PRESIDENCY UNIVERSITY

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PROGRAMME REGULATIONS & CURRICULUM

2024-28

PRESIDENCY SCHOOL OF COMPUTER SCIENCE & ENGINEERING

BACHELOR OF TECHNOLOGY (B.TECH.)

COMPUTER SCIENCE AND ENGINEERING (INTERNET OF THINGS)

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

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REACH GREATER HEIGHTS

PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Program Regulations and Curriculum 2024-2028

BACHELOR OF TECHNOLOGY (B.Tech.) in

COMPUTER SCIENCE AND ENGINEERING (Internet of Things)

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

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

Regulations No.: PU/AC-24.05/SOCSE04/CIT/2024-2028

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

AUGUST -2024

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PART A – PROGRAM REGULATIONS

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

1.1 Vision of the University

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

1.2 Mission of the University

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

1.3 Vision of Presidency School of 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 Credit System (CBCS) with focus on Industrial Based Project Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

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

3. Short Title and Applicability

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

4. Definitions

In these Regulations, unless the context otherwise requires:

a. "Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;
b. "Academic Council" means the Academic Council of the University;
c. "Academic Regulations" means the Academic Regulations of the University;
d. "Academic Term" means a Semester or Summer Term;
e. "Act" means the Presidency University Act, 2013;
f. "AICTE" means All India Council for Technical Education;
g. "Basket" means a group of courses bundled together based on the nature/type of the course;
h. "BOE" means the Board of Examinations of the University;
i. "BOG" means the Board of Governors of the University;
j. "BOM" means the Board of Management of the University;
k. "BOS" means the Board of Studies of a particular Department/Program of Study of the University;
l. "CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;
m. "Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;
n. "COE" means the Controller of Examinations of the University;
o. "Course In Charge" means the teacher/faculty member responsible for developing and 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, 2024-2028;*

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

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

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

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

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

kk. *"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 2024-2028 are

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

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as B.Tech. Computer Science and Engineering;
2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as B.Tech. Computer Science and Technology (Big Data);
3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as B.Tech. Computer Science and Engineering (Block Chain);
4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as B.Tech. Computer Science and Technology (Dev Ops);
5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as B.Tech. Computer Science and Engineering (Cyber Security);
6. Bachelor of Technology in Computer Science and Engineering (Internet of Things), abbreviated as B.Tech. Computer Science and Engineering (Internet of Things);
7. Bachelor of Technology in Computer Science and Engineering (Data Science), abbreviated as B.Tech. Computer Science and Engineering (Data Science);
8. Bachelor of Technology in Computer Science and Technology (Artificial Intelligence and Machine Learning), abbreviated as B.Tech. Computer Science and Technology (Artificial Intelligence and Machine Learning);
9. Bachelor of Technology in Information Science and Technology, abbreviated as B.Tech. Information Science and Technology;
10. Bachelor of Technology in Computer Science and Information Technology, abbreviated as B.Tech. Computer Science and Information Technology;
11. Bachelor of Technology in Computer Science and Engineering (Networks), abbreviated as B.Tech. Computer Science and Engineering (Networks);
12. Bachelor of Technology in Computer Engineering (Artificial Intelligence and Machine Learning), abbreviated as B.Tech. Computer Engineering (Artificial Intelligence and Machