solutions of ordinary differential equations. It also introduces sampling distributions and hypothesis testing for statistical decision-making. The course enables students to apply mathematical and statistical techniques to solve computational and real-world engineering problems.					
Course Objective	The objectives of this course are to develop the ability to solve ordinary differential equations arising in scientific and engineering applications. Introduce numerical techniques for solving systems of linear equations and nonlinear algebraic equations. Apply interpolation, differentiation, and integration methods for approximating mathematical functions and evaluating definite integrals. Employ numerical methods for obtaining approximate solutions of ordinary differential equations. Apply concepts of sampling distributions and statistical inference to estimate population parameters and support decision-making. Apply hypothesis testing techniques to real-world problems involving means, proportions, variances, and associations among variables.					
Course Outcomes	After successful completion of the course, students will be able to: **CO1:** Employ vector differential operators to solve problems involving scalar and vector fields and classify them as solenoidal or irrotational (L3) **CO2:** Apply vector integration techniques and integral theorems to a solve engineering problems. (L3) **CO3:** Use numerical methods to solve systems of linear and nonlinear equations. (L3) **CO4:** Implement numerical techniques for interpolation, differentiation, integration, and ordinary differential equations. (L3) **CO5:** Utilize sampling distributions and statistical inference techniques to solve statistical problems. (L3) **CO6:** Perform hypothesis testing for statistical decision-making. (L3)					
Course Content:						
Module 1	**Vector Calculus**				**(14L+5T=19 Sessions)**	
Vector & Scalar Functions and Fields, Derivatives, Curve, Arc length, Curvature & Torsion, Gradient of Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Physical interpretation, Solenoidal and Irrotational Vector Fields. Problems. Line Integrals, Path Independence of Line Integrals, Surface and Volume Integrals, Green's Theorem in the plane, Divergence Theorem of Gauss, Stokes's Theorem. Problems on Image Edge Detection, Robot Path Planning and 3D Surface Modelling						
Module 2	**Solution of Linear Systems and non-linear of Equation**				**(9L+3T=12 Sessions)**	
Introduction, Jacobi iteration method, Gauss-Seidel iteration method. Solution of Algebraic and Transcendental Equations: Bisection method, Regula-Falsi method, Newton-Raphson method, secant method, fixed point iteration method. Page Ranking, Network Analysis, Circuit Simulation, Root Finding, Load Balancing, and Computational Optimization Problems.						
Module 3	**Numerical Interpolations and Differential**				**(10L+3T=13 Sessions)**	

	Equations	
Newton's method, Divided difference method, Lagrange's method, Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Gaussian quadrature rule. Solution of ordinary differential equations: Taylor series method, modified Euler's method, Runge-Kutta method for 4th order. Problems on Signal Reconstruction, Sensor Data Interpolation and Trajectory Prediction.		
Module 4	**Sampling Distributions**	**(12L+4T=16 Sessions)**
Random sampling, sampling distributions, Standard Error, Type I & Type II errors, Testing of Hypothesis, Test of significance - Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations, Test for single mean, difference of means, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. A/B Testing, Fraud Detection, Spam Classification Evaluation, and Network Traffic Analysis.		
Targeted Applications & Mathematical Tools: • Analysis of fluid flow in open channels and pipelines, groundwater movement, stress and strain fields, terrain modelling, and 3D surface representation in civil engineering projects. • Structural analysis, load distribution in trusses and frames, hydraulic network analysis, foundation design computations, and optimization problems in transportation and water resource systems. • Estimation of terrain elevations, survey data interpolation, rainfall-runoff modelling, settlement prediction, traffic flow analysis, and numerical solutions of engineering differential equations. • Quality control of construction materials, reliability analysis, traffic studies, environmental data analysis, hydrological investigations, and hypothesis testing in engineering experiments. • Analysis of vector fields in fluid flow, electromagnetics, and heat transfer; image edge detection, robot path planning, and 3D surface modelling using gradients, divergence, curl, and integral theorems. Software: MATLAB, Python, Microsoft Excel Solver, LINDO/LINGO, AutoCAD, ETABS, Scilab.		
Assignment:		
Assignments will involve theoretical problem-solving and computational implementation using suitable programming tools. The assignments may be undertaken individually or in groups, as decided by the instructor.		
Text Book 1. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 7th ed. New Delhi, India: New Age International Publishers, 2019. 2. B. S. Grewal, *Higher Engineering Mathematics*, 45th ed. New Delhi, India: Khanna Publishers, 2022. 3. S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, 12th ed. New Delhi, India: Sultan Chand & Sons, 2020.		
References: 1. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 7th ed. New Delhi, India: New Age International Publishers, 2019. 2. S. S. Sastry, *Introductory Methods of Numerical Analysis*, 5th ed. New Delhi, India: PHI Learning Pvt. Ltd., 2012. 3. J. Kiusalaas, *Numerical Methods in Engineering with Python 3*, 3rd ed. Cambridge, U.K.: Cambridge University Press, 2025. 4. D. C. Montgomery and G. C. Runger, *Applied Statistics and Probability for Engineers*, 8th ed. Hoboken, NJ, USA: John Wiley & Sons, 2023. 5. D. D. Wackerly, W. Mendenhall, and R. L. Scheaffer, *Mathematical Statistics with Applications*, 7th ed. Belmont, CA, USA: Cengage Learning, 2008. 6. E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2011. 7. R. L. Burden, J. D. Faires, and A. M. Burden, *Numerical Analysis*, 11th ed. Boston, MA, USA: Cengage Learning, 2021.		

8. S. C. Chapra, *Applied Numerical Methods with MATLAB for Engineers and Scientists*, 4th ed. New York, NY, USA: McGraw-Hill Education, 2018.

E-resources/ Web links:

1. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=CUSTOM_PACKAGE_EBSCO_29052023_53751
2. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=TEXTBOOK_LIBRARY01_06082022_117
3. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=DOAB_1_06082022_7313
4. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=CUSTOM_PACKAGE_EBSCO_29052023_228965
5. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=DOAB_1_06082022_8838
6. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=SPRINGER_OPEN_ACCESS_BOOKS_10022025_1861
7. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=DOAB_1_06082022_7312

Topics relevant to SKILL DEVELOPMENT: Identification and solution of differential equations, application of numerical methods for algebraic and differential equations, implementation of interpolation and numerical integration techniques, statistical data analysis and hypothesis testing, and use of Python/MATLAB for engineering problem solving.

Catalogue prepared by	**Dr. V Ramalatha**
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CSS2251	Course Name: Data Communications and Computer Networks Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites			
Anti-requisites	NIL		
Course Description	The objective of this course is to provide knowledge in data communications and computer networks, its organization and its implementation, and gain practical experience in the installation, monitoring, and troubleshooting of LAN systems. . The associated laboratory is designed to implement and simulate various networks using Cisco packet tracer, NS2. All the lab exercises will focus on the fundamentals of creating multiple networks, topologies and analyzing the network traffics.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain Employability through Problem Solving Methodologies.		

<table>
<tr><td>Course Outcomes</td><td colspan="3">On successful completion of the course the students shall be able to:

CO1:Illustrate The Basic Concepts Of Data Communication And Computer Networks. [Level 3 - Apply]
CO2: Analyze the functionalities of the Data Link Layer. [Level 4 – Analyze]
CO3:Apply the Knowledge of IP Addressing and Routing Mechanisms in Computer Networks. [Level 3 – Apply]
CO4:Demonstrate the working principles of the Transport layer and Application Layer. [Level 3 – Apply]</td></tr>
<tr><td colspan="4">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction and Physical layer</td><td>Assessment: Assignment (Problem Solving)</td><td>9 Sessions</td></tr>
<tr><td colspan="4">Topics:
Introduction to Computer Networks and Data communications, Network Components – Topologies, Transmission Media –Reference Models - TCP/IP Suite, OSI Model .
Physical Layer -Analog and Digital Signals – Digital and Analog Signals – Transmission - Multiplexing and Spread Spectrum.</td></tr>
<tr><td>Module 2</td><td>Data Link Layer</td><td>Assessment: Assignment (Problem Solving)</td><td>12 Sessions</td></tr>
<tr><td colspan="4">Topics:
Data Link Layer - Error Detection and Correction– Parity, CRC, Hamming Distance Flow Control and Error Control, Stop and Wait, Multiple Access Protocols, CSMA/CD,CSMA/CA</td></tr>
<tr><td>Module 3</td><td>Network Layer</td><td>Assessment: Assignment (Problem Solving)</td><td>13 Sessions</td></tr>
<tr><td colspan="4">Topics:
Network Layer Services - Network Layer Services, Switching Techniques, IP Addressing methods- IPv4 IPV6 – Subnetting. Routing, - Distance Vector Routing, Link State Routing, RIP, OSPF, BGPV4.</td></tr>
<tr><td>Module 4</td><td>Transport and Application Layer</td><td>Assessment: Assignment (Problem Solving)</td><td>11 Sessions</td></tr>
<tr><td colspan="4">Topics:
Transport Layers - Connection management – Flow control-Sliding Window, Go-Back N ARQ, Selective Repeat ARQ, UDP, TCP, congestion control, Congestion avoidance The Application Layer: Domain Name System (DNS), Domain Name Space, FTP, Electronic Mail (SMTP), HTTP.</td></tr>
<tr><td colspan="4">Targeted Applications & Tools:Cisco Packet Tracer, Wireshark, and NS2 Simulator.</td></tr>
<tr><td colspan="4">Skill-Building Activities through Experiential Learning:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Text Book
T1: T1. Behrouz A. Forouzan, “Data Communications and Networking with TCP/IP Protocol Suite”, 6th Edition, Tata McGraw-Hill, 2022.
T2: Andrew S Tanenbaum, Nick Feamster & David J Wetherall, “Computer Networks” Sixth Edition, Pearson Publication, 2022.</td></tr>
<tr><td colspan="4">References
R1: “Computer Networking: A Top-Down Approach”, Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.
R2: William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007.
R3: Behrouz A. Forouzan, “Data Communications and Networking 5E”, 5th Edition, Tata McGraw-Hill, 2012</td></tr>
<tr><td colspan="4">E-Resources/Web Resources
1. https://www.geeksforgeeks.org/what-is-spread-spectrum/
2. https://www.geeksforgeeks.org/difference-between-fdma-tdma-and-cdma/
3. https://archive.nptel.ac.in/courses/106/105/106105183/</td></tr>
</table>

4.	http://www.nptelvideos.com/course.php?id=393
5.	https://www.digimat.in/keyword/106.htmlhttps://puniversity.informatics global.com/login

Course Code: CSS2252	Course Name: Data Communications and Computer NetworksLab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites			
Anti-requisites	NIL		
Course Description	This lab-based course provides hands-on experience in the principles and practices of data communications and computer networking. It is designed to complement theoretical concepts covered in the associated lecture course. Through a series of structured experiments and practical exercises, students will gain proficiency in configuring, analyzing, and troubleshooting computer networks. Key topics include network topology design, IP addressing and subnetting, Ethernet and LAN technologies, routing and switching, TCP/IP protocol suite, and basic network security measures. Students will work with industry-standard tools and equipment, including routers, switches, protocol analyzers, and network simulation software such as Cisco Packet Tracer or Wireshark.		
Course Objective	The objective of this lab course is to provide students with practical, hands-on experience in the configuration, operation, and troubleshooting of data communication systems and computer networks. Through guided experiments and real-world scenarios, students will reinforce theoretical knowledge, develop essential technical skills, and gain a deeper understanding of networking concepts, protocols, and devices used in modern communication systems.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:**Design and configure basic network topologies using routers, switches, and end devices to meet specified requirements [Level 3 – Apply] . **CO2:**Analyze and troubleshoot network connectivity and performance issues using tools such as Wireshark and network simulators. [Level 4 – Analyze] **CO3:**Demonstrate understanding of key networking protocols (e.g., TCP/IP, ARP, ICMP, DHCP) through practical implementation and observation. [Level 3 – Apply] **CO4:**Apply IP addressing and subnetting techniques to efficiently allocate and manage network resources in various networking scenarios. [Level 3 – Apply]		
Course Content:			
List of Laboratory Tasks: • **Lab sheet -1, M-1, 3 [2 Hours]** • **Experiment No 1:** Level 1: Study of basic network commands and network configuration commands. **Lab sheet -2, M-1[2 Hours]** • **Experiment No 1:** Level 1: Identify and explore Network devices, models and cables. Introduction to Cisco			

packet tracer.

- **Experiment No. 2:**
  Level 2 – Create various network topologies using a cisco packet tracer.

Lab sheet -3, M-2,3 [2 Hours]

- **Experiment No. 1:**
  Level 2 - Basic Configuration of switch/router using Cisco packet tracer.
- **Experiment No. 2:**
  Level 2 -Configure the privilege level password and user authentication in the switch/router.

Lab sheet – 4, M-3 [2 Hours]

- **Experiment No. 1:**
  Level 2 - Configure the DHCP server and wireless router and check the connectivity

Lab sheet – 5, M-3 [2 Hours]

- **Experiment No. 1:**
  Level 2 - Configure the static routing in the Cisco packet tracer.
- **Experiment No. 2:**
  Level 2 - Configure the dynamic routing protocol in the Cisco packet tracer.

Lab sheet – 6, M-4 [2 Hours]

- **Experiment No. 1:** Configuration of DNS Server with Recursive & Integrative approach in Cisco packet tracer.

Lab sheet – 7, M-4 [2 Hours]

- **Experiment No. 1:**
  Configure the telnet protocol in the router using the Cisco packet tracer.

Lab sheet – 8, M-4[2 Hours]

- **Experiment No. 1:**
  Level1- Introduction to NS2 and basic TCL program.

Lab sheet – 9, M-4 [2 Hours]

- **Experiment No. 1:**
  Level 1: Simulate three node Point to point network using UDP in NS2.
- **Experiment No. 2:**
  Simulate transmission of Ping message using NS2.

Lab sheet – 10, M-4[2 Hours]

- **Experiment No. 1:**
  Simulate Ethernet LAN using N-node in NS2.
- **Experiment No. 2:**
  Simulate Ethernet LAN using N-node using multiple traffic in NS2

Lab sheet –11, M-3,4 [2 Hours]

- **Experiment No. 1:**
  Level 1- Introduction to Wire Shark.
- **Experiment No. 2:**
  Level 2- Demonstration of packet analysis using wire shark.

Lab sheet –12, M-1,2,3 [2 Hours]

- **Experiment No. 1:**
  Level 2- Demonstration of switch and router configuration using real devices

Targeted Applications & Tools:

Cisco Packet Tracer, Wireshark, andNS2. Case Study/Assignment: Choose and analyze a network from any organization/Assignment proposed for this course in CO1-CO4 Problem Solving: Choose and appropriate devices and implement variousnetwork concepts. Programming: Simulation of any network using NS2.
Skill-Building Activities through Experiential Learning:
Text Book **T1:** Behrouz A. Forouzan, "Data Communications and Networking 5E", 5 th Edition,Tata McGraw-Hill, 2017. **T2:** Andrew S Tanenbaum, Nick Feamster & David J Wetherall, "Computer Networks" Sixth Edition, Pearson Publication, 2022
References **R1:** "Computer Networking: A Top-Down Approach", Eighth Edition, James F.Kurose, Keith W. Ross, Pearson publication, 2021. **R2:** William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007. **R3:** Larry L. Peterson and Bruce S. Davie: Computer Networks – A SystemsApproach, 4th Edition, Elsevier, 2007.
E-Resources/Web Resources 1.**https://archive.nptel.ac.in/courses/106/105/106105183/** **2.http://www.nptelvideos.com/course.php?id=393** **3.https://www.youtube.com/watch?v=3DZLItfbqtQ** **4.https://www.youtube.com/watch?v=_fIdQ4yfsfM** **5.https://www.digimat.in/keyword/106.html** 6. **https://puniversity.informatics global.com/login**

Course Code: CSS2253	Course Title: Data Structures Type of Course: Theory Course (PCC)	L-T- P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts of data structures and emphasizes the importance of selecting appropriate data structures and techniques for efficient program development. The course includes both theory and laboratory components focusing on the implementation and applications of data structures using the Java programming language. It also introduces emerging applications of data structures in cybersecurity, Artificial Intelligence, Machine Learning, blockchain, and intelligent computing systems. With strong knowledge of data structure fundamentals and practical implementation skills, students will be able to design and develop efficient, secure, and intelligent software applications.		
Course Objective	To develop a strong foundation in data structures by enabling students to understand fundamental data structures and their operations, analyze algorithm efficiency, implement linear and non-linear data structures, and apply appropriate techniques to solve real-world problems, including applications in cybersecurity, AI/ML, blockchain, and intelligent systems, while evaluating trade-offs between different data structures.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain the concepts of basic data structures such as arrays, stacks, and queues and their operations. Level 2 – Understand CO2: Apply linked list data structures to Level 3 – Apply		

	solve real-world problems. CO3: Utilize appropriate non-linear data structures such as trees and graphs for given problem scenarios. CO4: Implement and demonstrate various searching and sorting algorithms and analyze the efficiency of data structures and algorithms in terms of time and space complexity. CO5: Apply data structure concepts in cybersecurity, AI/ML, blockchain, and intelligent computing applications.	Level 3 – Apply Level 3 – Apply Level 3 – Apply
Course Content:		
Module 1	Introduction to Data Structure and Linear Data Structure – Stacks and Queues	9 Sessions
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	12 Sessions
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	12 Sessions
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, Hashing, Searching and Sorting	6 Sessions
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 Searching & Sorting Sequential and Binary Search, Sorting – Selection and Insertion sort, Quick sort, Merge Sort, Bubble sort.		
Module 5	Security and AI/ML Applications of Data Structures	6 Sessions
Topic: Secure Data Structures, Hashing Techniques, Secure Searching and Sorting, Trees and Graphs in Cybersecurity, Data Structures for AI & ML, Graph-based Intelligent Systems, Heaps in Machine Learning, Applications in Fraud and Intrusion Detection, Blockchain Data Structures, Quantum Computing Data Representation.		
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.informatics global.com/login
Topics relevant to development of "Skill Development": Linked list and stacks Topics relevant to development of "Environment and sustainability: Queues

Course Code: CHE7601	Course Name: Environmental Studies Type of Course:MOOC course	L- T-P-C	1-0-0-0
Version No.	1.0		
NCrF Level-	5.0		
Course Pre-requisites	NIL		
Co-requisites	CHE7601		
Anti-requisites	CSSXXXX		
Course Description	This course is designed to improve the learners' SKILL DEVELOPMENT by using PATICIPATIVE LEARNING techniques. This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers. This course is designed to cater to Environment and Sustainability		
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'PARTICIPATIVE LEARNING' techniques		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Describe the issues related to natural resources, ecosystems and biodiversity **L1**– Remember CO2: Identify environmental hazards affecting air, water and soil quality **L2**– Understand CO3:Recognize the importance of healthy environment and finding the sustainable methods to protect the environment **L3** – Apply CO4: Convert skills to address immediate environmental concerns through changes in environmental processes, policies, and decisions **L4** – Analyze		
Course Content:			
Module 1	Understanding Environment, Natural Resources, and Sustainability		
Topics: Classification of natural resources, issues related to Population growth and their overutilization, and strategies for their conservation. Water, air, soil, mineral, energy and food source. Effect of human activities on natural resources. Concept of sustainability- Sustainable Development Goals (SDGs)- targets and indicators, challenges and			

strategies for SDGs; Sustainable practices in managing resources, including deforestation, water conservation, Desalination – types, energy security, and food security issues, Life Cycle thinking and Circular Economy.			
Module 2	Ecosystems, Biodiversity, and Sustainable Practices		
Topics: Ecosystems and ecosystem services: Various natural ecosystems, Major ecosystem types in India and their basic characteristics; forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. The importance of biodiversity, Types of biodiversity, Biodiversity and Climate Change, the threats it faces, hotspots, and the methods used for its conservation. Strategies for in situ and ex situ conservation, mega diverse nation.			
Module 3	Environmental Pollution, Waste Management, and Sustainable Development		
Topics: Types of pollution- Chemical, - Biological, Biomedical, noise, air, water, soil, thermal, radioactive and marine pollution, and their impacts on society. Urbanization and Urban environmental problems; effects, and mitigation. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Sustainable Materials and Technologies: Biodegradable and compostable materials, Recycled and reclaimed materials (E-waste management), Sustainable manufacturing processes.			
Module 4	Social Issues, Legislation, and Practical Applications		
Topics: Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Hazardous waste Rule 1989, Biomedical Waste handling 1998, Fly Ash Rule 1999, Municipal Solid Waste Rule 2000, Battery Rules 2001, E- Waste Rules 2011, Plastic waste management Rules 2016, Construction Demolition waste Rules 2016 National Biodiversity Action Plan (NBAP) Major International Environmental Agreements: Convention on Biological Diversity (CBD), The Biological Diversity (Amendment) Act, 2023, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement. Major International organisations and initiatives: United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC).			
Targeted Application & Tools that can be used: Application areas are Energy, Environment and sustainability Tools: Online Tools – NPTEL and Swayam.			
Project work/Assignment:			
Assessment Type • Online exams (MCQs) will be conducted by the department of Chemistry			
Online Link*: 1) Lecure by Dr. Samik Chowdhury, Dr. Sudha Goel, NPTEL course: Environmental Science, https://nptel.ac.in/courses/109105203, 2024. 2) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024. * Other source links are available in below Resources link. Text Book 3. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA 4. Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co. 5. Bharucha, E. Textbook of Environmental Studies (3rd ed.) Orient Blackswan Private Ltd. 6. Dave, D., & Katewa, S. S. Text Book of Environmental Studies. Cengage Learning India Pvt Ltd.			

7. Rajagopalan, R. Environmental studies: from crisis to cure (4th ed.). Oxford University Press.
8. Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press.
9. Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books.
10. Pritwani, K. Sustainability of business in the context of environmental management. CRC Press.
11. Wright, R.T. & Boorse, D.F. Environmental Science: Toward A Sustainable Future (13th ed,). Pearson.

Reference Books

1. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022), Conservation through Sustainable Use: Lessons from India. Routledge.
2. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.
3. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
4. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
5. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press

Resources:

1. https://nptel.ac.in/courses/109105203
2. https://archive.nptel.ac.in/courses/120/108/120108004/
3. https://nptel.ac.in/courses/127105018
4. https://onlinecourses.nptel.ac.in/noc23_lw06/preview
5. https://onlinecourses.swayam2.ac.in/ini25_bt02/preview
6. https://archive.nptel.ac.in/courses/120/108/120108002/
7. https://onlinecourses.swayam2.ac.in/ini25_bt02/preview
8. https://nptel.ac.in/courses/102104088
9. https://nptel.ac.in/courses/124107165
10. https://nptel.ac.in/courses/109106200
11. https://archive.nptel.ac.in/content/storage2/courses/120108004/module1/lecture1.pdf
12. https://onlinecourses.swayam2.ac.in/nou25_ge19/preview
13. https://onlinecourses.swayam2.ac.in/ini25_hs01/preview
14. http://kcl.digimat.in/nptel/courses/video/105105184/L32.html
15. https://nptel.ac.in/courses/105105169

Topics relevant to Skill Development:

1. An attitude of enquiry.
2. Write reports

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

Course Code: CSS2254	Course Title: Data Structures Lab Type of Course: Laboratory Course (PCC)	L-T- P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
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	To develop programming and problem-solving skills by enabling students to implement various data structures, analyze their performance through experimentation and apply structured approaches to solve computational problems effectively.
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain the concepts of fundamental data structures such as arrays, stacks, and queues and their operations. — Understand CO2: Implement linear data structures such as linked lists to solve real-world problems. — Apply CO3: Utilize appropriate non-linear data structures such as trees and graphs for given problem scenarios. — Apply CO4: Implement and demonstrate various searching and sorting algorithms and analyze the efficiency of data structures and algorithms in terms of time and space complexity. — Apply CO5: Apply data structure concepts in cybersecurity, AI/ML, blockchain, and intelligent computing applications. — Apply
Course Content:	30 Sessions

List of Laboratory Tasks: 30 Sessions

WEEK 1: Introduction & Arrays
Lab Sheet 1: Arrays Basics
Level 1: Write a program to create an array and perform insertion and deletion operations.
Level 2: Write a program to find largest, smallest, and average elements in an array.
Lab Sheet 2: Array Applications
Level 1: Write a program to reverse an array.
Level 2: Write a program to merge two arrays and remove duplicates.

WEEK 2: Stack
Lab Sheet 3: Stack Implementation
Level 1: Implement stack using array (push and pop operations).
Level 2: Write a program to check overflow and underflow conditions.
Lab Sheet 4: Stack Applications
Level 1: Write a program to convert infix expression to postfix.
Level 2: Write a program to evaluate postfix expression.

WEEK 3: Queue
Lab Sheet 5: Queue Implementation
Level 1: Implement queue using array (enqueue and dequeue).
Level 2: Implement circular queue.
Lab Sheet 6: Queue Applications
Level 1: Write a program to simulate a queue in real-life scenario (ticket booking).
Level 2: Implement priority queue.

WEEK 4: Linked List Basics
Lab Sheet 7: Singly Linked List
Level 1: Create a singly linked list and perform insertion.
Level 2: Perform deletion and display operations.
Lab Sheet 8: Linked List Applications
Level 1: Count number of nodes in a linked list.
Level 2: Reverse a linked list.

WEEK 5: Advanced Linked List
Lab Sheet 9: Circular Linked List
Level 1: Create and traverse a circular linked list.
Level 2: Perform insertion and deletion in circular linked list.
Lab Sheet 10: Linked List Problems
Level 1: Merge two linked lists.
Level 2: Detect loop in linked list.

WEEK 6: Recursion
Lab Sheet 11: Recursion Basics
Level 1: Write a recursive program for factorial.
Level 2: Write a recursive program for Fibonacci series.
Lab Sheet 12: Recursion Applications
Level 1: Solve Tower of Hanoi using recursion.
Level 2: Compare recursive and iterative approaches.

WEEK 7: Trees Basics
Lab Sheet 13: Binary Tree
Level 1: Create a binary tree and perform traversal.
Level 2: Implement preorder, inorder, and postorder traversal.
Lab Sheet 14: Tree Properties
Level 1: Count nodes and height of tree.
Level 2: Check if tree is balanced.

WEEK 8: Binary Search Tree
Lab Sheet 15: BST Implementation
Level 1: Insert elements into BST.
Level 2: Delete elements from BST.
Lab Sheet 16: BST Applications
Level 1: Search an element in BST.
Level 2: Find minimum and maximum elements.

WEEK 9: Advanced Trees
Lab Sheet 17: AVL Trees
Level 1: Implement AVL tree insertion.
Level 2: Perform rotations (LL, RR, LR, RL).
Lab Sheet 18: Heaps
Level 1: Implement max heap.
Level 2: Perform heap sort.

WEEK 10: Expression Trees & Red-Black Trees
Lab Sheet 19: Expression Tree
Level 1: Construct expression tree from postfix.
Level 2: Evaluate expression tree.
Lab Sheet 20: Red-Black Tree
Level 1: Understand insertion rules.
Level 2: Implement basic operations.

WEEK 11: Graph Basics
Lab Sheet 21: Graph Representation
Level 1: Represent graph using adjacency matrix.
Level 2: Represent graph using adjacency list.
Lab Sheet 22: Graph Traversal
Level 1: Implement BFS.
Level 2: Implement DFS.

WEEK 12: Graph Algorithms

Lab Sheet 23: Shortest Path
Level 1: Implement Dijkstra's algorithm.
Level 2: Analyze shortest path in weighted graph.
Lab Sheet 24: Minimum Spanning Tree
Level 1: Implement Prim's algorithm.
Level 2: Implement Kruskal's algorithm.

WEEK 13: Hashing
Lab Sheet 25: Hash Tables
Level 1: Implement hashing using division method.
Level 2: Handle collisions using chaining.
Lab Sheet 26: Advanced Hashing
Level 1: Implement linear probing.
Level 2: Compare static vs dynamic hashing.

WEEK 14: Searching
Lab Sheet 27: Searching Techniques
Level 1: Implement sequential search.
Level 2: Implement binary search.
Lab Sheet 28: Searching Applications
Level 1: Compare searching techniques.
Level 2: Analyze time complexity.
Lab Sheet 29: Basic Sorting
Level 1: Implement bubble sort and selection sort.
Level 2: Implement insertion sort.
Lab Sheet 30: Advanced Sorting
Level 1: Implement quick sort.
Level 2: Implement merge sort and compare performance
WEEK 15: Sorting
Lab Sheet 31: Secure Data Structures and Hashing
Level 1: Implement hashing techniques for secure data storage and retrieval.
Level 2: Demonstrate collision handling methods and simple password verification using hashing.
Lab Sheet 32: AI/ML and Intelligent Data Structure Applications
Level 1: Implement graph or tree-based data representation for intelligent systems.
Level 2: Develop a simple application using data structures for recommendation, prediction, or intrusion detection systems.

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.informatics global.com/login

Topics relevant to development of "Skill Development": Linked list and stacks Topics relevant to development of "Environment and sustainability: Queues

Course Code: CSS2255	Course Title: Object Oriented Programming Using Java Type of Course: Theory	L-T- P- C	3-0-0-3
Version No.	2.0		
Course Pre-requisites	CSE1502		
Anti-requisites	Nil		
Course Description	This course introduces the core concepts of Object-Oriented Programming. The course includes both theory and laboratory components that emphasize the implementation and application of object-oriented programming paradigms using Java. It enables students to develop real-time, secure, and intelligent applications by applying object-oriented concepts for effective problem solving. The course also introduces modern concepts related to AI/ML-based application development, secure programming practices, and intelligent software systems. Students will understand the significance of object-oriented programming in designing scalable, reusable, secure, and intelligent applications.		
Course Objective	The objective of the course is to familiarize learners with problem-solving concepts using Java and to attain skill development through experiential learning techniques. The course also aims to develop the ability to design secure, scalable, and intelligent applications using object-oriented programming concepts with exposure to AI/ML-oriented programming practices and modern software development approaches.		
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the basic programming concepts. — L2 – Understand CO2: Apply the concept of classes, objects, and methods to solve problems. — L3 – Apply CO3: Apply the concept of arrays and strings. — L3 – Apply CO4: Implement inheritance and polymorphism for building secure applications. — L3 – Apply CO5: Apply Java I/O concepts for intelligent data processing, secure file handling, and AI/ML-based application development. — L3 – Apply		
Course Content:			
Module 1	Basic Concepts of Programming and Java	Assignment	Problem Solving	9 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	Assignment	Problem Solving	10 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	Assignment	Problem Solving	8 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	Assignment	Problem Solving	10 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	Advanced Java I/O, Security and AI/ML Applications	Assignment	Problem Solving	8 Sessions
Input/output Operation in Java (java.io Package), Streams and the New I/O Capabilities, Understanding Streams, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces, AI-based File Processing Concepts, Intelligent Data Stream Management, Machine Learning Applications in File and Data Handling.				
Text Book T1 Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education, 11th Edition,2019.				
References R1. Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Tenth Edition, Pearson 2015. R2: James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers.4th Edition, 2000. R3. E. Balagurusamy, "Programming with Java", Tata McGraw Hill Education, 6th Edition, 2019. E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf E book link R2: Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub) Web resources https://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q https://puniversity.informatics global.com:2229/login.aspx				
Topics relevant to development of "Skill Development": Static Polymorphism Method overloading, constructors constructor overloading this keyword static keyword and Inner classes Inheritance and Polymorphism. for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSS2256	Course Title: Object Oriented Programming Using Java Lab Type of Course: Laboratory Course (PCC)	L-T-P- C	0	0	2	1
Version No.	2.0					
Course Pre-requisites	NIL					

Anti-requisites	NIL
Course Description	This course introduces the core concepts of Object-Oriented Programming. The course includes both theory and laboratory components that emphasize the implementation and application of object-oriented programming paradigms using Java. It enables students to develop real-time, secure, and intelligent applications by applying object-oriented concepts for effective problem solving. The course also introduces modern concepts related to AI/ML-based application development, secure programming practices, and intelligent software systems. Students will understand the significance of object-oriented programming in designing scalable, reusable, secure, and intelligent applications.
Course Objective	The objective of the course is to familiarize learners with problem-solving concepts using Java and to attain skill development through experiential learning techniques. The course also aims to develop the ability to design secure, scalable, and intelligent applications using object-oriented programming concepts with exposure to AI/ML-oriented programming practices and modern software development approaches.
Course Outcomes	On successful completion of the course, students shall be able to: CO1: Demonstrate fundamental programming concepts. L3 – Apply CO2: Apply the concepts of classes, objects, and methods to solve problems. L3 – Apply CO3: Apply the concepts of arrays and strings. L3 – Apply CO4: Implement inheritance and polymorphism to develop secure applications. L3 – Apply CO5: Apply Java I/O concepts for intelligent data processing, secure file handling, and AI/ML-based application development. L3 – Apply

Course Content:	30 Sessions

List of Laboratory Tasks:

Week 1:

Lab Sheet 1: Java Program Structure & Basic I/O

Level 1:

Write a Java program to display “Hello, Java”.

Demonstrate use of variables and data types.

Level 2:

Write a Java program to take user input (name, age) and display formatted output.

Week 2:

Lab Sheet 2: Operators and Expressions

Level 1:

Write a Java program to perform arithmetic operations (+, -, *, /, %).

Level 2:

Develop a program to evaluate a complex expression using relational and logical operators.

Week 3:

Lab Sheet 3: Control Statements – Branching

Level 1:

Write a Java program to check whether a number is even or odd using if-else.

Level 2:

Implement a menu-driven calculator using switch-case.

Week 4:

Lab Sheet 4: Control Statements – Looping
Level 1:

Write programs using loops:

1. Print numbers from 1 to N
2. Find factorial of a number

Level 2:

Generate Fibonacci series and check whether a number is prime.

Week 5:

Lab Sheet 5: Classes and Objects
Level 1:

Create a class Student with data members and display details using object.

Level 2:

Create multiple objects and demonstrate accessing members using reference variables.

Week 6:

Lab Sheet 6: Methods and Access Specifiers
Level 1:

Write a class with methods to perform addition and subtraction.

Level 2:

Demonstrate use of public, private, and protected access specifiers.

Week 7:

Lab Sheet 7: Constructors and Overloading
Level 1:

Implement a class with a default constructor and parameterized constructor.

Level 2:

Demonstrate constructor overloading and use of this keyword.

Week 8:

Lab Sheet 8: Static Keyword & Nested Classes
Level 1:

Write a program demonstrating static variables and static methods.

Level 2:

Create a nested class and access its members from the outer class.

Week 9:

Lab Sheet 9: Arrays (1D and 2D)
Level 1:

Write programs for:

1. Sum of array elements
2. Find largest element

Level 2:

Perform matrix addition and multiplication using 2D arrays.

Week 10:

Lab Sheet 10: Array of Objects
Level 1:
Create an array of objects (e.g., Employee class).
Level 2:
Perform operations like sorting objects based on a field.

Week 11:

Lab Sheet 11: Strings and StringBuffer
Level 1:
Perform basic string operations: Length, concatenation, comparison
Level 2:
Demonstrate mutable operations using StringBuffer and StringBuilder.

Week 12:

Lab Sheet 12: Inheritance
Level 1:
Create a base class and derived class using single inheritance.
Level 2:
Implement multilevel inheritance and demonstrate use of super keyword.

Week 13:

Lab Sheet 13: Polymorphism & Abstract Classes
Level 1:
Demonstrate method overriding (runtime polymorphism).
Level 2:
Create an abstract class and implement its methods in a subclass.

Week 14:

Lab Sheet 14: Exception Handling
Level 1:
Handle exceptions using try-catch-finally.
Level 2:
Create custom exceptions and demonstrate multiple catch blocks.

Week 15:

Lab Sheet 15: File Handling and Serialization
Level 1:
Write a Java program to Create a file & Write and read data using File I/O
Level 2:
Implement object serialization and deserialization.
Use File streams and buffered streams for efficient I/O.

Week 15.1: AI/ML and Secure File Processing
Lab Sheet 16: Intelligent File Handling and Data Processing
Level 1:
Implement a Java program for secure file handling using buffered streams and file channels.
Level 2:

Develop a simple application for intelligent data analysis or log monitoring using Java File I/O and serialization concepts.
Targeted Application & Tools that can be used : JDK /Eclipse IDE/Visual Studio Code / net Beans IDE.
Text Book 1. Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education, 11th Edition,2019.
References 1. Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Tenth Edition, Pearson 2015. 2. James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers.4th Edition, 2000. 3. E. Balagurusamy, "Programming with Java", Tata McGraw Hill Education, 6th Edition, 2019. E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf E book link R2: Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub) Web resources https://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q https://puniversity.informatics global.com:2229/login.aspx
Topics relevant to development of "Skill Development": 1. Static Polymorphism 2. Method overloading, constructors 3. constructor overloading 4. this keyword 5. static keyword and Inner classes 6. Inheritance and Polymorphism. This is attained through assessment component mentioned in course handout.

Course Code: CSD1712	Course Name: Statistical Foundations for Data Science Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Co-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 Outcomes	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	Assignment	Programming	10 Sessions
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	Assignment	Programming	12 Sessions
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	Assignment	Programming	14 Sessions
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	Assignment	Programming	9 Sessions
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 Applications & Tools:			
Python (NumPy, pandas)	Core programming language and libraries used for data manipulation, cleaning, and preprocessing throughout the course.		
Torch			
Google Colaboratory			

Spider	
Jupiter Notebook	

Text Book

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.

E-Resources/Web Resources

1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP
2. https://presiuniv.knimbus.com/user#/

Course Code: CSD1713	Course Name: Statistical Foundations for Data Science Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	CSD1712		
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 Outcomes	**On successful completion of the course the students shall be able to:** 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. [Level 2 – Understand] CO2: Develop a strong foundation in multiple linear regression and the Gauss-Markov theorem. [Level 3 – Apply] CO3: Apply linear regression with random design and partial linear regression. [Level 3 – Apply] CO4: Apply the power method and learn about factor models and structured covariance learning. [Level 3 – Apply]		
Course Content:			

List of Laboratory Tasks:

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 Applications & Tools:

Torch	An open-source deep learning framework used for building, training, and deploying machine learning and neural network models.
Google Colaboratory	A cloud-based Python development environment that allows users to write and execute machine learning and data science programs through a web browser.
Spider	An open-source scientific Python development environment (IDE) used for data analysis, visualization, and machine learning applications.
Jupiter Notebook	An interactive web-based platform used for writing and executing code, data visualization, and documenting data science experiments.

Text Book

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.

E-Resources/Web Resources

1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP MIT OpenCourseware:
2. https://presiuniv.knimbus.com/user#/

Course Code: CSS2257	Course Title: Computer Organization and Architecture	L-T-P- C	3-0-0-3

	Type of Course: Theory Course (PCC)		
Version No.	2.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the core principles of computer architecture and organization from basic to intermediate level. This theory-based course emphasizes understanding the interaction between computer hardware and software. It equips students with the intuition behind assembly-level instruction set architectures and helps them interpret the operational concepts of computer technology and performance enhancement. The course also introduces emerging concepts in computer security, AI-enabled computing, intelligent processor optimization, and modern secure computing architectures.		
Course Objective	To develop a comprehensive understanding of computer system organization by enabling students to analyze processor architecture and instruction execution, explore memory hierarchy and cache mechanisms, examine input/output organization and interfacing, evaluate system performance and optimization techniques, and understand emerging applications in secure computing, AI-enabled architectures, and intelligent system design.		
Course Outcomes	On successful completion of this course, students will be able to: **CO1:** Describe the fundamental components of a computer system and their interconnections. — Remember **CO2:** Explain the concepts of Instruction Set Architecture (ISA) and memory organization. — Understand **CO3:** Apply techniques to perform arithmetic and logical operations in computer systems. — Apply **CO4:** Explain the organization and functioning of processor and memory subsystems. — Understand		
Course Content:			
Module 1	Basic Structure of Computer		12 Sessions
Topics: Computer Types, Functional Units, Basic Operational concepts, Bus Structures, Computer systems RISC & CISC, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Arithmetic Operations on Signed numbers. Instructions and Instruction Sequencing, Instruction formats, Memory Instructions.			
Module 2	Instruction Set Architecture and Memory Unit		12 Sessions
Topics: Instruction Set Architecture: Addressing Modes, Stacks and Subroutines. Memory System: Memory Location and Addresses, Memory Operations, Semiconductor RAM Memories, Internal Organization of Memory chips, Cache memory mapping Techniques.			
Module 3	Arithmetic And Input/output Design		10 Sessions
Topics: Arithmetic: Carry lookahead Adder, Signed-Operand Multiplication, Integer Division, and Floating point operations. Input/output Design: Accessing I/O Devices, I/O communication, Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits			

Module 4	BPU and Pipelining	05 Sessions
Topics: Basic Processing Unit: Fundamental Concepts, Single Bus organization, Control sequence, Execution of a Complete Instruction, Multiple Bus Organization. Pipelining: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Hazards.		
Module 5	Security, AI and Intelligent Computing Architecture	06 Sessions
Computer Security Fundamentals, Secure Instruction Execution, Memory Security and Protection Techniques, Cache and Processor Security, Cryptographic Fundamentals in Computer Architecture, AI-assisted Processor Design, Machine Learning Concepts in Hardware Optimization, Intelligent Memory Management Techniques, AI-based Performance Optimization, Applications of AI and Security in Modern Computing Systems.		
Targeted Application & Tools that can be used: Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc. Tools: Virtual Lab, IIT KGP Tejas – Java Based Architectural Simulator, IIT Delhi		
Project work/Assignment:		
Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments		
Textbook(s): 1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", Sixth Edition, McGraw-Hill Higher Education, 2023 reprint. 2. William Stallings, "Computer Organization & Architecture – Designing for Performance", 11th Edition, Pearson Education Inc., 2019.		
References 1. David A. Patterson & John L. Hennessy, "Computer Organization and Design MIPS Edition- The Hardware/Software Interface", 6th Edition, Morgan Kaufmann, Elsevier Publications, November 2020.		
2. https://nptel.ac.in/courses/106105163 3. https://nptel.ac.in/courses/106106092 4. https://puniversity.informatics global.com:2229/login.aspx		

Course Code: APT4002	Course Title:Introduction to Aptitude (Audited)	L-T- P- C	0-2-0-0
Version No.	1.0		

CoursePre-requisites	Students should know the basic Mathematics&aptitude along with understanding of English			
Anti-requisites	Nil			
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions.The focus of this course is to teach the students to not only get to the correct answers,butto get there fasterthanever before, which will improve their employability factor.			
Course Objective	The objective of the course is to familiarize the learners with the concepts ofAptitude and attain Skill Development through Problem Solving techniques.			
Course Outcomes	On successful completion of the course the students shall be ableto: CO1]Recall all the basic mathematical concepts they learnt in highschool. CO2] Identify the principle concept needed in a question. CO3] Solve the quantitative and logical ability questions with the appropriate concept. CO4]Analyze the data given in complex problems. CO5]Rearrange the information tosimplify thequestion			
CourseContent:				
Module1	Quantitative Ability	Assignment	Bloom'sLevel: Application	12Sessions
Topics: Introduction to Aptitude,workingofTables,Squares,Cubes				
Module2	Logical Reasoning	Assignment	Bloom'sLevel: Application	18Sessions
Topics: Linear&Circular Arrangement Puzzle,Coding&Decoding,BloodRelations,Directions,Orderingand Ranking, Clocks and Calendars,Number Series, Wrong number series, Visual Reasoning				
Targeted Application&Toolsthatcanbeused: Applicationarea:Placement activities and Competitive examinations. Tools: LMS				
TextBook 1. Quantitative Aptitude by RS Aggarwal 2. Verbal&Non-Verbal Reasoning by RSAggarwal				

References
1. www.indiabix.com 2. www.youtube.com/c/TheAptitudeGuy/videos
Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques.This is attained through assessment component mentioned in coursehandout.

Course Code: CIV7601	Course Title: Universal Human Values and Ethics Type of Course: MAC course	L-T-P-C	-	-	-	0
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of the course is to develop a holistic perspective in students' life. The course adopts a self-reflective methodology of teaching and is designed to equip the students to explore their role in all aspects of living as a part of the society. It presents a universal approach to value education by developing the right understanding of reality through the process of self-exploration. This self-exploration develops more confidence and commitment in students enabling them to critically evaluate their pre-conditioning and present beliefs. As an outcome of the holistic approach, the students will be able to practice the ethical conduct in the social and professional life. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information. This course is designed to cater to Human Values and Professional Ethics.					
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'SELF LEARNING' techniques					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Understand the concepts of human values, self-exploration, and holistic development in personal and social contexts. [Level 2 – Understand] CO2: Apply principles of human values and ethical conduct in personal, social, and professional life situations. [Level 3 – Apply] CO3: Apply the concepts of harmony and ethical reasoning to address issues in family, society, and professional environments. [Level 3 – Apply] CO4: Analyze the relationship between self and body, and the role of values in maintaining harmony within individuals and society. [Level 4 – Analyze] CO5: Evaluate personal beliefs, behaviors, and professional practices based on universal human values and ethical principles. [Level 5 – Evaluate]					
Course Content:						
Module 1	Introduction to Value Education	Online Assessment	MCQ Quiz	5 Sessions		
Topics: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.						
Module 2	Harmony in the Human Being	Online Assessment	MCQ Quiz	5 Sessions		

Topics:
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

Module 3	Harmony in the Family and Society	Online Assessment	MCQ Quiz	5 Sessions

Topics:
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Module 4	Implications of the Holistic Understanding – A Look at Professional Ethics	Online Assessment	MCQ Quiz	5 Sessions

Topics:
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Strategies for Transition towards Value-based Life and Profession

Targeted Application & Tools that can be used:
Application areas are Personal life, Education and Career, Workplace , Society and Environmental Responsibility
Tools: Online Tools – NPTEL and Swayam.

Project work/Assignment:

Assessment Type
- Online exams (MCQs) will be conducted by the Department of Civil Engineering through Linways.

Online Link*:
3) UHV II - https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&pp=0gcJCWMEOCosWNin
4) Lecture by Dr. Kumar Sambhav, NPTEL course: Universal Human Values, https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
5) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.

* Other source links are available in below Resources link.

Text Book

12. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
13. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2019.
14. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books

6. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
7. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
9. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
10. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
11. A N Tripathy, 2003, Human Values, New Age International Publishers.
12. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
13. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
14. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
15. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.

Resources: 16. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview 17. https://onlinecourses.nptel.ac.in/noc25_mg141/preview 18. https://onlinecourses.swayam2.ac.in/ini25_hs52/preview 19. https://onlinecourses.nptel.ac.in/noc25_hs219/preview 20. https://onlinecourses.swayam2.ac.in/cec25_mg14/preview 21. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview 22. https://onlinecourses.swayam2.ac.in/imb25_mg196/preview
Topics relevant to Skill Development: 3. An attitude of enquiry. 4. Write reports The topics related to Human values and Professional ethics: All topics in are relevant to Human values and Professional ethics.

Course Code: MAT2321	**Course Title:Discrete Mathematical Structures** **Type of Course:1] School Core**	**L-T- P- C**	**3**	**1**	**0**	**4**
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts of Discrete Mathematics, providing the mathematical foundations essential for computer science and related disciplines. It covers sets, relations, functions, closures, equivalence relations, and primitive recursive functions, followed by partially ordered sets, lattices, and Boolean algebras. The course also explores graph theory, including graph types, isomorphism, Euler and Hamiltonian paths, circuits, and graph coloring. In addition, students study algebraic structures such as semigroups, monoids, and groups, residue arithmetic, and group codes. Emphasis is placed on developing logical reasoning, mathematical modeling, and problem-solving skills applicable to computing, information systems, and network analysis.						
Course Objective	The primary objective of this course is to provide students with a strong foundation in discrete mathematical structures and logical reasoning that underpin computer science and related disciplines. It aims to develop the ability to construct mathematical arguments, analyze discrete problems, and apply formal methods to problem solving. The course introduces fundamental concepts of logic, sets, relations, functions, Boolean algebra, graph theory, and algebraic structures such as semigroups, monoids, and groups, while also exploring formal languages and grammar. Through these topics, students will acquire the analytical and mathematical skills necessary for applications in algorithm design, digital systems, coding theory, cryptography, and other areas of computing.						
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Apply propositional and predicate logic, logical equivalences, normal forms, inference rules, and proof techniques to analyze arguments and solve problems in mathematical reasoning and computer science. (L3) **CO2:** Apply the concepts of sets, relations, functions, closures, equivalence relations, and primitive recursive functions to model and solve problems in discrete mathematics and computer science. (L3) **CO3:** Employ partially ordered sets, lattices, Boolean algebras, and Boolean functions, and apply their properties to solve problems in discrete mathematical structures and logical systems. (L3) **CO4:** Apply the concepts of lattices, Boolean algebras, and Boolean functions to solve logical and computational problems. (L3) **CO5:** Apply graph theoretic concepts and techniques to solve problems in networks, connectivity, and optimization applications. (L3) **CO6:** Employ group theory and residue arithmetic techniques in coding,						

	computation, and information processing. (L3)	
Course Content:		
Module 1	**Fundamentals of Logic**	**(11L+4T=14 Sessions)**
Propositional Logic, Propositional Logic, Equivalences, Normal forms, Inference rules, Introduction to Proofs, Conversion to clausal form, Predicate calculus, The Statement function, Inference theory of the Predicate Calculus. Compiler optimization and program correctness verification, Cybersecurity and cryptographic protocol verification.		
Module 2	**Relations and Functions**	**(10L+3T=13 Sessions)**
Sets and set-operations, Relations, Functions, Properties of Relations & Representations of Relation, closure of different types of relations, equivalence relations, primitive recursive function. Database Management Systems, Artificial Intelligence and Machine Learning.		
Module 3	**Boolean Algebra and Graph Theory**	**(13L+4T=17 Sessions)**
Partially Ordered Sets, Lattices, Boolean Algebras, Functions of Boolean Algebras, Boolean Functions as Boolean Polynomials. Computer Networks: Routing and switching logic. Robotics: Decision-making using Boolean logic. Graph Theory-Basic Concept of Graph Theory, Types of Graphs, Isomorphism, Euler Paths and Circuits, Hamiltonian Paths and Circuits, Colouring of Graph. Social Networks (Facebook, Instagram, LinkedIn).and GPS & Navigation: Shortest path and route optimization.		
Module 4	**Groups**	**(11L+4T=15 Sessions)**
Semi Groups, Monoids, Groups, The applications of Residue Arithmetic to Computers, Group codes. Functional programming and distributed systems. Compiler design and programming languages.		
Targeted Application & Tools that can be used: • Compiler optimization, program correctness verification, cybersecurity protocol verification, automated reasoning, formal software verification. • Database Management Systems (DBMS), Artificial Intelligence (AI), Machine Learning (ML), knowledge representation, data modeling and query processing. • Digital circuit design, computer networks (routing and switching), robotics decision-making systems, logic controller design, social network analysis, GPS and navigation systems, route optimization, communication networks, and recommendation systems. • Cryptography, error-correcting codes, compiler design, distributed systems, residue arithmetic in computer architecture. Software: MATLAB, Lean 4, Mathematica, Maple, Python, GeoGebra, Octave, R, Scilab.		
Assignment:		
Assignments will involve theoretical problem-solving and computational implementation using suitable programming tools. The assignments may be undertaken individually or in groups, as decided by the instructor. Additionally, experiential learning activities will be conducted using Lean 4, enabling students to develop formal proofs, verify logical propositions, and gain hands-on experience in theorem proving and formal verification.		
Text Book 6. K. H. Rosen, *Discrete Mathematics and Its Applications*, 8th ed. New York, NY, USA: McGraw-Hill Education, 2019. 7. F. Harary, *Graph Theory*. Reading, MA, USA: Addison-Wesley Publishing Company, 1969.		
References: 1. S. Epp, *Discrete Mathematics with Applications*, 5th ed. Boston, MA, USA: Cengage Learning, 2019. 2. K. A. Ross and C. R. B. Wright, *Discrete Mathematics*, 6th ed. New Delhi, India: Pearson Education, 2018. 3. L. Mott, A. Kandel, and T. P. Baker, *Discrete Mathematics for Computer Scientists and Mathematicians*, 3rd ed. New Delhi, India: PHI Learning, 2016. **E-resources/ Web links:** 4. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=TEXTBOOK_LIBRARY01_06082022_289		

5. https://presiuniv.knimbus.com/portal/v2/default/viewDetail?searchResultType=ECATALOGUE_BASED&uniqueId=DOAB_1_06082022_8919 6. https://nptel.ac.in/courses/106108227 7. https://nptel.ac.in/courses/111106102 8. https://nptel.ac.in/courses/111106113
Topics relevant to SKILL DEVELOPMENT: The course develops skills in logical reasoning, mathematical modeling, problem-solving, algorithmic thinking, and graph analysis through the study of logic, relations, Boolean algebra, and graph theory. It also enhances computational and analytical skills by applying algebraic structures, formal languages, recursion, and coding techniques to real-world computing problems.

Catalogue prepared by	**Dr. Obbu Ramesh**
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CSS2258	Course Title: Web Technologies Type of Course : Theory Course (PCC)	L-T-P- C	3 – 0 – 0 - 3
Version No.	2.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course highlights the fundamentals of web design using Hypertext Markup Language and Cascading Style Sheets. Students will be trained in planning and designing effective web pages by writing code using current web technologies, enhancing web pages with layout techniques, text formatting, graphics, images, and multimedia. The course focuses on key technologies required to build Internet- and web-based applications that interact with databases and other applications. It also introduces concepts of secure web development, intelligent web applications, and AI-enabled web technologies.		
Course Objective	To develop a strong foundation in web technologies by enabling students to understand internet protocols, design and develop static and dynamic web applications, explore client-side scripting and frameworks, implement server-side programming with database integration, evaluate modern web application architectures, and develop secure and intelligent web applications using AI concepts.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain the fundamentals of web technologies, XHTML structure, and web architecture concepts. — Level 2 – Understand CO2: Apply CSS and advanced styling techniques to design responsive and interactive web pages. — Level 3 – Apply CO3: Develop dynamic web applications using JavaScript, DOM manipulation, and event handling techniques. — Level 3 – Apply CO4: Build server-side web applications using PHP and database connectivity concepts. — Level 3 – Apply CO5: Apply web technologies to develop secure and intelligent web — Level 3 – Apply		

	applications using AI concepts.	
Course Content:		
Module 1	Introduction to XHTML	10 Sessions
Topics: Basics: Web, WWW, Web browsers, Web servers, Internet. XHTML: Origins and Evolution of HTML and XHTML: Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Frames, Syntactic Differences between HTML and XHTML.		
Module 2	Advanced CSS	10 Sessions
Topics: CSS: Introduction to CSS, Defining & Applying a style, Creating style sheets, types of style sheet, selectors, CSS font properties, border properties, Box model, opacity, CSS pseudo class and pseudo-elements Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Responsive Design, CSS Frameworks XML: Basics, demonstration of applications using XML		
Module 3	Fundamentals of JavaScript	10 Sessions
Topics: JavaScript: Introduction to JavaScript, Basic JavaScript Instructions, Functions, Methods & Objects, Decisions and Loops, Document Object Model, Event handling, handling window pop-ups, JavaScript validation.		
Module 4	PHP – Application Level	08 Sessions
Topics: PHP: Introduction to server-side Development with PHP, Arrays, $GET and $ POST, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP.		
Module 5	Web Security and AI Applications	07 Sessions
Web Security Basics, Secure Web Development, Input Validation and Session Handling, Secure PHP and Database Access, Introduction to AI in Web Applications, AI-based Chatbots, Intelligent User Interfaces, Smart Web Applications.		
Targeted Application & Tools that can be used: Xampp web server to be used to demonstrate PHP.		
Project work/Assignment:		
Assignments are given after completion of each module which the student need to submit within the stipulated deadline.		
Textbook(s): T1. Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 8th Edition,2015. T2. CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022) T3. Deitel, Deitel, Goldberg,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education,2021.		
References: R1. Randy Connolly, Ricardo Hoar,"Fundamentals of Web Development", Pearson Education India,1st. Edition.2016. R2. Jeffrey C. Jackson,"Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.		

Topics related to development of "FOUNDATION": Web, WWW, Web browsers, Web servers, Internet. CSS, PHP. Designing for healthcare.
For Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.
E-References:

1. W3schools.com
2. Developer.mozilla.org/en-US/docs/Learn
3. docs.microsoft.com
4. informit.com/articles/ The Relationship Between Web 2.0 and Social Networking
5. https://presiuniv.knimbus.com/user#/home

Course Code: CSS2259	Course Title: Web Technologies Lab Type of Course: Laboratory Course (PCC)	L- T-P- C	0-0-2-1
Version No.	2.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course highlights the fundamentals of web design using Hypertext Markup Language and Cascading Style Sheets. Students will be trained in planning and designing effective web pages by writing code using current web technologies, enhancing web pages with layout techniques, text formatting, graphics, images, and multimedia. The course focuses on key technologies required to build Internet- and web-based applications that interact with databases and other applications. It also introduces concepts of secure web development, intelligent web applications, and AI-enabled web technologies.		
Course Objective	To develop a strong foundation in web technologies by enabling students to understand internet protocols, design and develop static and dynamic web applications, explore client-side scripting and frameworks, implement server-side programming with database integration, evaluate modern web application architectures, and develop secure and intelligent web applications using AI concepts.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain the fundamentals of web technologies, XHTML structure, and web architecture concepts. — Level 2 – Understand CO2: Apply CSS and advanced styling techniques to design responsive and interactive web pages. — Level 3 – Apply CO3: Develop dynamic web applications using JavaScript, DOM manipulation, and event handling techniques. — Level 3 – Apply CO4: Build server-side web applications using PHP and database connectivity concepts. — Level 3 – Apply CO5: Apply web technologies to develop secure and intelligent web applications using AI concepts. — Level 3 – Apply		

COURSE CONTENT:

List of Laboratory Tasks: 30 Sessions

WEEK 1: Introduction to Web & XHTML

Lab Sheet 1: Web Basics
Level 1: Create a simple XHTML page explaining Web, WWW, browsers, and servers.
Level 2: Design a webpage illustrating Internet architecture using text and images.
Lab Sheet 2: XHTML Structure
Level 1: Create a basic XHTML document with proper syntax and structure.
Level 2: Design a webpage using headings, paragraphs, and formatting tags.

WEEK 2: XHTML Elements
Lab Sheet 3: Lists and Links
Level 1: Create ordered, unordered, and definition lists in XHTML.
Level 2: Create hyperlinks for navigation between multiple pages.
Lab Sheet 4: Images and Tables
Level 1: Insert images into a webpage.
Level 2: Design a table with rows, columns, and formatting.

WEEK 3: XHTML Forms & Frames
Lab Sheet 5: Forms
Level 1: Create a form with text fields and buttons.
Level 2: Design a registration form with validation requirements.
Lab Sheet 6: Frames
Level 1: Create a webpage using frames.
Level 2: Design a multi-frame layout for a website.

WEEK 4: Introduction to CSS
Lab Sheet 7: CSS Basics
Level 1: Apply inline and internal CSS styles.
Level 2: Create an external stylesheet and apply it to multiple pages.
Lab Sheet 8: Selectors
Level 1: Use element, class, and ID selectors.
Level 2: Apply multiple selectors for styling complex pages.

WEEK 5: CSS Properties
Lab Sheet 9: Font and Text
Level 1: Apply font properties (size, style, family).
Level 2: Design a styled webpage using text formatting.
Lab Sheet 10: Box Model
Level 1: Demonstrate margin, padding, and border.
Level 2: Design layout using box model concepts.

WEEK 6: Advanced CSS
Lab Sheet 11: Positioning
Level 1: Use static and relative positioning.
Level 2: Design layout using absolute and fixed positioning.
Lab Sheet 12: Floating & Layout
Level 1: Apply float properties.
Level 2: Create a multi-column layout using float.

WEEK 7: Responsive Design
Lab Sheet 13: Responsive Web Design
Level 1: Use media queries.
Level 2: Design a responsive webpage.
Lab Sheet 14: CSS Frameworks
Level 1: Use a CSS framework (Bootstrap basics).
Level 2: Design responsive webpage using Bootstrap.

WEEK 8: XML Basics
Lab Sheet 15: XML Structure

Level 1: Create a simple XML document.
Level 2: Display XML data in webpage.
Lab Sheet 16: XML Applications
Level 1: Validate XML structure.
Level 2: Use XML for data representation in web pages.

WEEK 9: JavaScript Basics
Lab Sheet 17: JavaScript Introduction
Level 1: Write basic JavaScript program for output.
Level 2: Perform arithmetic operations using JavaScript.
Lab Sheet 18: Control Statements
Level 1: Use if-else statements.
Level 2: Implement loops in JavaScript.

WEEK 10: Functions & DOM
Lab Sheet 19: Functions
Level 1: Create and call functions.
Level 2: Use functions with parameters and return values.
Lab Sheet 20: DOM Manipulation
Level 1: Access HTML elements using DOM.
Level 2: Modify content dynamically using JavaScript.

WEEK 11: Events & Validation
Lab Sheet 21: Event Handling
Level 1: Handle click events.
Level 2: Create interactive webpage using events.
Lab Sheet 22: Form Validation
Level 1: Validate input fields using JavaScript.
Level 2: Create complete form validation system.

WEEK 12: Advanced JavaScript
Lab Sheet 23: Objects & Methods
Level 1: Create JavaScript objects.
Level 2: Use methods and object properties.
Lab Sheet 24: Pop-ups
Level 1: Implement alert and prompt.
Level 2: Create dynamic pop-up-based interaction.

WEEK 13: PHP Basics
Lab Sheet 25: PHP Introduction
Level 1: Write basic PHP script.
Level 2: Handle form input using PHP.
Lab Sheet 26: PHP Control Structures
Level 1: Use if-else in PHP.
Level 2: Implement loops in PHP.

WEEK 14: PHP Applications
Lab Sheet 27: PHP Forms
Level 1: Process form data using PHP.
Level 2: Create login system using PHP.
Lab Sheet 28: PHP File Handling
Level 1: Read/write files using PHP.
Level 2: Store and retrieve data dynamically.

WEEK 15: Integration & Mini Project
Lab Sheet 29: Web Integration
Level 1: Combine XHTML, CSS, JavaScript.

Level 2: Build dynamic webpage using all technologies.
Lab Sheet 30: Mini Project
Level 1: Design a complete website.
Level 2: Develop full web application using XHTML, CSS, JS, PHP.

WEEK 15.1: Secure and Intelligent Web Applications
Lab Sheet 31: Web Security and Smart Interfaces

Level 1: Implement secure form validation and session handling in web applications.
Level 2: Develop an intelligent web interface with chatbot or recommendation features.

Lab Sheet 32: AI-based Web Mini Project

Level 1: Design a secure responsive web application.
Level 2: Develop a smart web application integrating XHTML, CSS, JavaScript, PHP, and basic AI concepts.

Targeted Application & Tools that can be used:
Xampp web server to be used to demonstrate PHP.

Project work/Assignment:

Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Textbook(s):
T1. Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 8th Edition,2015.
T2. CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)
T3. Deitel, Deitel, Goldberg,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education,2021.

References:
R1. Randy Connolly, Ricardo Hoar,"Fundamentals of Web Development", Pearson Education India,1st. Edition.2016.
R2. Jeffrey C. Jackson,"Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.
E-References:

1. W3schools.com
2. Developer.mozilla.org/en-US/docs/Learn
3. docs.microsoft.com
4. informit.com/articles/ The Relationship Between Web 2.0 and Social Networking
5. https://presiuniv.knimbus.com/user#/home

Topics related to development of "FOUNDATION": Web, WWW, Web browsers, Web servers, Internet. CSS, PHP. Designing for healthcare For Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSS2260	Course Name: Database Management Systems Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites			

Anti-requisites	NIL
Course Description	This course introduces the foundational principles of database management systems, including data models, schemas, and architecture. 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 Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Describe the fundamental elements of relational database management systems. [Level 2 - Understand] **CO2**: Examine databases using SQL query processing and Optimization. [Level 3 – Apply] **CO3:** Design simple database systems applying the normalization constraints and demonstrate the database transaction processing, recovery, and security. [Level 3 – Apply] **CO4:** Interpret the concept of advanced databases and its applications. [Level 3 – Apply]

Course Content:

Module 1	Introduction to Database Modelling and Relational Algebra	Assessment: 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	Assessment : 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	Assessment: 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	Assessment : 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 Applications & Tools: 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.
Skill-Building Activities through Experiential Learning:
Text Book **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.
E-Resources/Web Resources

Course Code: CSS2261	Course Name: Database Management Systems Lab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites			
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 Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Demonstrate the database concepts, practice, and SQL queries. [Level 3 – Apply] **CO2:** Design and implement database schemas while applying normalization techniques to optimize structure. [Level 3 – Apply] **CO3:** Develop and implement stored procedures, triggers, and views for automation and efficiency. [Level 3 – Apply] **CO4:** Design and build database applications for real world problems. [Level 3 – 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. mplement 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 Applications & Tools:

Skill-Building Activities through Experiential Learning:

Text Book

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.

E-Resources/Web Resources

Course Code: CSS2262	Course Title: Analysis of Algorithms Type of Course: Theory Course (PCC)	L- T-P- C	3-1-0-4
Version No.	1.0		

<table>
<tr><td>Course Pre-requisites</td><td colspan="2">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="2">Nil</td></tr>
<tr><td>Course Description</td><td colspan="2">This course introduces techniques for the design and analysis of efficient algorithms and methods of application. The course discusses classic algorithm design approaches such as Divide and Conquer, Dynamic Programming, and Greedy Methods. It also covers strategies for searching solution spaces using Backtracking and Branch-and-Bound techniques. The course emphasizes the analysis of algorithms and their classification into various complexity classes. In addition, it introduces emerging concepts in AI-based optimization, intelligent search techniques, and algorithmic approaches for secure and smart computing applications.</td></tr>
<tr><td>Course Objective</td><td colspan="2">To develop the ability to design and analyze efficient algorithms by enabling students to evaluate time and space complexity, apply various algorithmic paradigms such as divide-and-conquer, greedy, dynamic programming, backtracking, and branch-and-bound, compare different approaches for solving computational problems, and understand intelligent optimization techniques used in AI-enabled and secure computing systems.</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">On successful completion of this course, students will be able to:
<table>
<tr><td>CO1: Explain the efficiency of algorithms in terms of time and space complexity.</td><td>Understand</td></tr>
<tr><td>CO2: Apply divide-and-conquer and decrease-and-conquer techniques to solve searching and sorting problems.</td><td>Apply</td></tr>
<tr><td>CO3: Apply dynamic programming and greedy techniques to solve computational problems.</td><td>Apply</td></tr>
<tr><td>CO4: Apply time–space trade-off techniques and analyze the limitations of algorithms for problem solving.</td><td>Apply</td></tr>
<tr><td>CO5: Analyze problems using backtracking, branch-and-bound, and AI-based optimization techniques to develop optimal solutions.</td><td>Analyze</td></tr>
</table></td></tr>
<tr><td colspan="3">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction</td><td>14 Sessions</td></tr>
<tr><td colspan="3">Introduction: Notion of algorithm, Importance of algorithm, Important Problem Types, Fundamentals of analysis of algorithm efficiency: General equation, Order of growth, basic efficiency classes, asymptotic notations, mathematical analysis of recursive & non-recursive algorithms, Brute Force technique: Bubble sort, selection sort, linear search, brute force string matching, Exhaustive search: Travelling salesperson problem, knapsack problem.</td></tr>
<tr><td>Module 2</td><td>Divide-and-conquer</td><td>11 Sessions</td></tr>
<tr><td colspan="3">Divide & Conquer technique: General Method, General recursive equation, Masters Theorem, Binary search, Merge sort, quick sort. Decrease & Conquer technique: General method, insertion sort, topological sorting</td></tr>
<tr><td>Module 3</td><td>Dynamic programming</td><td>13 Sessions</td></tr>
<tr><td colspan="3">Dynamic Programming: General method, Warshall algorithm, Floyd algorithm, 0/1 knapsack, Greedy method: General method, prim’s algorithm, Kruskal algorithm, Dijkstra’s algorithm, Huffman coding</td></tr>
<tr><td>Module 4</td><td>Space and time tradeoff:</td><td>11 Sessions</td></tr>
</table>

Space and time tradeoff: introduction, Input enhancement in string matching: Horspool algorithm and Boyer-Moore algorithm, Limitations of algorithm power: Introduction, lower bound arguments, decision trees, P, NP and NP-complete problems		
Module 5	Coping with Limitations of Algorithm Power and Intelligent Optimization	11 Sessions
Introduction to limitations of algorithm power, Backtracking: n-Queens Problem, Subset Sum Problem, Hamiltonian Circuit Problem, Branch and Bound: Travelling Salesperson Problem, Knapsack Problem, Job Assignment Problem, AI-based Search and Optimization Techniques, Machine Learning Approaches for Optimization Problems, Intelligent Decision-Making Algorithms, Applications in Secure and Smart Computing Systems.		
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.		
Reference Books: R1. AV Aho, J Hopcroft, JD Ullman, *"The Design and Analysis of Algorithms"*, Addison-Wesley, 1974 R2. Tim Roughgarden, *"Algorithms Illuminated"* (books 1 through 3), "Operating Systems Design and Implementation", Sound like yourself Publishing, 2017-2019. R3. J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005 Online Resources: 1. EBook: https://presiuniv.knimbus.com/user#/home 2. https://onlinecourses.nptel.ac.in/noc26_cs67/ 3. www.youtube.com/watch?v=so4zT-u09LM&list=PL8GCet93Cu1iRF611mrUu-Rhy12fMwZOf		
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: CSS2263	Course Title: Analysis of Algorithms Lab Type of Course: Laboratory Course (PCC)	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces techniques for the design and analysis of efficient algorithms and methods of application. The course discusses classic algorithm design approaches such as Divide and Conquer, Dynamic Programming, and Greedy Methods. It also covers strategies for searching solution spaces using Backtracking and Branch-and-Bound techniques. The course emphasizes the analysis of algorithms and their classification into various complexity classes. In addition, it introduces emerging concepts in AI-based optimization, intelligent search techniques, and algorithmic approaches for secure and smart computing applications.		
Course Objective	To develop the ability to design and analyze efficient algorithms by enabling students to evaluate time and space complexity, apply various algorithmic paradigms such as divide-		

	and-conquer, greedy, dynamic programming, backtracking, and branch-and-bound, compare different approaches for solving computational problems, and understand intelligent optimization techniques used in AI-enabled and secure computing systems.
Course Outcomes	On successful completion of this course, students will be able to: CO1: Compute the efficiency of algorithms in terms of time and space complexity. Level 3 – Apply CO2: Apply divide-and-conquer techniques to solve searching and sorting problems. Level 3 – Apply CO3: Apply dynamic programming techniques to solve computational problems. Level 3 – Apply CO4: Apply greedy techniques for solving optimization problems. Level 3 – Apply CO5: Analyze problems using backtracking, branch-and-bound, and AI-based optimization techniques to develop optimal solutions. Level 4 – Analyze

Course Content

List of Laboratory Tasks: 30 Sessions

WEEK 1: Algorithm Basics & Analysis
Lab Sheet 1: Algorithm Fundamentals
Level 1: Write an algorithm and program to find minimum and maximum elements in a list.
Level 2: Analyze the number of comparisons and derive time complexity.
Lab Sheet 2: Asymptotic Notations
Level 1: Write programs to demonstrate linear and quadratic time complexity.
Level 2: Compare growth rates of different functions using Big-O, Ω, and Θ.

WEEK 2: Efficiency Analysis
Lab Sheet 3: Recursive Algorithms
Level 1: Write a recursive program for factorial.
Level 2: Solve recurrence relations for recursive algorithms.
Lab Sheet 4: Non-Recursive Analysis
Level 1: Write programs with nested loops and count operations.
Level 2: Derive general equations and order of growth.

WEEK 3: Brute Force Techniques
Lab Sheet 5: Sorting Algorithms
Level 1: Implement Bubble Sort and Selection Sort.
Level 2: Compare their time complexity experimentally.
Lab Sheet 6: Searching & String Matching
Level 1: Implement Linear Search.
Level 2: Implement brute-force string matching algorithm.

WEEK 4: Exhaustive Search
Lab Sheet 7: Knapsack Problem
Level 1: Solve 0/1 Knapsack using brute force.
Level 2: Analyze solution space complexity.
Lab Sheet 8: Travelling Salesperson Problem
Level 1: Solve TSP using brute force approach.
Level 2: Compare performance for different inputs.

WEEK 5: Divide and Conquer
Lab Sheet 9: Binary Search
Level 1: Implement Binary Search.

Level 2: Analyze recurrence relation.
Lab Sheet 10: Merge Sort
Level 1: Implement Merge Sort.
Level 2: Analyze using Master's Theorem.

WEEK 6: Advanced Divide & Conquer
Lab Sheet 11: Quick Sort
Level 1: Implement Quick Sort.
Level 2: Compare best and worst cases.
Lab Sheet 12: Master's Theorem
Level 1: Solve recurrence equations.
Level 2: Apply Master's Theorem to different cases.

WEEK 7: Decrease and Conquer
Lab Sheet 13: Insertion Sort
Level 1: Implement Insertion Sort.
Level 2: Compare with Bubble Sort.
Lab Sheet 14: Topological Sorting
Level 1: Implement Topological Sort.
Level 2: Apply on real-world dependency graph.

WEEK 8: Dynamic Programming
Lab Sheet 15: Warshall Algorithm
Level 1: Implement Warshall algorithm.
Level 2: Compute transitive closure.
Lab Sheet 16: Floyd Algorithm
Level 1: Implement Floyd's algorithm.
Level 2: Compare with Dijkstra.

WEEK 9: DP Applications
Lab Sheet 17: Knapsack DP
Level 1: Solve 0/1 Knapsack using DP.
Level 2: Compare with brute force approach.
Lab Sheet 18: DP Optimization
Level 1: Identify overlapping subproblems.
Level 2: Convert recursive solution to DP.

WEEK 10: Greedy Algorithms
Lab Sheet 19: MST Algorithms
Level 1: Implement Prim's algorithm.
Level 2: Implement Kruskal's algorithm.
Lab Sheet 20: Shortest Path
Level 1: Implement Dijkstra's algorithm.
Level 2: Compare greedy vs DP approach.

WEEK 11: Huffman Coding
Lab Sheet 21: Huffman Tree
Level 1: Construct Huffman Tree.
Level 2: Analyze compression efficiency.
Lab Sheet 22: Greedy Analysis
Level 1: Demonstrate greedy choice property.
Level 2: Prove correctness of greedy algorithms.

WEEK 12: String Matching Optimization
Lab Sheet 23: Horspool Algorithm
Level 1: Implement Horspool algorithm.
Level 2: Compare with brute-force method.

Lab Sheet 24: Boyer-Moore Algorithm
Level 1: Implement Boyer-Moore algorithm.
Level 2: Analyze efficiency improvements.

WEEK 13: Complexity Theory
Lab Sheet 25: Lower Bounds
Level 1: Analyze decision tree for sorting.
Level 2: Derive lower bounds.
Lab Sheet 26: NP Problems
Level 1: Classify problems as P or NP.
Level 2: Analyze NP-complete problems.

WEEK 14: Backtracking
Lab Sheet 27: N-Queens
Level 1: Solve N-Queens problem.
Level 2: Analyze search tree.
Lab Sheet 28: Subset Sum
Level 1: Solve subset sum problem.
Level 2: Compare with DP solution.

WEEK 15: Branch & Bound
Lab Sheet 29: TSP
Level 1: Solve TSP using Branch & Bound.
Level 2: Compare with brute-force approach.
Lab Sheet 30: Job Assignment
Level 1: Solve assignment problem.
Level 2: Analyze pruning efficiency.
WEEK 15.1: AI-Based Optimization and Intelligent Search
Lab Sheet 31: Intelligent Optimization Techniques
Level 1: Implement AI-based heuristic search for optimization problems.
Level 2: Compare heuristic search with Branch & Bound approach for performance analysis.
Lab Sheet 32: Smart Decision-Making Applications
Level 1: Implement a simple recommendation or path optimization system using graph/search techniques.
Level 2: Analyze intelligent pruning and optimization efficiency in real-world problem solving.

Targeted Application & Tools that can be used :
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", Sound like yourself 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

Course Code: CSS2264	Course Title: Essentials of AI Type of Course: -Theory Course (ESC)	L-T-P-C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the fundamentals of Artificial Intelligence, AI tools, and prompt engineering techniques. It covers AI applications, evaluation of AI tools, ethical and responsible AI usage, and the social and economic impacts of AI. The course also introduces advanced AI technologies such as chatbots, voice assistants, image recognition, robotics, and intelligent automation through practical activities and case studies.		
Course Objectives	The course aims to introduce the fundamentals and applications of Artificial Intelligence, popular AI tools, and basic prompt engineering techniques. It also helps students evaluate AI tools, understand ethical and responsible AI usage, and gain knowledge of advanced AI technologies through practical examples and case studies.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain the fundamentals of Artificial Intelligence, its evolution, types, key concepts, and applications across various domains. . [Level 2 – Understand] CO2: Apply basic prompt engineering techniques for generating effective AI responses. [Level 3 – Apply] CO3: Evaluate and compare AI tools based on suitability, functionality, ethical considerations, privacy, and security requirements.. [Level 4 – Analyze] CO4: Understand the social, ethical, and economic impacts of AI technologies and their influence on society, industries, and employment. [Level 2 – Understand] CO5: Analyze advanced AI technologies and their real-world applications through case studies and practical scenarios. [Level 4 – Analyze]		
Course Content:			
Module 1	Introduction to Artificial Intelligence	Assignment (Fundamentals and Applications of Artificial Intelligence)	9 Sessions
Topics: Introduction to Artificial Intelligence – Definition and History of AI; Evolution of AI; Goals and Scope of AI; Types of AI – Narrow AI, General AI, Super AI. Key Concepts in AI – Machine Learning, Deep Learning, Neural Networks, Natural Language Processing (NLP), Computer Vision, Generative AI. AI vs Human Intelligence. AI Development Lifecycle. Applications of AI across domains – Healthcare, Education, Finance, Agriculture, Cybersecurity, and E-Commerce.			
Module 2	AI Tools and Effective Prompting Techniques	Practical Assignment (AI Tools and Prompt Engineering Techniques)	9 Sessions
Topics: Introduction to Popular AI Tools – Introduction to AI Tools – Overview of popular AI tools and their applications. AI tools for text generation, image generation, predictive analysis, and chatbot interactions. Prompt Engineering-Introduction to prompts and AI-generated responses. Importance of clear			

<table>
<tr><td colspan="4">instructions and effective questioning techniques. Understanding how AI interprets prompts.</td></tr>
<tr><td>Module 3</td><td>Suitability and Evaluation of AI Tools</td><td>Quiz + Assignment (Evaluation and Ethical Use of AI Tools)</td><td>9 Sessions</td></tr>
<tr><td colspan="4">Topics:
Introduction to AI Tool Evaluation, Evaluating Tool Suitability, AI Tools for Different Purposes, Comparison of AI Tools, Ethical Use of AI, Bias and Fairness in AI, Data Privacy and Security, Ethical Guidelines for Responsible AI Use</td></tr>
<tr><td>Module 4</td><td>Social, Ethical, and Economic Impacts of AI</td><td>Assignment (Social, Ethical, and Economic Impact Analysis of AI)</td><td>9 Sessions</td></tr>
<tr><td colspan="4">Topics:
Social, Ethical, and Economic Effects of AI – Ethical issues in AI, future challenges and opportunities, impact of AI on the economy and employment, and responsible use of AI technologies.</td></tr>
<tr><td>Module 5</td><td>Advanced AI Technologies case study</td><td>Mini Project / Case Study (AI Technologies and Real-World Applications)</td><td>9 Sessions</td></tr>
<tr><td colspan="4">AI Technologies – Voice assistants, image recognition applications, AI chatbots, robotic and intelligent automation systems, recommendation systems, and recent advancements and future trends in AI technologies.</td></tr>
<tr><td colspan="4">Targeted Application & Tools that can be used:
1. Implementation of AI-based content generation and chatbot interaction using prompt engineering techniques.
Tools: ChatGPT, Google Gemini, Hugging Face
2. Implementation of image generation and creative AI applications using generative AI tools.
Tools: Canva AI, DALL·E, Adobe Firefly
3. Implementation of predictive analytics and machine learning models for simple real-world datasets.
Tools: Google Colab, TensorFlow, Kaggle
4. Implementation of NLP-based applications such as sentiment analysis, text summarization, and language translation.
Tools: NLTK, spaCy, Hugging Face Transformers
5. Development of AI-based mini projects for solving real-world problems in healthcare, education, finance, agriculture, and cybersecurity.
Tools: IBM Watson, Microsoft Azure AI, Teachable Machine</td></tr>
<tr><td colspan="4">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).</td></tr>
<tr><td colspan="4">Textbook(s):
1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2022.
2. Elaine Rich and Kevin Knight, Artificial Intelligence, 3rd Edition, McGraw Hill Education, 2009.
3. Tom Taulli, Artificial Intelligence Basics: A Non-Technical Introduction, 1st Edition, Apress, 2019.</td></tr>
<tr><td colspan="4">References:
1. Ethem Alpaydin, Introduction to Machine Learning, 4th Edition, MIT Press, 2020.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016.
3. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, 1st Edition, Farrar, Straus and Giroux, 2019.
4. Pedro Domingos, The Master Algorithm, 1st Edition, Basic Books, 2015.
5. Kai-Fu Lee, AI Superpowers, 1st Edition, Houghton Mifflin Harcourt, 2018.</td></tr>
</table>

Weblinks • OpenAI • Google AI • IBM Artificial Intelligence • Microsoft AI Learning • Coursera – AI Courses • NPTEL – Introduction to Artificial Intelligence • NPTEL – Artificial Intelligence: Search Methods for Problem Solving

Course Code: CSS2265	Course Title: Essentials of AI Lab Type of Course: Laboratory Course (PCC)	L-T-P-C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces students to the fundamentals and practical applications of Artificial Intelligence through hands-on laboratory exercises. Students will explore AI tools, prompt engineering, generative AI, Natural Language Processing (NLP), basics of Machine Learning, chatbot development, recommendation systems, ethical AI, and voice assistant simulation. The course concludes with the development of AI-based mini projects for real-world applications.		
Course Objectives	To develop practical skills in Artificial Intelligence by enabling students to explore AI tools, apply prompt engineering techniques, implement basic NLP and Machine Learning tasks, develop intelligent AI-based applications, and analyze ethical and real-world aspects of AI systems.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Apply AI tools and prompt engineering techniques for generating effective AI-based outputs.. [Level 3 – Apply] CO2: Implement AI-based applications for text generation, image generation, and chatbot development. . [Level 3 – Apply] CO3: Apply Natural Language Processing and basic Machine Learning techniques for solving simple real-world problems.. [Level 3 – Apply] CO4: Analyze datasets and AI model outputs using preprocessing, visualization, and evaluation techniques. [Level 4 – Analyze] CO5: Analyze ethical issues, bias, and the impact of AI systems in practical applications [Level 4 – Analyze]		

Course Content:
Lab Sheet 1: Introduction to AI Tools • Problem Statement: • Explore different AI platforms such as ChatGPT, Gemini, and Hugging Face, and compare their outputs for various tasks based on relevance and accuracy. Lab Sheet 2: Prompt Engineering Basics • *(Using AI tools explored in Lab 1)* • Problem Statement: • Design effective prompts for text generation and summarization, and analyze how prompt structure influences AI-generated responses. Lab Sheet 3: Advanced Prompt Engineering • *(Continuing Lab 2)* • Problem Statement: • Develop role-based and instruction-based prompts to optimize AI outputs for accuracy, detail, and contextual understanding. Lab Sheet 4: AI Content Generation

- *(Using prompts designed in previous labs)*
- Problem Statement:
- Generate blogs, emails, resumes, and reports using AI tools and improve the outputs through iterative prompt refinement.

Lab Sheet 5: AI Image Generation
- *(Extending prompt engineering concepts)*
- Problem Statement:
- Generate AI-based posters, logos, and advertisements using generative AI tools and compare outputs generated using different prompt styles.

Lab Sheet 6: Dataset Collection & Preprocessing
- Problem Statement:
- Collect textual datasets from reviews or social media platforms and perform preprocessing techniques such as tokenization, stemming, and stopword removal.

Lab Sheet 7: Sentiment Analysis using NLP
- *(Using dataset prepared in Lab 6)*
- Problem Statement:
- Implement sentiment analysis on textual datasets using NLP libraries and analyze sentiment classification performance.

Lab Sheet 8: Text Summarization & Translation
- *(Continuing NLP tasks from Lab 6 & 7)*
- Problem Statement:
- Implement AI-based text summarization and language translation techniques and compare generated outputs with original content.

Lab Sheet 9: Introduction to Machine Learning
- *(Using processed datasets from previous labs)*
- Problem Statement:
- Understand supervised and unsupervised learning concepts by loading, splitting, training, and testing datasets using Scikit-learn.

Lab Sheet 10: Data Visualization & Feature Analysis
- *(Continuing Lab 9 using same dataset)*
- Problem Statement:
- Visualize datasets using Matplotlib and analyze feature relationships and data distributions using graphical techniques.

Lab Sheet 11: AI Chatbot Development
- *(Using NLP and prompt engineering concepts)*
- Problem Statement:
- Develop a rule-based chatbot using Python and integrate contextual AI-generated responses for interactive communication.

Lab Sheet 12: Recommendation System
- *(Using prediction concepts from previous labs)*
- Problem Statement:
- Implement a content-based recommendation system and analyze recommendation accuracy using similarity metrics.

Lab Sheet 13: Ethical AI and Bias Analysis
- *(Evaluating outputs generated in previous labs)*
- Problem Statement:
- Identify bias, hallucination, and ethical issues in AI-generated outputs and analyze their impact on responsible AI systems.

Lab Sheet 14: Voice Assistant Simulation
- *(Using NLP and chatbot concepts from previous labs)*
- Problem Statement:
- Develop a basic voice assistant using Python speech libraries and implement voice commands for search, greetings, and simple automation tasks.

Lab Sheet 15: AI Mini Project
- *(Combining concepts from all previous labs)*
- Problem Statement:
- Develop and demonstrate an AI-based application integrating concepts such as NLP, machine

learning, chatbot systems, or recommendation systems.
Targeted Application & Tools that can be used: 6. ChatGPT, Gemini, Hugging Face, Canva AI, Python 7. Python IDEs like PyCharm-Jupyer Notebook /Google Collab
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. 3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2022
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.

Course Code: FIN1002	Course Title: Essentials of Finance Type of Course: HSMC	L-T-P-C	3	0	0	
Version No.	1.0					
Course Pre-requisites	This course is designed to be accessible to all students, regardless of their prior financial knowledge.					
Anti-requisites						
Course Description	This course is designed to equip students with a foundational understanding of key financial concepts and principles. It will enable them to comprehend the core functions of finance, delve into the intricacies of financial management within organizations, and gain insights into the fundamental aspects of taxation. The course aims to develop students' abilities to interpret financial statements, evaluate investment opportunities, understand capital structure decisions, and navigate the basics of tax implications.					
Course Objective	Upon successful completion of this course, students will be able to: • Understand the basic forms of business organization and their financial implications. • Understand the fundamental principles and concepts that influence financial decision-making in various contexts. • Analyse and interpret financial statements to assess the financial health and performance of an organization. • Identify income under various heads of income as per Income Tax Act, 1961 and determine the tax liability.					
Course Outcomes	List the course outcomes On successful completion of this course the students shall be able to: 1. Understand the basic concepts of finance and financial markets and organizations. 2. Apply and interpret financial information for business decision making. 3. Identify various heads of income and deduction under Income Tax Act, 1961.					
Course Content:						
Module 1	Introduction to Finance	Assignment/ Quiz	Numerical solving	Sessions		

			Task	
Definition and Scope of Finance, Areas of Finance: Corporate Finance, Investments, Financial Institutions, International Finance; Types of Financial Markets: Money Markets vs. Capital Markets, Primary vs. Secondary Markets; Forms of Business Organization and Financial Goals:Shareholder Wealth Maximization vs. Profit Maximization; Understanding Financial Statements: Balance Sheet and Income Statement- Simple Numerical.				
Module 2	Financial Management	Assignment/ Quiz	Numerical solving Task	Sessions
Capital Budgeting Decisions: Payback Period, Net Present Value (NPV), Profitability Index (PI), Internal Rate of Return (IRR); Leverage- Basic Numerical; Capital Structure Decisions: Optimal Capital Structure, Trade-off Theory of Capital Structure; Cost of Capital: Equity, Debt, WACC; Dividend Policy: Factors influencing Dividend Policy.				
Module 3	Taxation	Assignment/ Quiz	Numerical solving Task	Sessions
Principles of a Good Tax System: Equity, Certainty, Convenience, Economy; Direct vs. Indirect Taxes; Residential Status of an Individual- Basic Problems; Heads of Income; Salary, House Property- Basic Numerical; Deductions under Chapter VI-A; Computation of Taxable Income and Tax Liability; E-Filing procedure.				
Targeted Application & Tools that can be used: Textbooks, PPT, Spreadsheet Software (e.g., Microsoft Excel), Official Website of Income Tax Department.				
Project Work/ Assignment: 1. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. 2. Case Study: - At the end of the course students will be given a 'real-world' cases like business models of successful companies or tax evasion by reputed companies on which they have to come up with detailed analysis and assessment.				
Text Book(s): 1. Dr. Vinod K. Singhania & Dr. Monica Singhania. (Latest Assessment Year Edition). *Students' Guide to Income Tax including GST*. Taxmann Publications. 2. Pandey, I. M. (2025). *Financial Management*. Vikas Publishing House.				
Reference Book (s): 1. Bhole, L.M., & Mahakud, J. (Current Edition). *Financial Institutions and Markets: Structure, Growth and Innovations*. McGraw Hill Education India. 2. Mehrotra, H.C., & Goyal, S.P. (Latest Assessment Year Edition). *Income Tax Law & Practice*. Sahitya Bhawan Publications. 3. Gordon, E., & Natarajan, K. (Current Edition). *Financial Markets and Services*. Himalaya Publishing House. Online Resources (e-books, notes, ppts, video lectures etc.): 1. https://presidency university.linways.com 2. https://onlinecourses.nptel.ac.in/noc24_ec01/preview 3. https://www.incometax.gov.in/iec/foportal/				
Topics relevant to "SKILL DEVELOPMENT": This course is designed to provide practical financial skills through participative learning techniques. Students will engage in performing suitable calculations to determine financial parameters (e.g., time value of money, investment returns, tax liabilities) and analysing financial statements to assess organizational performance and make informed decisions.				

Course Code: APT4004	Course Title:Aptitude Training- Intermediate Type of Course:PracticalOnlyCourse	L- T- P-C	0-0-2-0
VersionNo.	1.0		
CoursePre-requisites	Students should have the basic concepts of Quantitative aptitude along withits applications in real lifeproblems.		
Anti-requisites	NIL		
Course Description	Thisisaskill-based training program for the students.This course is designed to enable the students to enhance their skills in Quantitative Aptitude.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.		
CourseOut Comes	On successful completion of this course the students shall be ableto: CO1: Recall all the basic mathematicalconcepts. CO2:Identify the principle concept needed in aquestion. CO3: Solve the quantitative and logical ability questions with the appropriateconcept. CO4:Analyze the data given in complex problems.		
Course Content:			
Module1	Quantitative Ability1	Assignment	16Sessions
Topics: Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss			
Module2	Quantitative Ability2	Assignment	14Sessions
Topics: Time Speed and Distance,BoatsandStreams,SimpleInterest,Compound Interest,Probability, Permutation and Combination			
Targeted Application&Toolsthatcanbe used: Applicationarea:Placement activities and Competitive examinations. Tools: LMS			
ContinuousEvaluation:			

CA1–OnlineTest CA2–OnlineTest CA3–OnlineTest Assignment
Text Book: 1. Fast Track Objective by Rajesh Verma 2. RSAggarwal 3. RakeshYadav References: **1.** www.indiabix.com **2.** www.testbook.com **3.** www.youtube.com/c/TheAptitudeGuy/videos
Topics relevant to Skill Development:Quantitative aptitude forSkill Development through Problem solving Techniques. This is attained through components mentioned in course handout.

Course Code: CSS2266	Course Title: Theory of Computation Type of Course: Theory Course (PCC)	L- T- P- C	3-0-0-3
Version No.	2.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the theoretical foundations of computation through the study of formal languages and automata. It covers the design and analysis of finite automata and regular languages, context-free grammar and pushdown automata, and Turing machines as models of computation. The course further explores key concepts such as ambiguity, normal forms, computability, decidability, and complexity theory including classes like P and NP. It also highlights the relevance of Theory of Computation in modern computing domains such as artificial intelligence, natural language processing, cybersecurity, compilers, and intelligent systems.		
Course Objective	To build a strong foundation in formal languages and automata by enabling students to model and analyze computational systems using finite automata, pushdown automata, and Turing machines; to evaluate computability and complexity of problems; and to apply theoretical concepts to modern domains such as AI, cybersecurity, NLP, and intelligent systems.		
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain fundamental concepts of automata, formal languages, and finite state machines. — Level 2-Understand CO2: Design and analyze deterministic and nondeterministic finite automata and regular expressions for language recognition. — Level 3-Apply CO3: Construct and evaluate context-free grammar and pushdown automata, including ambiguity removal and normal forms. — Level 3-Apply CO4: Design Turing machines and interpret their role in solving computational problems and language recognition. — Level 3-Apply		

	CO5: Explain the applications of Theory of Computation concepts in real-world domains such as AI/ML, NLP, cybersecurity, compilers, and robotics.	Level 2- Understand

Course Content:

Module 1	Introduction to automata theory	7 Sessions

Topics:
Introduction to Automata Theory, Applications of Automata Theory, Alphabets, Strings, Languages & operations on languages, Representation of automata, Language recognizers, Finite State Machines (FSM): Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, Basic concepts of Finite automata, DFA- definitions of DFA, Deterministic Accepters Transition Graphs and Languages, and DFA's

Module 2	Finite Automata and Regular languages	12 Sessions

Topics:
Regular Languages, NFA- Definition of a Nondeterministic Accepter, Languages and NFA's Why Non-determinism? Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata. Formal Definition of a Regular Expression, Languages Associated with Regular Expressions, Languages, Regular Languages (RL) and Non-regular Languages: Closure properties of RLs, to show some languages are not RLs, Closure Properties of Regular

Module 3	Context Free Grammar and Pushdown automata	12 Sessions

Topics:
Context Free Grammars-Examples of Context-Free Languages, Leftmost and Rightmost Derivations, Derivation Trees, Relation Between Sentential Forms and Derivation Trees, Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity, Chomsky Normal Form, Gribiche Normal Form. Definition of a Pushdown Automaton, Language Accepted by a Pushdown Automaton, Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack Equivalence of PDA's and CFG's: From Grammars to Pushdown Automata.

Module 4	Turing Machines	06 Sessions

Topics:
Definition of a Turing Machine, Turing Machines as Language Accepters, Example Languages to construct Turing machine, Turing Machines as Transducers, Halting Programming Techniques for Turing Machines

Module 5	Complexity and Modern Applications of ToC	08 Sessions

Topics:
Complexity Theory - Time and Space Complexity, Complexity Classes: P, NP, NP-Complete (introductory), Intractability and Hard Problems-Applications of ToC in AI/ML/DL - Computability and Learnability (basic idea), Role of algorithms and complexity in ML, Expressive power of neural networks, NLP & Compilers -Regular Languages in Tokenization, CFG in Syntax Parsing, Ambiguity in Natural Language Processing-Cybersecurity & Blockchain- Hardness assumptions in cryptography, Automata in intrusion detection systems, Smart contracts as state machines, Decidability limits in security
Robotics & Intelligent Systems - Finite State Machines in robot control, Planning as a computational problem, Real-time decision constraints

Targeted Application & Tools that can be used:

Targeted Application:

1. Text Processing
2. Compilers
3. Text Editors
4. Robotics Applications
5. Artificial Intelligence

Tools: 1. JFLAP (Java Formal Language and Automata Package) Software simulation tool. Its interactive educational software written in Java to experiment topics in automata theory. 2. Turing machine Online simulators.
Text Book(s): 1. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publications 6th Ed, 2018. 2. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, 3rd Ed,2012
Reference(s): 1. Aho, Ullman and Hopcroft, "Theory of Computation", Pearson India 3rd Edition 2008. 2. Michael Sipser, "Theory of Computation", Cengage India 3rd Ed, 2014.
E Resources 1. NPTEL 2. Opencourseware 3. TOC Notes

Course Code: CSD2002	Course Name: Introduction to Data Science Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	NIL		
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 Objective	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 Outcomes	**On successful completion of the course the students shall be able to:** 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	Quiz	Knowledge based	10 sessions
Topics: 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	Assignment	Implementation	12 sessions
Topi 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	Term paper/Assignment	Implementation	11 sessions
Topics: 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	Term paper/Assignment	Implementation	12 sessions
Topics: 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			
Text Book **T1:** Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter ,Author: Wes McKinney,Publisher: O'Reilly Media, Edition: 3rd Edition, 2023			
References **R1:** Practical Statistics for Data Scientists: 50+ Essential Concepts,Authors: Peter Bruce, Andrew Bruce, Peter Gedeck, Publisher: O'Reilly Media, 2nd Edition (2021). **R2:** Title: Doing Data Science, Authors: Cathy O'Neil, Rachel Schutt, Publisher: O'Reilly Media. **R3:** Title: An Introduction to Statistical Learning with Applications in R,Authors: Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Publisher: Springer, 2nd Edition (2021)			
E-Resources/Web Resources 1. https://www.ibm.com/topics/data-science			

2. https://www.coursera.org/learn/what-is-datascience
3. https://www.kaggle.com/learn
4. https://www.datacamp.com/courses/introduction-to-data-science-in-python

Course Code: CSD2007	Course Name: R Programming For Data Science Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
NCrF Level-	5.0		
Course Pre-requisites	NIL		
Co-requisites	CSD2008		
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	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.		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Summarize the R functions effectively to perform fundamental data analysis. CO2: Apply suitable statistical methods to interpret diverse types of data CO3: Illustrate Regression analysis on provided datasets CO4: Demonstrate analytical and evaluative skills in machine learning classification CO5: Apply exploratory data analysis and visualization techniques to examine datasets and derive meaningful insights.		
Course Content:			
Module 1	Introduction TO R	Data Collection/Interpretation	12 Sessions
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.			
Module 2	Exploratory Data Analysis	Case Study	11 Sessions
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.			
Module 3	Regression Analysis	Project	10 Sessions
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.			
Module 4	Classification	Project	10 Sessions
Topics: Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Neatest Neighbors, Naïve Bayes Classifier, Decision Tree Classification, Random Forest Classification, Evaluation.			
Text Book T1. Hadley Wickham and Garrett Grolemund, R for Data Science Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, 2017. T2. Thomas Mailund, Beginning Data Science in R, Data Analysis, Visualization, and Modelling for the Data Scientist, APress, 2022. T3. 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 R1: Nina Zumel and John Mount Foreword By Jeremy Howard and Rachel Thomas, Practical Data Science with R, MANNING SHELTER ISLAND, 2020. R2: Dr. Bharati Motwani, "Data Analytics using R", Wiley, 2019.			
E-Resources/Web Resources 1. https://machine learning mind.com/2019/10/27/assumptions-of-linear-regression-how-to-validate-and-fix/ 2. https://r4ds.had.co.nz/ 3. https://nptel.ac.in/courses/106102064			

Course Code: CSD2008	Course Name: R Programming For Data Science Lab Type of Course: Lab Course	L- T-P- C	0-0-2-1
Version No.	1.0		
NCrF Level-	5.0		
Course Pre-requisites	NIL		
Co-requisites	CSD2007		
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 Outcomes	On successful completion of the course the students shall be able to: CO1: Develop foundational R scripts to manage data types, structures, and apply basic transformations CO2: Perform data manipulation and transformation using R packages such as dplyr and manage datasets efficiently. CO3: Create meaningful visualizations using ggplot2 and interpret patterns, trends, and relationships in data. CO4: Implement and evaluate regression, classification, and dimensionality reduction models using R. CO5: 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 data set
8. Implement the multiple regression model for the given dataset.
9. Principal Component Analysis - Perform Principal Component Analysis(PCA)usingR
10. Implementk-Nearest Neighbors(kNN)classification using R
11. Evaluate theperformance of NaiveBayes classifier usingR.

12. Evaluate the performance of the Decision Tree classifier using R. 13. Evaluate the performance of Random Forest Classifier using R.
Targeted Applications & Tools:
R Programming Language — A statistical computing and visualization language used for predictive analytics, data mining, forecasting, and advanced statistical analysis.
Text Book T1. Hadley Wickham and Garrett Grolemund, R for Data Science Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, 2017. T2. Thomas Mailund, Beginning Data Science in R, Data Analysis, Visualization, and Modelling for the Data Scientist, APress, 2022. T3. 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 R1: Nina Zumel and John Mount Foreword By Jeremy Howard and Rachel Thomas, Practical Data Science with R, MANNING SHELTER ISLAND, 2020. R2: Dr. Bharati Motwani, "Data Analytics using R", Wiley, 2019.
E-Resources/Web Resources 1. https://machine learning mind.com/2019/10/27/assumptions-of-linear-regression-how-to-validate-and-fix/ 2. https://r4ds.had.co.nz/ 3. https://nptel.ac.in/courses/106102064

Course Code: CSS2269	Course Name: Operating Systems Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	CAI2501		
Anti-requisites	NIL		
Course Description	This course introduces the concepts of Operating Systems operations, Operating System structure and its design and implementation. It covers the 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 Objective	To develop a comprehensive understanding of operating system principles by enabling students to analyze process management and scheduling algorithms, explore memory and virtual memory management, examine file systems and storage organization and evaluate		

	synchronization mechanisms and deadlock handling techniques.
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:**Explain the fundamental concepts of operating systems and relevant case studies. [Level 2 - Understand] **CO2**: Apply various CPU scheduling algorithms for process management. [Level 3 – Apply] **CO3:**Apply synchronization techniques to handle concurrency problems. [Level 3 – Apply] **CO4:**Apply deadlock detection and recovery methods in operating systems. [Level 3 – Apply] **CO5:** Explain various memory management techniques used in operating systems. [Level 3 -Apply]

Course Content:

Module 1	Introduction to Operating Systems	Assessment: Assignment (Programming using Keras/Sklearn)	9 Sessions

Topics:
Introduction to OS , Operating-System Operations, Operating Systems Services, , System Calls and its types, Operating Systems Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source Operating Systems

Module 2	Process Management	Assessment : Quiz + Assignment (Sklearn/Statsmodels)	12 Sessions

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**	Assessment : Assignment (Programming using Keras/Sklearn)	12 Sessions

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	Assessment : Programming Assignment (Keras/TensorFlow)	12 Sessions

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.

Project work/Assignment :

1. Demonstrate process concepts in LINUX OS.
2. Simulation of CPU scheduling algorithms.
3. Develop program to demonstrate use of Semaphores in threads.
4. Develop program to demonstrate use of deadlock avoidance algorithms.
5. Develop program to demonstrate use of page replacement algorithms.

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

Targeted Applications & Tools:

Use cases	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.
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.

Skill-Building Activities through Experiential Learning:

- Comparative Analysis of Ensemble Techniques
  Learners experiment with ensemble models like Random Forest, AdaBoost, and Gradient Boosting, conducting comparative studies on model variance, bias, and robustness. Through group assignments, students simulate real-world decision-making scenarios where ensemble strategies outperform individual models.

- Neural Network Construction Using Keras
  Using the Keras API, students build and train basic feedforward neural networks. They gain practical experience in selecting activation functions, configuring loss functions, tuning hyperparameters (e.g., learning rate, epochs), and applying backpropagation using optimizers like SGD and Adam.

- Unsupervised Learning for Pattern Discovery
  Through clustering algorithms such as K-Means, Hierarchical Clustering, DBSCAN, and Gaussian Mixture Models (GMM), learners segment real-world datasets and visualize clusters. They apply evaluation methods like the Elbow Method and Silhouette Score to validate clustering quality.

Text Book

T1: Silberschatz A, Galvin P B and Gagne G , "Silberschatz's Operating System Concepts", Paperback, Global Edition Wiley, 2019

References

R1: Silberschatz A, Galvin P B and Gagne G, "Operating System Concepts", 10th edition Wiley, 2018.

R2: William Stallings, "Operating Systems",Ninth Edition, By Pearson Paperback ,1 March 2018.

R3: Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, " Cracking the Operating System skills", Dreamtech, paperback, 2020.

R4: Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , "Operating Systems: Three Easy Pieces, Amazon digital Services", September 2018.

E-Resources/Web Resources

1. https://www.os-book.com/OS9/
2. https://pages.cs.wisc.edu/~remzi/OSTEP/
3. https://codex.cs.yale.edu/avi/os-book/OS10/index.html

Course Code: CSS2270	Course Name: **Operating Systems Lab** Type of Course: Laboratory Course	L- T-P- C	0-0-2-1

Version No.	1.0
NCrF Level-	5.0
Course Pre-requisites	NIL
Co-requisites	CAI2500
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 Objective	To develop practical skills in operating systems by enabling students to implement scheduling and memory management algorithms, simulate process synchronization and deadlock handling, and build system-level programming capabilities.
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Demonstrate system-level programming using system calls and operating system structures. [Level 3 – Apply] **CO2:** Simulate process scheduling and multithreading techniques. [Level 3 – Apply] **CO3:** Apply synchronization techniques using semaphores and shared memory to handle concurrency problems. [Level 3 – Apply] **CO4:** Demonstrate memory management and file system concepts using simulation or scripting tools. [Level 3 – Apply] **CO5:** Analyze the performance of operating system algorithms related to scheduling, synchronization and memory management. . [Level 4 – Analyze]

Course Content:

List of Laboratory Tasks:

- **Experiment 1: Introduction to OS**

OS Basics

Level 1: Write a program to demonstrate basic system calls (file operations like open, read, write).

Level 2: Analyze different OS services with real-time examples.

OS Structure

Level 1: Illustrate OS structures (monolithic, layered, microkernel).

Level 2: Compare open-source OS (Linux) with proprietary OS.

- **Experiment 2: System Parameters**

Linkers & Loaders

Level 1: Demonstrate compilation process (preprocessing, compiling, linking).

Level 2: Analyze object files and executable generation.

System Utilities

Level 1: Write simple shell commands using system calls.

Level 2: Implement a mini shell program.

- **Experiment 3: Process Concept**

Process Creation

Level 1: Write a program using fork() system call.

Level 2: Demonstrate parent-child communication.

Process Operations

Level 1: Implement process states and transitions.

Level 2: Simulate process control block (PCB).

- **Experiment 4: Inter Process Communication**

Pipes:

Level 1: Implement communication using pipes.

Level 2: Implement bidirectional communication using pipes.

Sockets/RPC

Level 1: Write a client-server program using sockets.

Level 2: Simulate RPC communication.

- **Experiment 5: Threads**

Thread Creation

Level 1: Create threads using pthread library.

Level 2: Compare multi-threading vs multi-processing.

Thread Issues

Level 1: Demonstrate thread synchronization issues.

Level 2: Solve race condition problem.

- **Experiment 6: CPU Scheduling**

FCFS & SJF

Level 1: Implement FCFS scheduling.

Level 2: Implement SJF and compare results.

Advanced Scheduling

Level 1: Implement Round Robin scheduling.

Level 2: Implement Priority scheduling and analyze performance.

- **Experiment 7: Synchronization**

Critical Section

Level 1: Implement Peterson's solution.

Level 2: Analyze critical section problem.

Semaphores

Level 1: Implement semaphore operations

Level 2: Solve producer-consumer problem using semaphores.

- **Experiment 8: Classical Problems**

Reader-Writer

Level 1: Implement Reader-Writer problem.

Level 2: Analyze starvation issues.

Dining Philosophers

Level 1: Implement Dining Philosophers problem.

Level 2: Avoid deadlock using strategies.

- **Experiment 9: Dead Locks**

Deadlock Detection

Level 1: Implement Resource Allocation Graph.
Level 2: Detect deadlock using algorithm.
Deadlock Avoidance
Level 1: Implement Banker's algorithm.
Level 2: Analyze safe and unsafe states.

- **Experiment 10:Memory Management Basics**

Memory Allocation
Level 1: Implement First Fit, Best Fit, Worst Fit.
Level 2: Compare memory utilization.
Paging
Level 1: Simulate paging mechanism.
Level 2: Analyze page table structure.

- **Experiment 11: Virtual Memory**

Page Replacement
Level 1: Implement FIFO page replacement.
Level 2: Implement LRU and Optimal algorithms.
Page Faults
Level 1: Calculate page faults.
Level 2: Analyze thrashing condition.

- **Experiment 12: Advanced Memory Management**

Segmentation
Level 1: Implement segmentation.
Level 2: Compare segmentation vs paging.
Demand Paging
Level 1: Simulate demand paging.
Level 2: Analyze copy-on-write mechanism.

- **Experiment 13: File System**

File Operations
Level 1: Implement file operations (create, read, write).
Level 2: Simulate directory structure.
File Allocation
Level 1: Implement file allocation methods.
Level 2: Compare allocation techniques.

- **Experiment 14: File System Implementation**

File System Design
Level 1: Design simple file system.
Level 2: Analyze file system performance.
Access Methods
Level 1: Implement sequential access.
Level 2: Implement indexed access.

- **Experiment 15: Integration & Simulation**

OS Simulation
Level 1: Simulate OS components (process + memory).
Level 2: Integrate scheduling and memory management.
Mini Project
Level 1: Implement OS concept-based project.

Level 2: Analyze performance and optimization.

Project Work/Assignments

1. Demonstrate process concepts in LINUX OS.
2. Simulation of CPU scheduling algorithms.
3. Develop program to demonstrate use of Semaphores in threads.
4. Develop program to demonstrate use of deadlock avoidance algorithms.
5. Develop program to demonstrate use of page replacement algorithms.
6. Simulation of memory allocation strategies [first fit, best fit and worst fit]

Targeted Applications & Tools:

Use cases	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.
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.

Skill-Building Activities through Experiential Learning:

- **Data Preprocessing with Real-World Datasets**
  Learners perform hands-on preprocessing of real-world datasets (e.g., UCI, Kaggle) by handling missing values, scaling features, and encoding categorical variables. This foundational step helps them understand the impact of clean data on model performance.

- **Exploratory Data Analysis and Visualization**
  Using libraries such as Matplotlib and Seaborn, students conduct exploratory data analysis through plots like scatter plots, heatmaps, and pair plots. Visualizations are used to identify patterns, correlations, and anomalies before model building.

- **Model Building with Supervised Learning Algorithms**
  Students implement regression and classification algorithms—Linear Regression, Logistic Regression, Naïve Bayes, and SVM—on structured datasets. They analyze model predictions using decision boundaries, ROC curves, and learning curves.

Text Book

T1: Silberschatz A, Galvin P B and Gagne G , “Silberschatz's Operating System Concepts”, Paperback, Global Edition Wiley, 2019

References

R1: Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts”, 10th edition Wiley, 2018.

R2: William Stallings, “Operating Systems”,Ninth Edition, By Pearson Paperback ,1 March 2018.

R3: Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, “ Cracking the Operating System skills”, Dreamtech, paperback, 2020.

R4: Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , “Operating Systems: Three Easy Pieces, Amazon digital Services”, September 2018.

E-Resources/Web Resources 1. https://www.os-book.com/OS9/ 2. https://pages.cs.wisc.edu/~remzi/OSTEP/ 3. https://codex.cs.yale.edu/avi/os-book/OS10/index.html

<table>
<tr><td>Course Code:
CSD2009</td><td>Course Name: Data Handling and Visualization
Type of Course: Theory Course</td><td>L- T-P- C</td><td>3-0-0-3</td></tr>
<tr><td>Version No.</td><td colspan="3">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="3">NIL</td></tr>
<tr><td>Co-requisites</td><td colspan="3">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="3"></td></tr>
<tr><td>Course Description</td><td colspan="3">The purpose of the course is to install a strong foundation of scientific process orientation that is the cornerstone of effective data handling, and creative design thinking appended with strong programming skills to create meaningful visualizations of data. The student should have prior knowledge of python programming and basic knowledge of data concepts. The associated laboratory provides an opportunity to strengthen student's skillset in the arena of Data Preprocessing and Visualization. With a good knowledge in the fundamental concepts of the various libraries for handling and visualizing data the student can gain a stronghold in Data Science enabling the student to be an effective analyst for prospective employers.</td></tr>
<tr><td>Course Objective</td><td colspan="3">• 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</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">On successful completion of the course the students shall be able to:
<table><tr><td>CO1: Understand the various types of data, apply and classify the principles of data visualization</td><td>Level 2 – Understand</td></tr><tr><td>CO2: Illustrate the visualization techniques to a problem and its associated dataset</td><td>Level 2 – Understand</td></tr><tr><td>CO3: Implement interactive visualization for better insight using various visualization tools</td><td>Level 3- Apply</td></tr><tr><td>CO4: Demonstrate the visualization concepts practically using Python</td><td>Level 3- Apply</td></tr><tr><td>CO5:Design intelligent data science solutions by selecting and integrating appropriate machine learning techniques, optimization methods, and explainable AI approaches for real-world applications.</td><td>Level 3 – Apply</td></tr></table></td></tr>
<tr><td colspan="4">Course Content:</td></tr>
</table>

Module 1	Introduction to Data Visualization	Assessment: Programming Activity	07 Sessions
Topics: Data collection Data Preparation Basic Models Overview of data visualization Data Abstraction Task Abstraction Analysis: Four Levels for Validation Interacting with Databases Data Cleaning and Preparation Handling Missing Data Data Transformation. Python Libraries: NumPy, pandas, matplotlib, GGplot Introduction to pandas Data Structures			
Module 2	Data Visualization Techniques	Assessment: Programming Activity	07 Sessions
Topics: Scalar and point techniques vector visualization techniques matrix visualization Visualization Techniques for Trees Graphs, and Networks Multidimensional data Visual Variables Networks and Trees Map Color and Other Channels Manipulate View Heat Map.			
Module 3	Visual Analysis of data from various domain	Assessment:Programming Activity	08 Sessions
Topics: Time-oriented data visualization Spatial data visualization Text data visualization Multivariate data visualization case studies, Finance- marketing-insurance-healthcare etc.			
Module 4	Visualization of Streaming Data	Assessment: Programming Activity	08 Sessions
Topics: Guidelines for designing successful visualizations Data visualization dos and don'ts Best practices of Data Streaming processing streaming data for visualization presenting streaming data streaming visualization techniques streaming analysis.			
Targeted Applications & Tools:			
Python	A versatile programming language widely used for data analysis, visualization, and scientific computing		
Matplotlib	A plotting library used to create static and interactive visualizations in Python.		
Tableau	A business intelligence and visualization tool used for creating dashboards and reports.		

Streamlit	A Python framework for building interactive data visualization and analytics web applications.

Text Book

T1. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media.
T2. Munzner, T., "Visualization Analysis and Design", CRC Press, (2015).
T3.Dr. Ossama Embarak, "Data Analysis and Visualization Using Python", Apress,(2018)

References

R1. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Author: Wes McKinney, Publisher: O'Reilly Media, 2nd Edition, 2017.
R2. Visualization Analysis and Design, Author: Tamara Munzner, Publisher: CRC Press, 2015.
R3. Data Analysis and Visualization Using Python, Author: Dr. Ossama Embarak, Publisher: Apress, 2018.
R4. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, Author: Claus O. Wilke, Publisher: O'Reilly Media, 2019.
R5. Interactive Data Visualization for the Web, Author: Scott Murray, Publisher: O'Reilly Media, 2nd Edition, 2017.

E-Resources/Web Resources

1. Pandas Documentation
2. NumPy Documentation
3. Matplotlib Documentation
4. Seaborn Documentation
5. Plotly Documentation
6. Streamlit Documentation

Course Code: CSD2010	Course Name: Data Handling and Visualization Lab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	CSD2009-Data Handling and Visualization		
Anti-requisites	NIL		
Course Description	This lab-oriented course provides practical exposure to data acquisition, preprocessing, analysis, and visualization techniques using modern tools and platforms. Students will learn to work with structured and unstructured datasets, perform data cleaning, transformation, and derive insights using descriptive and inferential statistical techniques. The course emphasizes hands-on experience with data visualization libraries and tools to create meaningful graphical representations that support data-driven decision-making.		
Course Objective	1.To introduce students to the fundamental concepts of data handling, including data acquisition, cleaning, and transformation. 2.To provide hands-on experience with tools and libraries used for data manipulation and visualization. 3.To develop the ability to perform exploratory data analysis and derive meaningful insights from datasets. 4.To equip students with the skills to create effective visual representations of data for communication and decision-making. 5.To encourage the use of real-world datasets in solving practical problems through data visualization techniques.		

Course Outcomes	**On successful completion of the course the students shall be able to:**	
	CO1: Implement cleaning and transforming structured and unstructured data using Python libraries, and apply data abstraction and validation techniques to prepare data for analysis.	Level 2 – Understand
	CO2: Apply appropriate visualization techniques—scalar, vector, matrix, and network-based—along with visual variables and layout manipulations to effectively represent complex and multidimensional data.	Level 3 – Apply
	CO3: Analyze and visualize domain-specific datasets, such as those from finance, healthcare, and marketing, using suitable visualization strategies tailored to time-oriented, spatial, textual, and multivariate data.	Level 4-Aalyze
	CO4: Implement visualizations for real-time streaming data by following best practices in streaming analysis, and present dynamic insights through responsive and interactive visual dashboards.	Level 3 – Apply
	CO5:Design and develop interactive data visualization solutions by integrating data handling, analytical techniques, and visualization tools to solve real-world problems and support data-driven decision-making.	Level 6 – Create

Course Content:

List of Laboratory Tasks:

Experiment 1: Collect structured and unstructured data from online sources (CSV, JSON, API, etc.) and load it using Python.
Experiment 2: Explore and summarize datasets using NumPy and pandas (head, describe, info, etc.).
Experiment 3: Perform data cleaning: handle missing values using mean/median/mode/drop strategies.
Experiment 4: Perform data transformation: normalization, encoding categorical data, and feature scaling.
Experiment 6: Demonstrate task and data abstraction with a case study (e.g., customer dataset), and validate using statistical summaries.
Experiment 6: Visualize scalar and point data using line charts, bar charts, and scatter plots (matplotlib/seaborn).
Experiment 7: Apply vector visualization techniques (e.g., quiver plots or flow fields).
Experiment 8: Use heatmaps and matrix visualizations to display correlation matrices or similarity scores.
Experiment 9: Visualize hierarchical data using tree maps or dendrograms.
Experiment 10: Create network graphs for social or connectivity datasets using networkx and visualize them.
Experiment 11: Apply visual variables (color, shape, size) and map interactions to adjust views (zoom, filter, etc.).
Experiment 12: Time-series analysis and visualization for stock market data using line plots, moving averages, etc.
Experiment 13: Visualize spatial data using geopandas or folium (e.g., crime rate by district, COVID-19 map).
Experiment 14: Text data visualization using word clouds, word frequency histograms, or topic modeling visualization.
Experiment 15: Visualize multivariate data from a real-world case (e.g., healthcare: patient records with multiple attributes).
Experiment 16: Demonstrate streaming data analysis techniques (e.g., rolling averages, anomaly detection).
Experiment 17: Final mini-project: Design and present a complete streaming data visualization solution with annotations and user interaction.

Targeted Applications & Tools:

Python	A versatile programming language widely used for data analysis, visualization, and scientific computing

Matplotlib	A plotting library used to create static and interactive visualizations in Python.
Tableau	A business intelligence and visualization tool used for creating dashboards and reports.
Streamlit	A Python framework for building interactive data visualization and analytics web applications.

Text Book

T1. Dr. Ossama Embarak, "Data Analysis and Visualization Using Python", Apress,(2018)

T2. Wes McKinney "Python for Data Analysis" Edition: 3rd Edition (2022)
Publisher: O'Reilly Media

References

R1 : "Interactive Data Visualization for the Web" by Scott Murray- Edition: 2nd Edition (2017)- Publisher: O'Reilly Media

E-Resources/Web Resources

1. Python Official Documentation
2. NumPy Documentation
3. Pandas Documentation
4. Matplotlib Documentation
5. Seaborn Documentation
6. Streamlit Documentation

Course Code: CSS7000	Course Title: Internship Type of Course: PRW	L- T-P- C	0-0-0-2
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 methods of scientific experimentation, and often get opportunities to see, study, and operate sophisticated and costly equipment. They also get opportunities to work with advanced software tools and modern technologies used in industries and research environments. Students use tools and technologies from emerging fields such as Artificial Intelligence (AI), Machine Learning (ML), Cyber Security, Blockchain, and Data Science to develop solutions for real-world and industry-related problems. They also learn about the implementation of management principles taught in the classroom by observing multidisciplinary teams of experts from engineering, science, economics, operations research, and management dealing with techno-economic problems at both micro and macro levels. The course further enables students to develop and refine their language, communication, teamwork, and interpersonal skills through various activities such as seminars, group discussions, project presentations, and report preparation.		

	The broad-based core education, supported by strong foundations in mathematics, science, and analytical tools, provides the necessary background for students to properly understand and solve practical real-life problems. Students have the flexibility to pursue this course either as Project Work and Dissertation within the university, as Project Work in an Industry, Company, or Research Laboratory, or through Internship Programs in industries and organizations.
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, students shall be able to: CO1: Identify engineering problems related to local, regional, national, and global needs. [Level 2 - Understand] CO2: Apply appropriate techniques and modern tools to solve engineering problems. [Level 3 - Apply] CO3: Design experiments in accordance with standard procedures and specifications. [Level 4- Analyze] CO4: Conduct experiments and collect relevant data for analysis. [Level 3 - Apply] CO5: Interpret experimental results and draw meaningful conclusions. [Level 6 - Create]

Course Code: APT4006	Course Title: Logical and Critical Thinking Type of Course: Audited		L- T-P- C	0-0-2-0
Version No.	1.0			
Course Pre-requisites	Students should have the basic concepts of Logical reasoning and Critical thinking, along with its applications in real life problems.			
Anti-requisites	Nil			
Course Description	This is a skill-based training program for the engineering students (Undergraduate). This course is designed to enable the students to enhance their skills in Logical reasoning and Critical thinking.			
Course Objective	The objective of the course is to familiarize the learners with concepts in in Logical reasoning and Critical thinking through problem solving techniques suitable for their career development.			
Course Outcomes	On successful completion of the course the students shall be able to:			
	CO1] Understand all the concepts.			
	CO2] Apply the concepts in problem solving (Bloom's taxonomy Level 3)			
	CO3] Analyze and structure the reasoning techniques and spatial visualization skills			
Course Content:				
Module 1	Logical Thinking	Assignment		16 Sessions
	Topics:			

	Syllogisms, Cubes and Dices, Mirror and Water images, Paper cutting and Folding, Embedded figures & Completion of figures, Data Interpretation, Data sufficiency			
Module 2	Critical Thinking	Assignment		14 Sessions
	Topics:			
	Analogy, Symbol and Notations, Statement and assumption, Cause of action, Statement and conclusion, Puzzles			
	Targeted Application & Tools that can be used:			
	Application area: Placement activities and Competitive examinations.			
	Tools: LMS			
Evaluation	Continuous Evaluation			
	· Topic wise evaluation			
	· Internal Assessments			
	Text Book			
	1. A new approach to reasoning verbal, non-verbal & analytical by BS Sijwali			
	2. R S Aggarwal			
	3. Kiran publications			
	References			
	1. www.indiabix.com			
	2. www.testbook.com			
	3. www.youtube.com/c/TheAptitudeGuy/videos			
	Topics relevant to Skill Development Logical reasoning and Critical thinking for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.			

Course Code: CSS2271	Course Title: Software Design and Development Type of Course: Theory Course (PCC)	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces foundational concepts of software engineering and emphasizes a practical, structured approach to software system development. It spans software requirement analysis, process modeling, system design, Agile principles, DevOps culture, testing strategies, quality assurance, and software maintenance. Hands-on assignments and problem-solving activities foster understanding of contemporary software practices and industry tools such as CASE tools, GitHub, and Selenium. The course also introduces secure software engineering practices, DevSecOps concepts, and AI-enhanced tools for documentation, automation, intelligent testing, and software quality prediction workflows.		

Course Objectives	To develop a comprehensive understanding of software engineering by enabling students to analyze software development life cycle models, apply design principles and patterns, develop modular and maintainable software systems, perform testing and quality assurance, manage software projects effectively, and understand secure and AI-driven software development practices.	
Course Outcomes	On successful completion of this course, students will be able to: CO1: Explain software engineering principles, ethics, and various software development life cycle models. — Level 2 – Understand CO2: Identify software requirements and develop design models, including Software Requirement Specification (SRS) documents. — Level 3 – Apply CO3: Apply Agile development practices and DevOps principles in software development. — Level 3 – Apply CO4: Apply software testing strategies, configuration management, and maintenance techniques. — Level 3 – Apply CO5: Evaluate secure and AI-driven software engineering practices to ensure software quality, reliability, scalability, and intelligent automation. — Level 5 – Evaluate	
Course Content:		
Module 1	Introduction to Software Engineering and Process Models	10 Sessions
Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle. Models: Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.		
Module 2	Software Requirements, Analysis and Design	12 Sessions
Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, Software Requirements Specification (SRS), Requirement Analysis and validation. Requirements modelling- Introduction to Use Cases, Activity diagram and Swim lane diagram. CASE support in Software Life Cycle, Characteristics of CASE Tools, Architecture of a CASE Environment. Design: Design concepts, Architectural design, Component based design, User interface design.		
Module 3	Agile Principles & Devops	10 Sessions
Agile: Scrum Roles and activities, Sprint Agile software development methods - Scaling, User Stories, Agile estimation techniques, Product backlogs, Stake holder roles, Dynamic System Development Method. DevOps: Introduction, definition, history, tools.		
Module 4	Software Testing and Maintenance	08 Sessions

Software Testing-verification and validation, Test Strategies - White Box Testing, Black box Testing. Automation Tools for Testing. Software Quality Assurance-Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management- SCM process, SCM Tools (GitHub). Maintenance- Characteristics of Software Maintenance, Software Reverse Engineering, Software Maintenance Process Models.		
Module 5	Secure, Intelligent and AI-Driven Software Engineering	05 Sessions
Secure Software Development Practices, Software Security Testing, AI in Software Engineering, Intelligent Requirement Analysis, AI-based Testing and Debugging, DevSecOps Concepts, Machine Learning for Software Quality Prediction, Smart Project Management Tools, Applications of AI in Modern Software Development.		
Targeted Application & Tools that can be used: Git hub/Lambda/Taskade/Bit.ai/Testsigma/TestRogor		
Text Books: T1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", VII Edition, McGraw-Hill, 2017. T2. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGraw-Hill, 2018.		
References: R1. Rajib Mall, "Fundamentals of Software Engineering", VI Edition, PHI learning private limited, 2015. R2. Ian Sommerville, "Software Engineering", IX Edition, Pearson Education Asia, 2011. R3. Agile Software Development Principles, Patterns and Practices.1st Edition, Wiley, 2002 Journals / Magazines • IEEE Software • ACM Transactions on Software Engineering and Methodology • Journal of Systems and Software SWAYAM / NPTEL / MOOCs • NPTEL – Software Engineering (Prof. Rajib Mall, IIT KGP) • Coursera – Agile Development (University of Virginia) • Udemy – DevOps Masterclass • EdX – Software Testing Fundamentals (TUM)		
Topics Relevant to "Skill Development": Black box Testing, White box Testing, AI tools for design, modelling, testing and document Automated Testing for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout		

Course Code: CSD2021	Course Name: Machine Learning for Intelligent Data Science Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	CSD2024- Machine Learning for Intelligent Data Science Lab		
Anti-requisites			
Course Description	This course introduces the concepts, techniques, and applications of Machine Learning for intelligent data-driven decision making. It focuses on supervised, unsupervised, and ensemble learning methods along with model evaluation and optimization techniques. Students will learn how to build intelligent systems capable of extracting patterns, predicting outcomes, and supporting real-world data science applications using modern machine learning		

	frameworks and tools.
Course Objective	• To understand the fundamentals of machine learning and intelligent data science concepts. • To develop predictive models using supervised and unsupervised learning techniques. • To apply machine learning algorithms for classification, regression, clustering, and pattern recognition tasks. • To evaluate and optimize machine learning models for real-world intelligent applications.
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Understand the fundamentals of machine learning algorithms and intelligent data science workflows. — [Level 2-Understand] **CO2**: Apply supervised learning techniques for predictive analytics and classification tasks. — [Level 3-Apply] **CO3:** Implement unsupervised and ensemble learning methods for pattern discovery and intelligent decision-making. — [Level4-Analyze] **CO4:** Evaluate machine learning models and interpret their performance for real-world applications. — [Level5-Evaluate]

Course Content:

Module 1	Introduction to Machine Learning and Intelligent Data Science	Assessment: Preprocessing	10 Sessions

Topics:
Introduction to Artificial Intelligence, Machine Learning, and Data Science
Types of Machine Learning
Machine Learning workflow
Data preprocessing and feature engineering
Training, validation, and testing datasets
Evaluation metrics and model selection
Introduction to Python libraries for ML
Applications of intelligent data science

Module 2	Supervised Learning Techniques	Assessment: Supervised Learning	11 Sessions

Topics:
Regression and Classification concepts
Linear Regression
Logistic Regression
Decision Trees
Naïve Bayes Classifier
Support Vector Machines (SVM)
K-Nearest Neighbors (KNN)
Performance evaluation metrics
Overfitting and underfitting

Module 3	Unsupervised and Ensemble Learning	Assessment: Clustering	12 Sessions

Topics: Clustering concepts and applications K-Means Clustering Hierarchical Clustering Dimensionality Reduction Principal Component Analysis (PCA) Association Rule Mining Ensemble Learning concepts Random Forest Boosting and Bagging techniques			
Module 4	Advanced Machine Learning and Intelligent Applications	Assessment: Intelligent Applications	12 Sessions
Topics: Introduction to Deep Learning Neural Networks fundamentals Model optimization techniques Cross-validation and hyperparameter tuning Explainable AI (XAI) basics Intelligent recommendation systems Time series forecasting Real-world case studies in healthcare, finance, and smart systems Ethical considerations in Machine Learning			

Targeted Applications & Tools:	
Python	Programming language widely used for machine learning and intelligent data science applications.
Jupyter Notebook	Interactive environment for coding, visualization, and machine learning experimentation.
TensorFlow	Open-source deep learning framework used for building intelligent AI models.
Scikit-learn	Python library used for implementing machine learning algorithms and model evaluation.

Text Book

T1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – O'Reilly Media.
T2. Machine Learning – McGraw Hill Education.
T3. Pattern Recognition and Machine Learning – Springer.

References

R1. Introduction to Machine Learning with Python – O'Reilly Media.
R2. Deep Learning – MIT Press.
R3. Data Mining Concepts and Techniques – Morgan Kaufmann.
R4. Artificial Intelligence: A Modern Approach – Pearson..

E-Resources/Web Resources

1.Scikit-learn Documentation
2.TensorFlow Official Documentation
3.Kaggle Machine Learning Resources
4.Coursera Machine Learning Courses
4.Google AI Learning Resources
5.Towards Data Science

Course Code: CSD2024	Course Name: Machine Learning for Intelligent data Science Lab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		

Course Pre-requisites	NIL
Co-requisites	CSD2021- Machine Learning for Intelligent data Science
Anti-requisites	NIL
Course Description	This laboratory course provides practical exposure to machine learning techniques and intelligent data science applications using modern tools and frameworks. Students will learn to preprocess datasets, implement supervised and unsupervised learning algorithms, evaluate predictive models, and develop intelligent analytical solutions for real-world applications through hands-on experiments and mini-projects.
Course Objective	• To provide practical knowledge of machine learning workflows and intelligent data science techniques. • To implement supervised and unsupervised learning algorithms using Python libraries. • To perform model evaluation, optimization, and visualization of analytical results. • To develop intelligent predictive solutions using machine learning frameworks and tools.
Course Outcomes	**On successful completion of the course the students shall be able to:**

CO1: Implement machine learning workflows and data preprocessing techniques using Python tools.	[Level 3 – Apply]
CO2: Develop supervised learning models for prediction and classification tasks.	[Level 4 – Analyze]
CO3: Apply clustering, dimensionality reduction, and ensemble learning methods for intelligent analytics.	[Level 4 – Analyze]
CO4: Evaluate and optimize machine learning models for real-world intelligent data science applications.	[Level 5-Evaluate]

Course Content:

List of Laboratory Tasks:

Experiment 1:Installation and setup of Python, Jupyter Notebook, and required ML libraries
Experiment 2: Perform data preprocessing, cleaning, and handling missing values
Experiment 3:Implement feature scaling and normalization techniques
Experiment 4:Perform Exploratory Data Analysis (EDA) and data visualization
Experiment 5:Implement Linear Regression for predictive analysis
Experiment 6:Build Logistic Regression models for classification
Experiment 7:Implement Decision Tree and Random Forest algorithms
Experiment 8:Apply K-Nearest Neighbors (KNN) classification
Experiment 9:Perform Support Vector Machine (SVM) classification
Experiment 10: Evaluate models using confusion matrix, accuracy, precision, recall, and F1-score
Experiment 11: Apply K-Means clustering on real-world datasets
Experiment 12:Perform Hierarchical Clustering and cluster visualization
Experiment 13:Implement Principal Component Analysis (PCA) for dimensionality reduction
Experiment 14:Perform hyperparameter tuning and cross-validation
Experiment 15:Mini Project: Intelligent predictive analytics using machine learning techniques

Targeted Applications & Tools:

Python	Programming language used for implementing machine learning and intelligent data science applications.
Jupyter Notebook	Interactive environment used for coding, visualization, and experimentation.
Scikit-learn	Python library used for machine learning model implementation and evaluation.

TensorFlow	Deep learning framework used for building intelligent AI and neural network models.

Text Book

T1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – O'Reilly Media.
T2. Introduction to Machine Learning with Python – O'Reilly Media.
T3. Machine Learning – McGraw Hill Education.

References

R1.Pattern Recognition and Machine Learning – Springer.
R2.Deep Learning – MIT Press.
R3.Data Mining Concepts and Techniques – Morgan Kaufmann.
R4.Python Machine Learning – Packt Publishing.

E-Resources/Web Resources

1. Scikit-learn Documentation
2. TensorFlow Official Documentation
3. Kaggle Machine Learning Resources
4. Google AI Learning Resources
5. Coursera Machine Learning Courses
6. Towards Data Science

Course Code: CSD2501	Course Name: Predictive Analytics Type of Course: Theory Course	L- T-P- C	2-0-0-2
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	CSD2502		
Anti-requisites	NIL		
Course Description	Predictive Analytics subject is conceptual in nature. The students will be benefited in this course to know about modern data analytic concepts and develop the skills for analyzing and synthesizing data sets for decision making in the firms.		
Course Objective	The objective of the course is skill development of student by using Learning techniques		

Course Outcomes	On successful completion of the course the students shall be able to: CO1: Define the nature of analytics and its applications. CO2: Summarize the concepts of predictive analytics and data mining. understand CO3: Construct the analytical tools in business scenarios to achieve competitive advantage.(Apply) CO4: Build the real-world insights in decision trees and time series analysis methods in dynamic business environment.(Apply)	[Level1 - Knowledge] [Level2 – Comprehension] [Level 3 – Apply] [Level 3 – Apply]

Course Content:

Module 1	Introduction to Predictive Analytics	Self-Learning	7 sessions
Topics: Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics; Popularity in Analytics; Predictive analytics in business Scenarios- case studies			
Module 2	Principles and Techniques	Case analysis	8 sessions
Topics: Predictive modeling: Propensity models, cluster models, collaborative filtering, applications and limitations - Statistical analysis: Univariate Statistical analysis, Multivariate Statistical analysis			
Module 3	Model Selection	Participative Learning & Case Analysis	7 sessions
Topics: Preparing to model the data: supervised versus unsupervised methods, statistical and data mining methodology, cross-validation, overfitting, bias-variance trade-off, balancing the training dataset, establishing baseline performance. Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models			
Module 4	Time Series Analysis	Discussion & Presentation	8 sessions
Topics: Time series Model: ARMA, ARIMA, ARFIMA - Temporal mining - Box Jenkinson method, temporal reasoning, temporal constraint networks			

Text Book

T1: Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015

T2: Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

References

R1: Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making. .

R2: Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012

E-Resources/Web Resources

1. https://www.sas.com/en_in/insights/analytics/predictive-analytics.html
2. https://www.techtarget.com/search business analytics/definition/predictive-analytics
3.https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data-

Course Code: CSD2502	Course Name: Predictive Analytics Lab Type of Course: Laboratory Course	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	NIL		
Co-requisites	CSD2501		
Anti-requisites	NIL		
Course Description	Predictive Analytics subject is conceptual in nature. The students will be benefited in this course to know about modern data analytic concepts and develop the skills for analyzing and synthesizing data sets for decision making in the firms.		
Course Objective	The objective of the course is skill development of student by using Learning techniques		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Define the nature of analytics and its applications. (Remember) . [Level 1 – Knowledge] CO2: Summarize the concepts of predictive analytics and data mining. [Level 2 – Understand] CO3: Construct the analytical tools in business scenarios to achieve competitive advantage. [Level 3 – Apply] CO4: Build the real-world insights in decision trees and time series analysis methods in dynamic business environment. [Level 3 – Apply]		

Course Content:

List of Laboratory Tasks:

- Experiment 1: Predicting buying behaviour

a. Analytics to identify buying habits based on previous purchase history.

b. Predict customer purchase patterns.

- Experiment 2: Fraud detection

a. To identify anomalies in the system and detect unusual behavior to determine threats.

b. Experts can feed historical data of cyberattacks and threats to the system. When the predictive analytics algorithm identifies something similar, it will send a notification to the respective personnel.

- Experiment 3: Healthcare diagnosis
  a. Understanding the disease by providing an accurate diagnosis based on past data.
  b. Predictive analytics help doctors reach the root cause of diseases.
- Experiment 4: Card abandonment

a. Predict how likely a customer is to abandon the cart.

b. It will also provide companies with details about each customer about whether they will purchase or abandon the cart based on the previous visits to the store.

Experiment 5: Content recommendation

  a. Entertainment companies can predict what users want to watch based on their history.
  b. Use analytics for predicting the user's behavior.
- Experiment 6: Content recommendation
  a. Entertainment companies can predict what users want to watch based on their history.
  b. Use analytics for predicting the user's behavior.

<table>
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- Experiment 7 : Equipment maintenance
The machinery would alert the personnel and the maintenance can be done to avoid unscheduled and accidental breakdowns.

</td></tr>
<tr><td colspan="2">Targeted Applications & Tools:</td></tr>
<tr><td>Statistical tools</td><td>Tools used for data analysis, statistical computations, and interpretation of datasets to support decision-making.</td></tr>
<tr><td>Documentary review</td><td>Systematic examination and analysis of documents, reports, research papers, and records to gather relevant information and insights.</td></tr>
<tr><td>Case analysis and Simulation help students to understand the data driven decisions for firms</td><td>Real-world case studies and simulation exercises that enable students to analyze business scenarios and make data-driven decisions effectively.</td></tr>
<tr><td colspan="2">Text Book
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T2: Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.</td></tr>
<tr><td colspan="2">References
R1: Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making.
R2: Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012.</td></tr>
<tr><td colspan="2">E-Resources/Web Resources
1.https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
2.https://onlinecourses.nptel.ac.in/noc19_mg42/preview</td></tr>
</table>

Course Code: CSS2274	Course Title: Competitive Programming and Problem Solving Type Of Course: Laboratory Course (ESC)	L-T-P-C	0-0-4-2
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course equips students with efficient problem-solving skills for competitive programming and real-world computational challenges. Starting with brute-force approaches, students learn to optimize time and space complexity using advanced techniques such as greedy algorithms, dynamic programming, backtracking, graph algorithms, and heuristic optimization methods. Hands-on practice using platforms such as CodeChef and Codeforces helps students solve problems related to number theory, data structures, and algorithmic paradigms. The course also introduces intelligent problem-solving strategies, AI-assisted coding concepts, and optimization techniques for competitive programming. By understanding competitive programming constraints and developing a strategic problem-solving mindset, students gain confidence for coding competitions, technical interviews, and real-world applications.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Competitive Programming and Problem Solving, enabling them to develop efficient coding, optimization, and analytical skills through experiential learning techniques and intelligent problem-solving approaches.		

Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Understand the challenges of online competitive programming platforms, interpret problem constraints, and understand brute-force solution approaches used in competitive programming. **Level 2 – Understand** **CO2:** Analyze the time and space complexity of number-theoretic solutions to determine the need for optimization under competitive programming constraints. **Level 4 – Analyze** **CO3:** Apply appropriate algorithmic paradigms and data structures to solve problems within defined time and memory constraints. **Level 3 – Apply** **CO4:** Analyze execution failures and identify algorithmic inefficiencies in solutions involving advanced data structure concepts to redesign optimized solutions within given time and memory constraints. **Level 4 – Analyze** **CO5:** Analyze advanced problem-solving and intelligent optimization techniques using dynamic programming, greedy methods, backtracking, and heuristic approaches for large-scale competitive programming problems. **Level 4 – Analyze**

Course Content:

Module 1	Introduction to Competitive Programming	NA

Topics:
Overview of Efficient Coding for Problem Solving and CP: Introduction to competitive programming (CP); revisit of complexity analysis; introduction to online platforms such as codechef, codeforces etc and online submission; constraints during CP, online testing process and common errors such as TLE; use of STL.
CP Problem Solving using Advanced Topics: concept of disjoint sets and their efficient representation, algorithmic approaches such as Greedy, Backtracking, Dynamic Programming and applying them for CP problems using bottom-up dynamic programming.

Module 2:	Number Theory for Problem-Solving	NA

Topics:
Use of Number Theory for problem-solving: reducing time/space complexity of brute force coding solution of Sieve Method, Inverse Module, Euclidian Method of factorization; efficient coding for Permutation Combination; XORing based and pattern-based solutions.

Module 3:	Optimizing Time & Space Using Sequential Storage	NA

Topics:
Coding for Optimizing time and Space using Sequential Storage: two pointer approach; problem-solving using arrays and strings such as rotation on sorted arrays, duplicate removal, string matching algorithms; Kadane's algo, stacks, priority-queues and hashing based efficient coding; median based problems and alternate solutions.

Module 4:	Non-Linear Data Structures & Problem Solving using Advanced Topics	NA

Topics:

Applying Non-Linear Data Structures for real-life problems: design of efficient solutions for problems such as finding loops in a linked list, memory efficient DLL, block reversal in LL; problem solving using trees and binary trees, Catalan numbers, applications of graphs, spanning tree and path algos for CP problems with reduced time/space complexity. CP Problem Solving using Advanced Topics: concept of disjoint sets and their efficient representation, algorithmic approaches such as Greedy, Backtracking, Dynamic Programming and applying them for CP problems using bottom-up dynamic programming.

Module 5:	Advanced Competitive Programming and Intelligent Problem Solving	NA

Topics:

Disjoint Sets and Efficient Representation, Greedy Algorithms, Backtracking Techniques, Dynamic Programming using Bottom-up Approach, Advanced Graph Algorithms for Competitive Programming, AI-assisted Problem Solving Concepts, Heuristic and Optimization Techniques, Intelligent Coding Strategies for Time and Space Optimization.

List of Practical Tasks 60 Sessions

WEEK 1

Lab Sheet 1: Sorting & Ranking

Level 1: Write a program to find the runner who finished in the third position from the given finishing times of N runners.

Level 2: Write a program to find the top 10 runners along with their bib numbers efficiently for large datasets.

Lab Sheet 2: Searching Techniques

Level 1: Write a program to check whether a given book ID exists in a library database.

Level 2: Design and implement a system to search books efficiently by title using an appropriate data structure.

WEEK 2

Lab Sheet 3: Cost Calculation

Level 1: Write a program to calculate the total cost of products in a shopping cart.

Level 2: Design an algorithm to apply multiple discount rules and compute the final bill.

Lab Sheet 4: Modular Arithmetic

Level 1: Write a program to compute (a^m \mod p).

Level 2: Implement binary exponentiation for efficient computation of large powers modulo p.

WEEK 3

Lab Sheet 5: Combinatorics

Level 1: Write a program to calculate the number of ways to choose K cards from N cards.

Level 2: Design an algorithm to calculate probabilities of drawing specific card combinations.

Lab Sheet 6: Graph Connectivity

Level 1: Write a program to determine if a path exists between two nodes in a network.

Level 2: Design an algorithm to detect anomalies in a network using XOR-based comparison techniques.

WEEK 4

Lab Sheet 7: Array Processing

Level 1: Write a program to find the minimum time required for cars to pass a point based on their speeds.

Level 2: Implement a two-pointer approach to simulate movement of cars with different lengths.

Lab Sheet 8: String Matching

Level 1: Write a program to count occurrences of a substring in a given string.

Level 2: Implement the KMP algorithm to efficiently find all occurrences of a pattern in a text.

WEEK 5

Lab Sheet 9: Priority Queue

Level 1: Write a program to track the highest bid in an auction system.
Level 2: Design a system to handle concurrent bids efficiently and update the highest bid.

Lab Sheet 10: Shortest Path

Level 1: Write a program to check if two users are connected in a social network.
Level 2: Implement Dijkstra's algorithm to find the shortest path between users.

WEEK 6

Lab Sheet 11: Tree Traversal

Level 1: Write a program to traverse a file system and display all files and directories.
Level 2: Design a file system supporting operations like create, delete, and search.

Lab Sheet 12: Tree Applications

Level 1: Write a program to calculate the total price of items in a shopping cart represented as a tree.
Level 2: Design a system to apply discounts efficiently in a hierarchical shopping cart.

WEEK 7

Lab Sheet 13: Disjoint Set

Level 1: Write a program to check whether all users in a group are connected.
Level 2: Find the minimum number of connections required to connect all users.

Lab Sheet 14: Greedy Algorithms

Level 1: Write a program to find the cheapest path to reach a destination.
Level 2: Design an algorithm to find the fastest path considering time constraints.

WEEK 8

Lab Sheet 15: BFS Applications

Level 1: Write a program to find the minimum number of moves for a rook to reach a target square.
Level 2: Implement BFS to find shortest path in a grid.

Lab Sheet 16: Game Algorithms

Level 1: Represent a game state using a tree structure.
Level 2: Implement minimax algorithm with alpha-beta pruning.

WEEK 9

Lab Sheet 17: Sorting Algorithms

Level 1: Write a program to implement insertion sort.
Level 2: Write a program to implement merge sort or quick sort.

Lab Sheet 18: Searching Algorithms

Level 1: Write a program to perform linear search.
Level 2: Write a program to perform binary search efficiently.

WEEK 10

Lab Sheet 19: Algorithm Analysis

Level 1: Write a program to compare execution time of two algorithms.
Level 2: Optimize a given algorithm to improve performance.

Lab Sheet 20: Recursion

Level 1: Write a program to solve Tower of Hanoi.
Level 2: Compare recursive and iterative solutions for a problem.

WEEK 11

Lab Sheet 21: Graph Representation

Level 1: Represent a graph using adjacency list.
Level 2: Represent a graph using adjacency matrix.

Lab Sheet 22: Graph Traversal

Level 1: Implement Depth First Search (DFS).
Level 2: Implement Breadth First Search (BFS).

WEEK 12

Lab Sheet 23: Data Structure Integration
Level 1: Combine arrays and lists to solve a problem.
Level 2: Use multiple data structures (tree + hash table) in one solution.
Lab Sheet 24: Real-world Application
Level 1: Design a simple recommendation system.
Level 2: Optimize it for large-scale data.

WEEK 13
Lab Sheet 25: String Algorithms
Level 1: Write a program for basic string matching.
Level 2: Implement efficient pattern matching algorithm.
Lab Sheet 26: Network Algorithms
Level 1: Check connectivity in a network.
Level 2: Detect anomalies using data comparison techniques.

WEEK 14
Lab Sheet 27: Algorithm Design
Level 1: Solve a problem using brute-force approach.
Level 2: Improve the solution using greedy or dynamic approach.
Lab Sheet 28: Performance Evaluation
Level 1: Analyze runtime of a program.
Level 2: Compare different algorithmic approaches.

WEEK 15: Intelligent Optimization and Competitive Programming
Lab Sheet 29: Advanced Problem Solving
Level 1: Solve optimization problems using greedy or dynamic programming techniques.
Level 2: Implement backtracking or graph-based solutions for competitive programming problems.
Lab Sheet 30: Intelligent Algorithm Analysis
Level 1: Analyze time and space complexity of advanced algorithms.
Level 2: Compare heuristic, dynamic programming, and brute-force approaches for performance optimization.

Targeted Application & Tools that can be used:

1. C or C++ Compiler (g++): The standard compiler for CP. Familiarize students with compilation flags (e.g., -O2 for optimization).
2. IDE (Integrated Development Environment): Code:: Blocks, Visual Studio, CLion, or similar IDEs. These provide debugging capabilities, code completion, and other helpful features.
3. Online Judges (CodeChef, Codeforces, LeetCode, HackerRank): Essential for practicing and submitting solutions.
4. Debugger (gdb): Crucial for understanding code execution and finding bugs. Origin, excel and Mat lab soft wares for programming and data analysis.
5. Number Theory Libraries: Some libraries provide pre-built functions for number theory operations (though often it's better to implement them yourself for learning).
6. Wolfram Alpha: A useful tool for verifying number theory calculations and exploring concepts.
7. String Libraries: Familiarize students with the string manipulation functions available in C++.
8. Graph Visualization Tools: Tools like Graphviz can be helpful for visualizing graphs and understanding graph algorithms.
9. DP Debugging Techniques: Practice debugging DP solutions, as they can be complex. Visualizing the DP table can be helpful

Text Books:

1 Guide to Competitive Programming: Learning and Improving Algorithms Through Contests" (3rd Edition), *Antti Laaksonen, springer, 2024*

2 "Data Structures and Algorithms in Java: A Project-Based Approach" – *Dan S. Myers, Cambridge*

University Press Reference Books: 1. Data Structures and Algorithmic Thinking with Python/C++/Java", Narasimha Karumanchi, 5th Edition, Career Monk, 2017. 2. Introduction to Algorithms, Thomas H. Cormen (Author), Charles E. Leiserson (Author), RonaldL. Rivest , fourth edition April 2022 . Web Resources 1. https://nptel.ac.in/courses/106106231
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
Assessment Type 1. Midterm exam 2. Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.) 3. Quiz 4. End Term Exam 5. Self-Learning

Course Code: LAW7601	Course Name: : Indian Constitution Type of Course:Theory Course	L- T-P- C	1-0-0-0
Version No.			
Course Pre-requisites	NIL		
Co-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course is designed to improve the learners' SKILL DEVELOPMENT by using PATICIPATIVE LEARNING techniques. This course aims to familiarize students with fundamentals of Indian Constitution concepts and their relevance to 75+ Years of Republic of India (https://constitution75.com/) as well as #Azaadi Ka Amrut Mahotsav / Azadi Ka Amrit Mahotsav (https://amritmahotsav.nic.in). It is designed to equip students with the knowledge about the Constitution of India. This course aims to introduce the constitutional law of India to students from all walks of life and help them understand the constitutional principles as applied and understood in everyday life. The objective of making the Constitution of India, familiar to all students, and not only to law students, this course aims and objectifies legal understanding in the simplest of forms. This course is designed to cater to Constitutional Studies.		
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'PARTICIPATIVE LEARNING' techniques		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:**Describe the basic understanding of the Indian Constitution and the concepts and issues relevant to day-to-day life of the nation and to equip the Citizen with the zeal of capacity building. Recognizing and identify the values of the Constitution of India. [Level 2 - Understand] **CO2**:Enabling the Citizen-centric Awareness of Rights and Responsibilities of the State. [Level 2 – Understand] **CO3:**3. Explain the role of the State actors in building India. [Level 2 – Understand]		

	CO4: 4. Understanding the Gandhian vision over the power of the LSG (Local Self-Governance) [Level 2 – Understand]		
Course Content:			
Module 1	Understanding the Making of the Constitution: The Constituent Assembly & The Constitution of India	Assessment: Quiz	5 sessions
Topics: Historical Context of Constituent Assembly - Compositions & Functions of Constituent Assembly What is a Constitution? – Why have a Constitution? – Constitutional Change - Features of Indian Constitution – Preamble of Indian Constitution			
Module 2	Citizen's Fundamental Rights and State's Responsibilities (Directive Principles)	Assessment	5 Sessions
Topics: Topics: Introduction to Fundamental Rights - Right to Equality – Facets of Right to Equality - Right to Freedom - Constitutional Position of Some Democratic Rights - Right Against Exploitation - Right to Freedom of Religion - Right to Constitutional Remedies Directive Principles of the State Policy			
Module 3	Organs Of the Government	Assessment : Presentation	5 Sessions
Topics: Executive: The President of India - Powers and Functions of President of India - Emergency Powers and the Position of the President Legislature: Union Council of Ministers - Prime Minister - The Rajya Sabha - The Lok Sabha - Relation between the Lok Sabha & Rajya Sabha - Office of the Speaker – Important Parliamentary Committees Judiciary: The Structure and Organization of the Judiciary & the High Court - The Supreme Court - Role of The Supreme Court - Judicial Activism in India - Basic Structure Doctrine & PIL			
Module 4	Federalism & Decentralization		6 sessions
Topics: What is Federalism? - Centre-State Legislative Relations - Centre-State Administrative Relations - Centre-State Financial Relations The 5th & 6th Schedules - Municipality- (History of Indian Municipality, Organization & Functions) – Panchayat 1 (Idea of Panchayat, Organization and Powers of Panchayats in India)			
Text Book **T1:** Durga Das Basu --- Introduction to the Constitution of India, 23rd Edition (Gurgaon; LexisNexis, 2018**).** **T2:** MP Jain's Constitutional Law of India, Lexis Nexis			
References **R1**: Himangshu Roy and M.P.Singh – Indian Political System, 4th Edition (Bengaluru; Pearson Education, 2018) **R2**: Vidya Bhushan & Vishnoo Bhagwan--- Indian Administration (S. Chand, 2011)			
E-Resources/Web Resources			

1. https://openFullText.html?DP=https://legislative.gov.in/constitution-of-india/
2. https://openFullText.html?DP=https://nptel.ac.in/courses/109104074
3. https://openFullText.html?DP=https://www.indiacode.nic.in/

Course Code: APT4005	Course Title:Aptitude For Employability Type of Course: Practical Only		L- T-P-C	0-0-2-1
Version No.		1.0		
CoursePre-requisites		Students should have the basic concepts of Quantitative aptitude, Verbal ability along with its applications in real life problems.		
Anti-requisites		Nil		
CourseDescription		This course is designed to enable the students to enhance their skills in quantitative aptitude and verbal ability skills.		
CourseObjective		The objective of the course is to familiarize the learners with concepts inQuantitative Aptitude and Verbal ability through problem solving techniques suitable for their career development.		
CourseOutcomes		On successful completion of the course the students shall be able to: CO1] Recall all the basic mathematical concepts CO2]Identify the principle concept needed in aquestion CO3]Solve the quantitative and logical ability questions with the appropriate concept.		
CourseContent:				
Module1	QuantitativeAbility	Lab-10hrs	Platform Assessment-10hrs	20Sessions
	Topics: Number System, Percentage, Ratio andProportion,Average,Mixture and Allegation,Time andWork, Profit and Loss, Time Speed and Distance, Simple Interest and Compound Interest, Probability, Permutation and Combination.			
Module2	VerbalAbility	Lab-5hrs	Platform Assessment-5hrs	10Sessions
	Topics:-PartsofSpeech,Subject Verb Agreement,SpottingError,ClozeTest,VerbalAnalogies, Reading Comprehension,Idioms&Phrases,ParaJumbles			
	Targeted Application&Toolsthatcanbeused: Applicationarea:Placement activities and Competitive examinations. Tools: LMS			

Evaluation	ContinuousEvaluation • Topicwise evaluation
TextBook 1. Fast track objective by Rajesh Verma 2. R S Aggarwal 3. S.PBakshi	
References 1. www.indiabix.com 2. www.testbook.com 3. www.youtube.com/c/TheAptitudeGuy/videos	
Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques.This is attained through assessment component mentioned in coursehandout.	

Course Code: CSS7100	Course Title: Mini Project Type of Course: PRW	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 methods of scientific experimentation, and often get opportunities to see, study, and operate sophisticated and costly equipment. They also get opportunities to work with advanced software tools and modern technologies used in industries and research environments. Students use tools and technologies from emerging fields such as Artificial Intelligence (AI), Machine Learning (ML), Cyber Security, Blockchain, and Data Science to develop solutions for real-world and industry-related problems. They also learn about the implementation of management principles taught in the classroom by observing multidisciplinary teams of experts from engineering, science, economics, operations research, and management dealing with techno-economic problems at both micro and macro levels. The course further enables students to develop and refine their language, communication, teamwork, and interpersonal skills through various activities such as seminars, group discussions, project presentations, and report preparation. The broad-based core education, supported by strong foundations in mathematics, science, and analytical tools, provides the necessary background for students to properly understand and solve practical real-life problems. Students have the flexibility to pursue this course either as Project Work and Dissertation within the university, as Project Work in an Industry, Company, or Research Laboratory, or through Internship Programs in industries and organizations.		

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, students shall be able to: CO1: Identify engineering problems related to local, regional, national, and global needs. [Level 2 - Understand] CO2: Apply appropriate techniques and modern tools to solve the intended problems. [Level 3 - Apply] CO3: Design experiments in accordance with standards and specifications. [Level 4- Analyze] CO4: Interpret events and results to derive meaningful conclusions. [Level 5- Evaluate] CO5: Appraise project findings and communicate effectively through scholarly publications. [Level 6 - Create]

Course Code: PPS3018	Course Title:PreparednessforInterview Type of Course:PracticalOnly Course	L- T-P-C	0-0-2-1
VersionNo.		1.0	
CoursePre-requisites		Students are expected to understand BasicEnglish. Students should have desire and enthusiasm to involve,participateandlearn.	
Anti-requisites		NIL	
Course Description		This course is designed to enable students to understand soft skills concepts to be corporate ready. The modules are set to improve self-confidence, communicate effectively and Prepare for the Interview to assist in employability.It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in crafting different types of resumes. The pedagogy used will be group discussions,flipped classrooms,continuous feedback,role-playandmentoring.	
CourseObjective		The objective of the course is to familiarize the learners with the concepts of	

CourseOutcomes		On successful completion of this course the students shall be ableto: CO1: Develop professional Resumes CO2: Illustrate Resumes effectively CO3:Apply skills and knowledge learnt for active and effective Group Discussions and Interview	
CourseContent:			
Module1	ResumeBuilding	Classroomactivity	10 Sessions
	Topics: Resume structure,use of templates, Do's and Don'ts, ATS methods, Cover Letter and Video Resume Activity:Realworldscenarios		
Module2	GroupDiscussion	MockGD	9 Sessions
	Topics:-Group discussion as aplacement process,GD techniques like Keyword.SPELT&POVofaffected parties.Do&Don'tofGD,Case-lets and topics for GD,practice session andevaluation Activity:-Realworldscenarios		
Module3	PersonalInterview	Groomingchecks+Evaluation+ Mock Interview+ Role Play	9 Sessions
	Topics:Placement process,Different interview rounds,HRinterviews,Interview questions and desired answers, Different types of interviews, Do's and Don'ts. Activity:-RolePlay&Real-worldscenario		
Module4	Recap/Revision/FeedbackSession	Practicesessions	2Sessions
	Targeted Application&Toolsthatcanbe used: 1. TED Talks 2. YouTube Links 3. RolePlayactivities		
	Projectwork/Assignment:Mention the Type of Project/Assignment proposed for thiscourse		

	Continuous IndividualAssessment
	The Topics related to SkillDevelopment:Art Of Presentation and Group Discussion forSkill DevelopmentthroughParticipative Learning Tech- niques. This is attained through assessment Component mentioned in course handout.

Course Code: CSS7300	Course Title: Capstone Project Type of Course: PRW	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 learn by observing science and technology in real-life applications and gain knowledge through practical experimentation and hands-on activities. They get opportunities to study and work with advanced equipment, software tools, and modern technologies. Students use tools and technologies from emerging fields such as Artificial Intelligence (AI), Machine Learning (ML), Cyber Security, Blockchain, and Data Science to develop solutions for real-world and industry-related problems. The course helps students understand how engineering, science, economics, operations research, and management work together to solve technical and business-related challenges. By working on projects, seminars, group discussions, and report preparation, students improve their communication, teamwork, presentation, and interpersonal skills. The strong foundation in mathematics, science, and analytical thinking helps students understand and solve practical problems effectively. Students can complete the course through Project Work and Dissertation within the university, by doing projects in industries or research laboratories, or through internship programs in companies and organizations.		
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, students shall be able to: CO1: Identify engineering problems at various societal levels [Level 2 - Understand] CO2: Apply tools and techniques for problem solving. [Level 3 - Apply] CO3: Design and plan experiments per industry standards. [Level 3- Apply] CO4: Interpret the events and results for meaningful conclusions. [Level 5- Evaluate] CO5: Appraise project findings and communicate effectively through scholarly publications. [Level 6- Create]		

Discipline Electives:

Course Code: CSS3426	Course Name: Front-end Full Stack Development Course Type : Lab Integrated	L- T-P- C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	CSE2258		
Co-requisites			
Anti-requisites	NIL		
Course Description	This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.		
Course Objectives	The objective of the course is to familiarize the learners with the concepts Front end Full Stack Development and attain Employability through experiential Learning techniques.		
Course Outcomes	On successful completion of the course the students shall be able to: CO1 Describe the fundamentals of DevOps and Front-end Full Stack Development. — Level 2 – Comprehension (Understanding) CO2 Illustrate a basic web design using HTML, CSS, and JavaScript. — Level 3 – Application CO3 Illustrate the development of a responsive web application. — Level 3 – Application CO4 Apply the concepts of Angular.js to develop a web front-end application. — Level 3 – Application CO5 Develop and deploy a complete front-end web application by integrating DevOps practices and modern web technologies. — Level 3 – Application		
Course Content:			
Module 1	Fundamentals of DevOps	Assessment: Project	04 Sessions
Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control.			
Module 2	Web Design & Development	Assessment: Project	03 Sessions
Topics: HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform; Assignment: Develop a website for managing HR policies of a department.			
Module 3	Responsive web design	Assessment: Project	08 Sessions
Topics: BootStrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society.			
Module 4	Fundamentals of Angular.js	Project | Programming	15 Sessions
Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http			

Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma). Overview of React.js
Assignment: Develop a software tool to do inventory management in a warehouse.

Targeted Application & Tools that can be used:

GCC compiler.	An open-source compiler that converts source code written in languages like C and C++ into executable machine code, providing error checking and optimization support.

Text Book:

T1. Fender, Young, "Front-end Fundamentals", Leanpub, 2015

T2. Northwood, Chris, "The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer", APress, 2018

References:

R1. Flanagan D S, "Javascript : The Definitive Guide" 7th Edition. 7th ed. O'Reilly Media; 2020.

R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. "Responsive Web Design with HTML5 and CSS3 Essentials", Packt Publishing, 2016

R3. Duckett J Ruppert G Moore J. "Javascript & Jquery : Interactive Front-End Web Development."; Wiley; 2014.

R4. Web Reference:
https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2

R5. Web Reference: https://www.freecodecamp.org/news/frontend-web-developer-bootcamp/
https://puniversity.informatics global.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live
https://nptel.ac.in/courses/106102064

Topics relevant to development of "Employability": DevOps Tools Overview – Jenkins, Docker, Kubernetes for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSS3427	Course Name: Java Full Stack Development Course Type: Lab Integrated	L- T-P- C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	CSE2258		
Co-Requisite	NIL		
Anti-requisites	NIL		
Course Description	This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.		
Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Practice the use of Java for Full Stack Development. — Level 3 – Apply CO2: Develop web applications using Java EE. — Level 3 – Apply CO3: Solve application development — Level 3 – Apply		

	problems using Java Persistence and Hibernate. CO4: Apply Spring Framework concepts to develop Full Stack applications. CO5: Employ automation tools such as Maven and Selenium for Full Stack Development.	 Level 3 – Apply Level 3 – Apply

Course Content:

Module 1	Introduction	Assesment:Project	03 Sessions
Topics: Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools.			
Module 2	Java EE Web Applications	Assesment: Project	05 Sessions
Topics: Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App Assignment: Develop an application for managing HR policies of a department.			
Module 3	Java Persistence using JPA and Hibernate	Assesment: Project	06 Sessions
Topics: Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA) Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society.			
Module 4	Spring Core	Assesment: Project	10 Sessions
Topics: Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate o Spring AOP (Aspect Oriented Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development Assignment: Develop a software tool to do inventory management in a warehouse.			
Module 5	Automation tools	Assesment: Project	06 Sessions
Topics: Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup - Commandline and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands Assignment: Illustrate the use of automation tools in the development of a small software project.			

Targeted Application & Tools:

Eclipse	An open-source Integrated Development Environment (IDE) widely used for Java application development.
NetBeans	A free IDE that supports Java, web, and enterprise application development with built-in development tools.
Hibernate	An Object-Relational Mapping (ORM) framework that simplifies database operations in Java applications.
Selenium	An automation testing tool used for testing web applications across different browsers and platforms.

Maven	A project management and build automation tool used for dependency management and project lifecycle management in Java projects.
Git	A distributed version control system used to track changes in source code and support collaborative software development.

Project work/Assignment:

Problem Solving: Design of Algorithms and implementation of programs.
Programming: Implementation of given scenario using Java.

Text Book:
T1: Fender, Young, "Front-end Fundamentals", Leanpub, 2015

References
R1. Soni, Ravi Kant. "Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful." , Apress, 2017.
R2. Mardan, Azat. "Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB.", Apress, 2015

Course Code: CSS3428	Course Name: .NET Full Stack Development Course Type: Lab Integrated	L- T-P- C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	CSE2258		
Co-Requisite	NIL		
Anti-requisites	NIL		
Course Description	This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.		
Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Practice the use of C# for developing small applications. — Level 3 – Apply CO2: Develop web applications using Entity Framework. — Level 3 – Apply CO3: Solve simple web application problems using SQL and ASP.NET. — Level 3 – Apply CO4: Apply ASP.NET concepts to develop Full Stack applications. — Level 3 – Apply CO5: Employ debugging, testing, and deployment techniques for developing and maintaining ASP.NET applications. — Level 3 – Apply		
Course Content:			
Module 1	C# Programming for Full Stack Development	Assesment:Project	10 Sessions
	Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions,		

<table>
<tr><td></td><td colspan="3">Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework
Assignment: Develop a small application for managing library using C#.</td></tr>
<tr><td>Module 2</td><td>Entity Framework Core 2.0</td><td>Assesment:Project</td><td>06 Sessions</td></tr>
<tr><td></td><td colspan="3">Topics:
Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET
Assignment: Develop an application for managing HR policies of a department.</td></tr>
<tr><td>Module 3</td><td>ASP.NET</td><td>Assesment:Project</td><td>06 Sessions</td></tr>
<tr><td></td><td colspan="3">Topics:
ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts;

Assignment: Develop a web application to mark entry/exit of guests in a building.</td></tr>
<tr><td>Module 4</td><td>ASP.NET</td><td>Assesment:Project</td><td>08 Sessions</td></tr>
<tr><td></td><td colspan="3">Topics:
Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application
Assignment: Develop a software tool to do inventory management in a warehouse.</td></tr>
<tr><td></td><td colspan="3">Targeted Application & Tools that can be used:<table><tr><td>Visual Studio</td><td>A comprehensive IDE for developing, debugging, testing, and deploying .NET applications.</td></tr><tr><td>SQL Server</td><td>A relational database management system used to store and manage application data.</td></tr></table></td></tr>
<tr><td></td><td colspan="3">Project work/Assignment:</td></tr>
<tr><td></td><td colspan="3">Problem Solving: Design of Algorithms and implementation of programs.
Programming: Implementation of given scenario using .NET.</td></tr>
<tr><td></td><td colspan="3">Text Book:
T1. Fender, Young, “Front-end Fundamentals”, Leanpub, 2015
T2. Valerio De Sanctis, “ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11”, 4th Edition, Packt, 2021.</td></tr>
<tr><td></td><td colspan="3">References
R1. Benjamin Perkins, Jon D. Reid, “Beginning C# and .NET”, Wiley, 2021 Reid, 2021.
R2. Piotr Gankiewicz, “Full Stack .NET Web Development”, Packt Publishing, 2017.
R3. Tamir Dresher, Amir Zuker, Shay Friedman, “Hands-On Full-Stack Web Development with ASP.NET Core”, Packt Publishing, 2018.
R4. Dustin Metzgar, “Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core”, Manning, 2017.</td></tr>
</table>

Course Code: CSD3401	Course Name: Business Continuity and Risk Analysis for Data Science Type of Course:Discipline elective	L- T-P- C	3-0-0-3
Version No.			
NCrF Level-			

Course Pre-requisites	CSD1716-Fundamentals of Data Analytics		
Co-requisites			
Anti-requisites	NIL		
Course Description	This course provides data science students with a comprehensive understanding of business continuity planning (BCP) and risk analysis frameworks, integrating data-driven strategies for resilience and risk mitigation. It focuses on identifying potential threats, assessing vulnerabilities, and designing robust recovery strategies using data analytics. The course includes case studies from industries such as finance, manufacturing, and healthcare, emphasizing predictive risk models, disaster recovery, and regulatory compliance in a data-centric world.		
Course Objective	To equip students with the knowledge and skills to identify, assess, and manage risks using data-driven approaches, and to develop effective business continuity plans. The course emphasizes the application of statistical models, predictive analytics, and risk management frameworks to ensure organizational resilience and informed decision-making in the face of disruptions.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Understand BCP fundamentals and its integration with SDLC. [Level 3 - Apply] **CO2:** Perform risk assessments and conduct Business Impact Analysis (BIA). [Level 3 – Apply] **CO3:** Apply mitigation strategies using security technologies and data recovery methods. [Level 3 – Apply] **CO4:** Plan and test business recovery procedures and conduct staff training. [Level 3 – Apply]		
Course Content:			
Module 1	**Fundamentals of Business Continuity Planning**	**QUIZ**	10 Sessions
Topics: Business Continuity Planning - Building - Types of Contingency Plans - Preparing Plans - BCP Planning and the Systems Development Life Cycle (SDLC); BCP Standards and Guidelines - BCP Project Organization			
Module 2	**Risk Assessment**	**ASSIGNMENT**	10 Sessions
Topics:Determining Threats - Risk Management - The Risk Manager - Risk Assessment - Business Risk Assessment - Business Impact Analysis (BIA) - Identification of Key Business Processes - Establishing Requirements for Business Recovery - BIA Questionnaire Development - BIA Report Format - Fine-Tuning Priorities - Determining Resource Dependencies - Organizing and Tabulating the Results			
Module 3	**Mitigation Strategies**	**ASSIGNMENT**	13 Sessions
Topics: Migration Strategies - Preventative Measures for Information Security Managers - VPNs and Remote Access - Firewalls - Encryption - Intrusion Detection and Prevention Systems - Antivirus, Anti-Spyware, and Anti-Spam Software - Theft Prevention for Proprietary/Intellectual Property - Information Security Preventative Controls - Restarting or Recovering System - Backing up Data - Managing Backup and Recovery Procedures - Recovery and Restoring of Data Files			
Module 4	**Business Recovery Phase and Testing, Auditing, and Training**	**ASSIGNMENT**	12 Sessions

Topics: Business Recovery Planning Process - Testing the Business Recovery Process - Security Testing - Monitoring and Updating - Auditing Fundamentals - Basic Audit Methods and Tools - Training Staff for the Business Recovery Process
Text Book **T1:** "Business Continuity and Disaster Recovery for Infosec Managers", by John W.Rittinghouse, James F. Ransome, Elsevier Digital Press, 2005. **T2:** "A Guide to Business Continuity Planning", by James C Barnes, John Wiley & Sons, Ltd, 2001.
References **R1:** "Managing Risk and Information Security", by Malcolm W. Harkins, Apress open, 2016.
E-Resources/Web Resources W1. EBook: https://presiuniv.knimbus.com/user#/home W2. Seminar: https://nptel.ac.in/courses/108/102/108102047/ W3. Case Study: http://www.digimat.in/nptel/courses/video/108102047/L01.html

Course Code: CSD3402	Course Title: Web Data Analytics for Data Science Type of Course: Integrated	L-T- P- C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	Web Technology, Python Programming		
Anti-requisites	NIL		
Course Description	The purpose of this course is to introduce the students to the Web data analytics concept. The course is both conceptual and analytical and is understood with practical knowledge. The course develops critical thinking skills by augmenting the student's ability to develop web data analytical models for various data sets which helps to overcome many problems. The course involves quizzes and assignments. The course emphasizes deriving insights for real-world applications in data science.		
Course Objective	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.		
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Understand the concept and importance of Web analytics in an organization and the role of Web analytic in collecting, analyzing and reporting website traffic. CO2: Apply key tools and diagnostics associated with Web analytics. CO3: Use sentiment and trend analysis using APIs and social media platforms. CO4: Design dashboards and visualize web analytics results effectively.		
Course Content:			
Module 1: Introduction to Web Analytics			8 Sessions
	Introduction to Web Analytics: Web Analytics Approach – Data collection methods in Web Analytics -A Model of Analysis – Context matters – Data Contradiction – Working of Web Analytics: Log file analysis – Page tagging – Metrics and Dimensions – Interacting with data in Google Analytics.		
Module 2: Web Usage and Log Data Analytics			8 Sessions

	Introduction – Goals and Conversions – Conversion Rate – Goal reports in Google Analytics – Performance Indicators – Analyzing Web Users: Learning about users – Traffic Analysis – Analyzing user content – Click-Path analysis – Segmentation.
Module 3 Social Media and Open Web Engine Data Analytics	10 Sessions
	Sentiment analysis on Twitter, Reddit, etc.,Trend analysis and opinion mining, Google Trends and open web metrics, Case studies and dashboard creation with real-time data
Module 4 Qualitative Analysis	10 Sessions
	Lab Usability Testing- Heuristic Evaluations- Site Visits- Surveys (Questionnaires) - Testing and Experimentation: A/B Testing and Multivariate Testing-Competitive Intelligence - Analysis Search Analytics: Performing Internal Site Search Analytics, Search Engine Optimization (SEO) and Pay per Click (PPC)-Website Optimization against KPIs- Content optimization- Funnel/Goal optimization - Text Analytics: Natural Language Processing (NLP)- Supervised Machine Learning (ML) Algorithms-API and Web data scarping using R and Python
	Exp. No. Title 1 Extract data from static web pages using BeautifulSoup 2 Perform web scraping from paginated or dynamic content using Scrapy 3 Access and parse REST APIs (e.g., GitHub, Twitter) with JSON data 4 Clean and preprocess web server logs (Apache or Nginx formats) 5 Identify sessions and users from clickstream logs 6 Perform sentiment analysis using Twitter API and TextBlob/VADER 7 Conduct trend analysis using Google Trends and visualize it 8 Create a live dashboard using Streamlit/Plotly to present web insigh
	Text Book Title: Mining the Web: Discovering Knowledge from Hypertext Data, Author: Soumen Chakrabarti, Publisher: Morgan Kaufmann (Elsevier),Year of Publication: 2022 Reprint Edition (original concepts updated with modern tools and use cases),ISBN: 9780128164852
	R1 :Title :Mining the Web: Discovering Knowledge from Hypertext Data, Author: Soumen Chakrabarti, Publisher: Morgan Kaufmann (Elsevier),Year: 2022 Reprint Edition,ISBN: 9780128164852 R2: Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Authors: Bing Liu, Publisher: Springer,Edition: 2nd Edition,Year: 2020,ISBN: 9783030421568. R3: Data Wrangling with Python: Tips and Tools to Make Your Life Easier,Author: Jacqueline Kazil, Katharine Jarmul, Publisher: O'Reilly Media,Edition: 2nd Edition, Year: 2022, ISBN: 9781098102012

Course Code: CSD3403	Course Title: Optimization Techniques for Data Science Type of Course: Theory Integrated	L- T-P-C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	MAT1001 Calculus and Linear Algebra		
Anti-requisites	NIL		

Course Description	This course provides a comprehensive introduction to optimization techniques with a strong focus on their applications in data science and machine learning. Students will explore the mathematical foundations of optimization, including convexity, duality, and gradient-based methods, and apply them to solve real-world problems involving regression, classification, clustering, and neural network training. The course covers both unconstrained and constrained optimization, delves into modern algorithms like stochastic gradient descent and Adam, and introduces advanced topics such as non-convex optimization and hyperparameter tuning. Through a blend of theory, algorithmic development, and hands-on coding assignments, students will gain the skills needed to formulate and solve optimization problems critical to effective data-driven decision making.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Optimization for data science and attain Experiential Learning and Problem Solving techniques.			
Course Out Comes	On successful completion of this course the students shall be able to: 1. Describe the fundamental concepts of optimization, including convexity, gradients, and optimality conditions. [Remember] 2. Describe unconstrained optimization algorithms such as gradient descent, stochastic gradient descent, and quasi-Newton methods for solving machine learning models. [Understand] 3. Apply constrained optimization techniques, including KKT conditions and duality theory, to solve problems in support vector machines and resource-constrained data science scenarios. [Apply] 4. Apply and implement advanced optimization methods—including non-convex optimization, hyperparameter tuning, and metaheuristic approaches—in practical data science workflows.[Apply]			
Course Content:				
Module 1	Foundations of Optimization	Assignment		16 Sessions [L-8 + P-8]
Topics: Introduction to Optimization in Data Science - Types of Optimization Problems: Convex vs. Non-convex - Mathematical Foundations: Vectors, Norms, Gradients, Hessians - Linear Algebra essentials for optimization - Convex sets and functions -Optimization Problem Formulation- First-order and Second-order Optimality Conditions.				
Module 2	Unconstrained Optimization Techniques	Assignment		16 Sessions [L-8 + P-8]
Topics: Gradient Descent and Variants - Stochastic Gradient Descent (SGD)- Mini-batch Gradient Descent - Momentum, RMSProp, Adam. Newton's Method and Quasi-Newton Methods (BFGS, L-BFGS) - Line Search and Step Size Strategies- Convergence Analysis.				
Module 3	Constrained Optimization and Duality	Quiz		16 Sessions [L-8 + P-8]
Topics: Lagrange Multipliers - Karush-Kuhn-Tucker (KKT) Conditions- Convex Optimization with Constraints- Duality Theory: Lagrangian Dual, Strong/Weak Duality- Quadratic Programming (QP), Linear Programming (LP)- Optimization in Support Vector Machines (SVM).				

Module 4	Advanced Topics and Applications in Data Science	Mini Project		12 Sessions [L-6 + P-6]

Topics:
Non-convex Optimization in Deep Learning -Optimization landscapes of neural networks - Saddle points and local minima -Bayesian Optimization-Hyperparameter Tuning (Grid Search, Random Search, BO)-Optimization in Clustering (e.g., k-means)-Large-scale and Online Optimization-Metaheuristic Methods: Genetic Algorithms, Simulated Annealing.

List of Laboratory Tasks:
Lab Sheet 1:
Gradient Descent on a Simple Function
Lab Sheet 2:
Logistic Regression with Batch Gradient Descent
Lab Sheet 3:
Compare Batch, Stochastic, and Mini-batch Gradient Descent
Lab Sheet 4:
Linear Regression using Normal Equation vs Gradient Descent
Lab Sheet 5:
Constrained Optimization with Lagrange Multipliers
Lab Sheet 6:
Visualizing Convex vs Non-Convex Functions
Lab Sheet 7:
Optimization in k-Means Clustering
Lab Sheet 8:
Support Vector Machine (SVM) Optimization using Quadratic Programming
Lab Sheet 9:
Hyperparameter Tuning: Grid Search vs Random Search
Lab Sheet 10:
Bayesian Optimization for Hyperparameter Tuning
Lab Sheet 11:
Implement Genetic Algorithm for Feature Selection
Lab Sheet 12:
Simulated Annealing for TSP (Traveling Salesman Problem)
Lab Sheet 13:
Solve Optimization Problem using Newton's Method
Lab Sheet 14:
Visualizing Optimization in Deep Learning Loss Landscapes
Lab Sheet 15:
Online Learning with SGDClassifier

Targeted Application & Tools that can be used: Google Colab

Project work/Assignment:
1] Projects on Model Optimization , Feature Selection, Real world optimization techniques.
2] Programming: problem solving and implement it using optimization techniques.
3] Real-world data science problem involving optimization

Text Book

1] Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright "Optimization for Machine Learning" 1st Edition (2011), MIT Press.
2] Stephen Boyd and Lieven Vandenberghe "Convex Optimization" , 1st Edition (2004), Cambridge University Press.
3] Jorge Nocedal and Stephen J. Wright "Numerical Optimization" 2nd Edition (2006), Springer.
4] Sébastien Bubeck "Convex Optimization: Algorithms and Complexity", 1st Edition (2015), Now Publishers.

E Book Link

1. https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf
2. https://www.math.uci.edu/~qnie/Publications/Numerical Optimization.pdf
3. https://sbubeck.com/Bubeck15.pdf
4. https://vim.ustc.edu.cn/_upload/article/files/86/7f/bf0a1fff499994d5fd8d17a7b5d5/c0feccd1-f58a-40ca-8e2e-720d276be00c.pdf

Web Links:

1. Technology Enabled Learning - NPTEL offers as Course on "Optimization for Data Science" by Prof. Pravesh Biyani , IIT, Delhi.

References

1] R. Fletcher , Practical Methods of Optimization" 2nd Edition (2021) - Wiley-Interscience publishers
2] Amir Beck "First-Order Methods in Optimization" 1st Edition (2017), SIAM-Society for Industrial and Applied Mathematics publishers.

Topics relevant to development of "Skill Development":
Formulating optimization problems from real-world scenarios.

Course Code: CSD3408	Course Title:Data Mining and Warehousing Type of Course:1] PCC	L-T-P-C	3	0	0	3
VersionNo.	1.0					
CoursePre-requisites	CSE1510					
Anti-requisites	NIL					
Course Description	This course covers the fundamental concepts, techniques, and tools used in data mining and data warehousing. Students will learn how to design and implement data warehouses and how to extract meaningful patterns and knowledge from large datasets using data mining methods. Topics include data preprocessing, association rules, classification, clustering, OLAP operations, and warehouse schema design. Real-world applications and hands-on projects using industry-standard tools form an essential part of the learning experience.					
Course Objective	To teach principles, concepts and applications of data warehousing and data mining To introduce the task of data mining as an important phase of knowledge recovery process To inculcate Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment. for Employability through Problem Solving Methodologies.					

CourseOutComes		On successful completion of this course the students shall be ableto: 1. Describe the fundamentals of data mining techniques (Understand) 2. Illustrate data knowledge using data warehousing techniques. (Apply) 3. Interpret the various new data mining tools. (Apply) 4. Illustrate recent trends in data mining such as web mining, spatial-temporal mining. (Apply)	
Course Content:			
Module1	Introduction to Data Mining	Assignment	11 Hours
Data Mining - Definition - DM Techniques - Current Trends in Data Mining - Different forms of Knowledge - Data Selection, Cleaning, Integration, Transformation, Reduction and Enrichment. Data: Types of Data - Data Quality - Data Preprocessing - Measures of Similarity and Dissimilarity.			
Module2	Introduction to Data Warehousing	Assignment	11 Hours
Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Logical (Multi- Dimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Olap Operations.			
Module3	Cluster Analysis –Basic Concepts and Methods	Assignment	12Hours
Introduction: - Clustering Paradigms - Partitioning Algorithms - K Means & K Medoid Algorithms - CLARA - CLARANS - Hierarchical Clustering - BIRCH , Categorical Clustering Cluster Density-Based Clustering-DBSCAN ,DENCLUE			
Module4	WEB MINING	Assignment	11Hours
Introduction: Web Content Mining - Web Structure Mining - Web Usage Mining - Text Mining - Text Clustering, Temporal Mining - Spatial Mining. Visual Data Mining: Knowledge Mining - Various Tools and Techniques for Implementation using Weka, Rapidminer and MATLAB.			
Text Book T1: Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei.3rd Edition, , Morgan Kaufmann Publishers, Elsevier,2023 T2: Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data" by Bing Liu,Springer,2nd Edition,2015			
References 1. R1. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball,2017 2. R2. Introduction to Data Mining" by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar,2018 3. R3. Practical Text Mining and Statistical Analysis for Non-structured Text Data Applications" by Gary Miner et al.,2012			

Course Code: CSSXXXX	**Course Title:Advanced Statistical Computing and Applied Inference Systems** **Type of Course:PCC–Theory&Practical**	**L-T-P-C**	2	0	2	3
VersionNo.	1.0					
CoursePre-requisites	CSSXXXX					
Anti-requisites	**NIL**					
Course Description	This course trains students in advanced statistical techniques and computational inference used in real-world data-driven systems. It blends theoretical depth with hands-on implementation across estimation, hypothesis testing, regression modeling, and uncertainty quantification. The course also covers simulation-based methods and Bayesian approaches,with emphasis on applying statistical reasoning in domains such as finance, operations, and digital experimentation.					
Course Objective	To equip students with the ability to design,implement,and interpret statistical models for inference and decision-making in large-scale, complex data environments.					
Course Outcomes	On successful completion of this course,the students shall be ableto: 1. **Apply**statistical estimation and hypothesis testing in real-worldscenarios 2. **Use**simulation techniques to approximate inference in non-analyticsettings 3. **Implement**advanced regression and multivariatemodeling 4. **Develop**Bayesian models for data-drivendecision-making					
Course Content:						
Module1:	**Estimation Theory and Statistical Reasoning**	**Quiz**		Knowledge-based Quiz		**9 Sessions**
Topics: Pointestimation,confidence intervals,sampling distributions,maximum likelihood estimation (MLE), Fisher information, sufficiency **Tools:Python(SciPy,Statsmodels)R(base +infer)JASP**for reproducible inference **UseCases:** • Estimate churn probability usingMLE • Construct CI for mean revenue in A/Btestresults						
Module 2:	**Hypothesis Testing and Decision Rules**	**Quiz**		Knowledge-based Quiz		**9 Sessions**
Topics: Parametric and non-parametrictests,t-tests,ANOVA,chi-square,poweranalysis,TypeI/II errors, sequential testing **Tools:**Python(Pingouin,Statsmodels)R(tidyverse+car)G*Power **UseCases:**						

- **Run ANOVA on multi-region campaign effectiveness**
- **Perform real-time sequential testing on streaming conversion rates**

Module 3:	**Regression Models and Inference**	**Quiz**		Knowledge-based Quiz	**9 Sessions**

Topics: Linear and generalized linear models(GLM),multicollinearity,heteroskedasticity,diagnostics, residual analysis, model comparison

Tools:R(caret,glmnet),Python(Statsmodels,scikit-learnforGLM),Orange Data Mining(GUI-based)

UseCases:

- Build a salary prediction model using GLM with categoricalcontrols
- Compare linear vs ridge regression on salesforecasting

Module 4:	**Simulation-Basedand Bayesian Inference**	**Quiz**		Knowledge-based Quiz	**9 Sessions**

Topics: Monte Carlo simulation, resampling, bootstrapping, Bayesian priors/posteriors, MAP estimation, MCMC (Metropolis-Hastings, Gibbs) **Tools: PyMC**, **Stan (via R or Python), SimPy**, **Resample**, **ArviZ**

UseCases:

- Bootstrap confidence intervals for samplemedians
- Use MC MC to estimate posterior in campaignattribution

Module 5:	**Capstone&Applied Inference Case Studies**	**Quiz**		Knowledge-based Quiz	**9 Sessions**

Topics: Real-world case studies in FinTech,eCommerce,EdTech,operations management.Emphasison end-to-end statistical workflow from problem framing to inference and decision.

Tools: Custom notebooks with integrated Jupyter/R Markdown environments,Datadrawnfrom simulated case environments

UseCases:

- Capstone:Use inference methods to assess treatment effects in an A/B/ntestingsetup for a mock EdTech product
- Quantifyoperationalrisk from loan defaults using Bayesian GLM

Projectwork/Assignment:

Students will be assigned a business or public sector data challenge requiring them to frame hypotheses, run appropriate tests or simulations, apply regression or Bayesian inference, and present their results with code, plots, and interpretations. Deliverables include notebooks, statistical summaries, and an executive-style insights memo.

TextBook

T1.Co-branded Zell and Paytm Textbook for*Advanced Statistical Computing and Applied Inference Systems*

References

- **T2. Casella & Berger – Statistical Inference**
- **T3. Kruschke – Doing Bayesian Data Analysis, Academic Press**
- **T4. Efron & Tibshirani – An Introduction to the Bootstrap, Chapman & Hall**

Web References

- **https://docs.aws.amazon.com/s3/**
- **https://cloud.google.com/storage/docs**
- **https://mc-stan.org/**
- **https://cloud.google.com/storage/docs**

Topics relevant to SKILL DEVELOPMENT:
This course prepares students for roles that demand rigorous statistical thinking, including data scientist, research analyst, and quant analyst positions. Through extensive hands-on work with real and simulated data, learners gain the ability to run inferential analysis, justify decisions with probabilistic reasoning, and communicate uncertainty in a business-relevant context. The course also emphasizes reproducibility, model critique, and cross-functional data storytelling using modern toolchains.

Course Code: CSSXXXX	Course Title: Predictive Systems Engineering for Structured Data 1Type of Course: PCC– Theory & Practical	L-T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSSXXXX					
Anti-requisites	NIL					
Course Description	This course focuses on the design, implementation, and evaluation of predictive models built specifically for structured/tabular data systems. Students will apply statistical and algorithmic modeling techniques to business, financial, and operational datasets with a strong focus on deployment-readiness, interpretability, and reliability. Core themes include supervised learning, feature selection, model validation, regularization, and practical ensemble methods.					
Course Objective	To train students to develop robust predictive systems for structured data using algorithmic modeling, with a focus on evaluation, interpretability, and real-world application.					
Course Outcomes	On successful completion of this course, the students shall be able to: Design and implement predictive models for structured datasets Apply preprocessing and feature engineering tailored to tabular formats Use ensemble and regularized models to improve generalization Perform rigorous validation and avoid model overfitting					
Course Content:						
Module 1:	Predictive Modeling Framework and Data Preparation	Quiz		Knowledge-based Quiz	9 Sessions	

Topics: Types of predictive problems (classification, regression), supervised learning pipeline, data cleaning, missing value imputation, outlier handling Tools: Python (pandas, sklearn, missingno), R (tidymodels, mice), OpenRefine for structured data QA Use Cases: Clean insurance application dataset with policy gaps Prepare a telecom customer dataset for churn prediction					
Module 2:	Feature Engineering and Selection	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Encoding schemes, interaction features, binning, scaling, variance-based filtering, recursive feature elimination, regularized feature selection Tools: Feature-engine, scikit-learn, Boruta, R's caret and recipes Use Cases: Create credit risk score variables from loan application historyEngineer interaction terms for regional sales + time features					
Module 3:	Algorithmic Modeling and Ensemble Techniques	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Decision trees, random forests, gradient boosting (XGBoost, LightGBM), regularized linear models (Ridge, Lasso), bagging, stacking Tools: scikit-learn, XGBoost, LightGBM, catboost, mlr3 Use Cases: Compare XGBoost and Ridge models on house price prediction Build and tune a fraud detection model with LightGBM					
Module 4:	Model Validation, Diagnostics, and Interpretability	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Train/test splits, cross-validation, ROC, AUC, confusion matrix, error metrics, SHAP, LIME, model audit frameworks Tools: SHAP, LIME, Yellowbrick, sklearn.metrics, DALEX (R) Use Cases: Use cross-validation to avoid leakage in a churn prediction pipeline Interpret model risk scores using SHAP in a credit underwriting tool					
Module 5:	Deployment, Maintenance, and Capstone	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Model persistence (Pickle, Joblib), versioning, retraining schedules, monitoring drift, performance tracking post-deployment Tools: MLflow, DVC, Evidently, BentoML, FastAPI Use Cases: Package and deploy a predictive model for small business credit approval Monitor model drift in a hospital readmission predictor					

Project work/Assignment: Students will develop a full predictive system for a real-world tabular dataset. They will preprocess the data, engineer features, build and validate multiple models, explain model behavior using SHAP or LIME, and prepare a deployable version with appropriate documentation. The system will be graded on accuracy, reliability, and interpretability.
Text Book T1. Co-branded Zell and Paytm Textbook for Predictive Systems Engineering for Structured Data
References T2. Gareth James et al. – An Introduction to Statistical Learning T3. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow T4. Max Kuhn – Feature Engineering and Selection, CRC Press
Web References https://scikit-learn.org/ https://hadoop.apache.org/ https://kafka.apache.org/ https://hive.apache.org/ https://databricks.com/ https://xgboost.readthedocs.io/
Topics relevant to SKILL DEVELOPMENT: This course develops core competencies in predictive modeling and machine learning for structured data systems. Students gain hands-on expertise in handling business datasets, applying feature transformations, building interpretable models, and preparing them for real-world deployment. These skills directly map to roles in applied data science, credit analytics, risk modeling, and operations forecasting, where structured data is central to strategic decisions.

Course Code: CSSXXXX	Course Title: Data Engineering Pipelines and Visual Analytics for Strategic Communication Type of Course: PCC– Theory & Practical	L-T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSSXXXX					
Anti-requisites	NIL					
Course Description	This course focuses on the design and execution of data pipelines and the development of meaningful visual analytics for communicating insights. It integrates practical aspects of data ingestion, transformation, storage structuring, and multi-level reporting. Students will explore scalable wrangling techniques, dashboarding frameworks, and visual storytelling best practices tailored for operations, management, and policy decisions.					
Course Objective	To train students in building automated, auditable data engineering workflows and converting them into domain-specific visual insights for operational or strategic communication.					

Course Outcomes	On successful completion of this course, the students shall be able to: Build structured, scalable data pipelines from raw sources Apply transformation and enrichment techniques for business readiness Create visual dashboards and analytics tailored for decision-makers Design data workflows for reproducibility and compliance				
Course Content:					
Module 1:	Data Acquisition and Workflow Orchestration	Quiz		Knowledge-based Quiz	9 Sessions
Topics: ETL and ELT, ingestion from APIs, flat files, databases; scheduling and dependency tracking; reproducibility and audit logs Tools: Apache Airflow, Prefect, Luigi, Pandas, Requests Use Cases: Build a pipeline to pull and process daily COVID-19 data Schedule ETL from CRM system to business warehouse					
Module 2:	Transformation, Structuring, and Validation	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Normalization, denormalization, schema mapping, data validation, pipeline testing, type casting, outlier handling, lookup table generation Tools: dbt (Data Build Tool), Great Expectations, SQLAlchemy, Pydantic Use Cases:					
Clean transaction records from a lending app Validate input types for pricing feeds in a marketplace					
Module 3:	Analytical Aggregations and Storage	Quiz		Knowledge-based Quiz	9 Sessions
Topics: OLAP vs OLTP structuring, window functions, cohort creation, timeseries aggregation, handling slowly changing dimensions (SCD) Tools: SQL (PostgreSQL, BigQuery), ClickHouse, DuckDB, Polars Use Cases: Create rolling weekly dashboards for user retention Build cohort retention summaries for a streaming service					
Module 4:	Visual Analytics and Executive Dashboards	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Graph types and use cases, user-focused design, interactivity, filtering, dashboard KPIs, color and typography for clarity Tools: Power BI, Tableau, Plotly Dash, Metabase, Streamlit Use Cases: Build a real-time dashboard for operations support in logistics Create investor-oriented visualizations for business KPIs					
Module 5:	Capstone – Reporting Pipelines for Business Impact	Quiz		Knowledge-based Quiz	9 Sessions

Topics: Visual storytelling, tailoring reports for stakeholders, automation of reporting cycles, error-handling in pipelines, documentation best practices Tools: Jupyter + nbconvert, Apache Superset, Google Data Studio, Notion for report delivery Use Cases: Automate weekly report on customer segmentation for a D2C brand Convert analytical notebooks into stylized, sharable insight reports
Project work/Assignment: Students will design a complete data reporting pipeline for a business or institutional use case. It must ingest raw or semi-structured data, apply transformations, load it into a queryable store, and present key insights through a structured dashboard or visual report. Deliverables include the data pipeline code, dashboard link or screenshots, and an insight memo for a specific stakeholder group.
Text Book T1. Co-branded Zell and Paytm Textbook for Data Engineering Pipelines and Visual Analytics for Strategic Communication
References T2. Noah Gift – Practical Data Engineering, Addison-Wesley T3. Cole Nussbaumer Knaflic – Storytelling with Data, Wiley T4. Valliappa Lakshmanan – Data Pipelines Pocket Reference, O'Reilly
Web References https://docs.getdbt.com/ https://pytorch.org/ https://keras.io/ https://huggingface.co/ https://paperswithcode.com/
Topics relevant to SKILL DEVELOPMENT: This course builds foundational skills in end-to-end data engineering and analytics reporting, focused on creating automated, trustworthy insight pipelines. Students gain experience working with real-world ETL tools, managing schema transformations, and structuring visual reports that drive action. These capabilities map directly to roles in data analytics engineering, business intelligence, and stakeholder-oriented reporting teams across sectors like finance, healthcare, and consumer technology.

Course Code: CSSXXXX	Course Title: Distributed Data Systems and High-Throughput Analytics Type of Course: PCC– Theory & Practical	L-T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSSXXXX					
Anti-requisites	NIL					

Course Description	This course covers the architecture and engineering of large-scale, distributed data systems used for real-time and batch analytics. Students will work with modern data processing engines, cloud-native storage layers, and columnar formats to design scalable data solutions. Emphasis is placed on speed, fault tolerance, partitioning, parallel execution, and the ability to serve multiple analytical workloads with guaranteed reliability and efficiency.				
Course Objective	To enable students to design, build, and optimize scalable data systems that support high-throughput analytics across distributed computing platforms.				
Course Outcomes	On successful completion of this course, the students shall be able to: Engineer distributed data pipelines using modern processing frameworks Choose appropriate storage and partitioning strategies for speed and scale Optimize query execution across large datasets Implement fault-tolerant real-time and batch pipelines				
Course Content:					
Module 1:	Distributed Storage and Processing Foundations	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Distributed file systems, data locality, partitioning strategies, columnar formats (Parquet/ORC), object storage (S3, GCS) Tools: HDFS, Amazon S3, Google Cloud Storage, Parquet, Avro, DuckDB Use Cases: Store and compress retail transaction data using Parquet Partition ride-sharing data by geohash for distributed querying					
Module 2:	Batch Processing at Scale	Quiz		Knowledge-based Quiz	9 Sessions
Topics: MapReduce patterns, DAG scheduling, data shuffling, join optimization, job retries and fault recovery Tools: Apache Spark, Databricks, Google Dataflow Use Cases: Perform distributed joins across product logs and user metadataRun hourly batch processing of video engagement metrics					
Module 3:	Real-Time and Stream Processing	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Stream ingestion, event time vs processing time, windowed aggregations, watermarking, stateful processing, at-least-once vs exactly-once guarantees Tools: Apache Kafka, Apache Flink, Spark Structured Streaming, Kafka Connect Use Cases: Ingest and process financial tick data in near real time Implement session-based windowing for online activity streams					
Module 4:	Query Engines and Analytical Interfaces	Quiz		Knowledge-based Quiz	9 Sessions

Topics: SQL-on-big-data, cost-based optimization, distributed joins, caching, federation, and lakehouse architecture Tools: Presto/Trino, BigQuery, Dremio, Starburst, Delta Lake Use Cases: Query JSON logs across multiple cloud buckets using Presto Join S3-based tables with JDBC sources using federated queries					
Module 5:	Capstone – Pipeline Design, Benchmarking, and Observability	Quiz		Knowledge-based Quiz	9 Sessions
Topics: Performance monitoring, data lineage, logging & metrics, job orchestration, alerting, scalability benchmarking Tools: Airflow, Prometheus + Grafana, Great Expectations, OpenLineage Use Cases: Benchmark pipeline throughput across storage tiers Set alerts for late data arrival or job failures					
Project work/Assignment: Students will design a production-ready analytics pipeline for a domain dataset (e.g., eCommerce, IoT telemetry, or digital banking). It should demonstrate scalable ingestion, transformation, storage, and query capability over large volumes. Deliverables include architecture diagrams, code artifacts, benchmark metrics, and a report documenting design decisions.					
Text Book T1. Co-branded Zell and Paytm Textbook for Distributed Data Systems and High-Throughput Analytics					
References T2. Jeff Carpenter – Fundamentals of Data Engineering, O'Reilly T3. Matei Zaharia et al. – Spark: The Definitive Guide T4. Holden Karau – High Performance Spark					
Web References https://flink.apache.org/ https://matplotlib.org/ https://public.tableau.com/ https://powerbi.microsoft.com/ https://towards data science.com/					
Topics relevant to SKILL DEVELOPMENT: This course develops the ability to build high-scale data systems for both real-time and batch analytics. Students learn to choose the right tools and storage formats, optimize workloads, and troubleshoot performance issues in distributed environments. These competencies directly support roles in data engineering, cloud analytics, and platform architecture for large-scale systems in industries like finance, healthcare, logistics, and consumer platforms.					

Course Code: CSS3502	Course Title: Multidimensional Data Modeling and Representation Learning Type of Course: PEC – Theory G Lab Integrated	L-T- P-C	2	0	2	3
Version No.	1.0					

Course Pre-requisites	CSSXXXX				
Anti-requisites	NIL				
Course Description	This course focuses on modeling and learning from high-dimensional, structured, and unstructured data using neural architectures and representation learning techniques. It includes architectural considerations for tabular, text, image, and mixed-format inputs. Topics cover feature embeddings, deep multilayer models, convolutional architectures, autoencoders, and embedding spaces for downstream tasks such as classification, ranking, and retrieval.				
Course Objective	To develop practical competence in designing and training deep models that extract useful representations from high-dimensional data for real-world predictive and descriptive tasks.				
Course Outcomes	Upon successful completion of the course, students will be able to: Model structured and unstructured data using neural networks Extract and interpret data representations using dimensionality-reduction and embeddings Design architectures suited for tabular, text, and visual input types Train, validate, and monitor deep models for generalization and stability				
Course Content:					
Module 1:	Deep Feedforward Models for Tabular and Mixed Data	Quiz		Knowledge based Quiz	9 Sessions
Topics: Multilayer perceptrons, hidden layer tuning, activation design, dropout, batch normalization, categorical embeddings Tools: PyTorch, TensorFlow/Keras, FastAI Tabular, Weights C Biases Use Cases: Learn feature interactions in a loan default prediction task Compare learned embeddings to one-hot encodings in retail datasets					
Module 2:	Representation Learning for Text and Sequences	Quiz		Comprehension based Quiz	9 Sessions
Topics: Word embeddings (Word2Vec, GloVe), sequence modeling with RNN/LSTM, attention, padding/masking strategies Tools: spaCy, HuggingFace Transformers, Gensim, TorchText Use Cases: Build customer review embeddings for sentiment clustering Use LSTM for event log sequence classification					
Module 3	Convolutional Architectures and Dimensionality Reduction	Assignment		Batch-wise Assignments	09 Sessions
Topics: CNNs for image/structured input, pooling, receptive fields, autoencoders, latent space compression, t-SNE, PCA, UMAP Tools OpenCV + PyTorch, TensorBoard, scikit-learn, UMAP-learn Use Cases: Train convolutional model on business document image classification Build autoencoder for anomaly detection in sensor data					
Module 4:	Model Tuning, Regularization, and Deployment	Assignment and Presentation		Batch-wise Assignment and Presentations	09 Sessions

Topics: Overfitting mitigation, early stopping, weight decay, model checkpointing, inference optimization Tools: Optuna, Keras Tuner, ONNX, TorchScript, Flask/Streamlit for deployment Use Cases: Deploy tabular deep learning model via lightweight API Auto-tune hyperparameters for churn prediction task				
Module 5:	Capstone – Representational Systems in Industry Contexts	Assignment and Presentation	Batch-wise Assignment and Presentation	9 Sessions
Topics: End-to-end modeling workflows on real data; explainability (SHAP for NN), domain-aligned representations, embedding visualization and export Tools: Captum, Lucid (feature visualization), Netron, TensorBoard Projector Use Cases: Build full pipeline for customer behavior modeling with embeddings Apply dimensionality reduction and cluster visualization for patient diagnosis data				
Project work/Assignment: Students will build an end-to-end modeling pipeline that learns data representations and uses them for a downstream task (classification, regression, anomaly detection, etc.). Deliverables include the trained model,				
visualization of learned representations, deployment-ready notebook, and a written summary of architecture design decisions.				
Text Book T1. Co-branded Zell and Paytm Textbook for Multidimensional Data Modeling and Representation Learning				
Reference T2. Ian Goodfellow et al. – Deep Learning, MIT Press T3. Sebastian Raschka – Machine Learning with PyTorch and Scikit-Learn T4. Francois Chollet – Deep Learning with Python Web References https://www.tensorflow.org/ https://umap-learn.readthedocs.io/en/latest/				
Topics relevant to SKILL DEVELOPMENT: This course prepares students to build neural architectures that learn from complex, multidimensional data. They gain practical exposure to tabular, textual, and visual modeling pipelines, and acquire skills in dimensionality reduction, embedding optimization, and deployment of trained models. These skills are directly applicable to roles in data science, AI product engineering, personalization systems, and anomaly detection in business or operational workflows.				

Course Code: CSS3502	Course Title: Operational Analytics and Computational Optimization Techniques? Type of Course: PEC – Theory G Lab Integrated	L-T- P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSSXXXX					
Anti-requisites	NIL					

Course Description	This course focuses on the application of optimization and decision-making frameworks in real-world operational contexts such as supply chain management, workforce scheduling, transportation, and finance. Students learn to formulate problems mathematically, implement computational optimization algorithms, and build analytics solutions that support strategic and tactical decisions under constraints.				
Course Objective	To train students to design and implement analytics-driven optimization models that enhance operational efficiency, resource utilization, and planning accuracy across industries.				
Course Outcomes	By the end of this course, students will be able to: Translate real-world constraints into solvable optimization models Apply mathematical programming to multi-variable operational problems Use solvers and simulation tools to derive and validate solutions Build reproducible analytics systems for logistics, planning, and scheduling				
Course Content:					
Module 1:	Computational Strategies for Linear and Integer Optimization	Quiz		Knowledge based Quiz	9 Sessions
Topics: Problem formulation, linear programming (LP), integer programming (IP), duality, feasibility, boundedness, sensitivity analysis Tools: PuLP, SciPy.optimize, Google OR-Tools, R's lpSolve Use Cases: Optimize vendor selection with capacity and cost constraints Allocate marketing budget across regions to maximize ROI					
Module 2:	Resource Allocation and Scheduling Models	Quiz		Comprehension based Quiz	09 Sessions
Topics: Knapsack, assignment, transportation, and job-shop scheduling problems; penalty costs, priorities, and time windows Tools: Gurobi, CPLEX, MiniZinc, Pyomo					
Use Cases: Schedule a delivery fleet for urban last-mile logistics Assign workers to shifts minimizing total overtime					
Module 3	Network and Flow Optimization	Assignment		Batch-wise Assignments	09 Sessions
Topics: Network flows, max-flow/min-cut, shortest path, multi-commodity flow, vehicle routing, bottleneck analysis Tools: NetworkX, Google OR-Tools Routing, Graph-too Use Cases: Route optimization for supply chain hubs Analyze flow saturation in telecom or energy networks					
Module 4:	Simulation and Metaheuristics	Assignment and Presentation		Batch-wise Assignment and Presentations	09 Sessions

Topics: Monte Carlo simulation, stochastic optimization, genetic algorithms, simulated annealing, tabu search, constraint relaxation Tools: SimPy, DEAP, Optuna, AnyLogic Use Cases: Run simulations to test various demand planning scenarios Apply evolutionary algorithms to product bundling problems				
Module 5:	Capstone – Real-World Decision Optimization	Assignment and Presentation	Batch-wise Assignment and Presentation	09 Sessions
Topics: Integrated optimization and analytics workflow, solution reporting, model validation, stakeholder alignment Tools: PowerBI/Tableau for impact dashboards, Python notebooks, Dash Use Cases: Capstone: Build an end-to-end solution to optimize operations in a mock airline, retailer, or hospital Integrate solver outputs into dashboard for decision-makers				
Project work/Assignment: Students will build an optimization system for a chosen operational domain (e.g., logistics, inventory, energy, workforce planning). The solution must include model formulation, computational implementation, scenariotesting, and stakeholder-friendly reporting. Deliverables include a coded model, validation outputs, and an executive presentation of impact.				
Text Book - T1. Co-branded Zell and Paytm Textbook for Operational Analytics and Computational Optimization Techniques				
Reference T2. Winston & Goldberg – Operations Research: Applications and Algorithms T3. Paul A. Jensen – Introduction to Optimization Techniques T4. Ravindra K. Ahuja – Network Flows: Theory, Algorithms, and Applications Web References https://www.gurobi.com/https://networkx.org/				
Topics relevant to SKILL DEVELOPMENT: This course prepares students for high-impact roles in operations research, supply chain analytics, logistics optimization, and quantitative strategy. Through end-to-end modeling and decision-support simulations, learners gain the ability to build scalable, interpretable optimization systems that respond to changing operational constraints. Students graduate with a portfolio-ready project and the technical proficiency to contribute to planning, resourcing, and performance optimization in complex business environments				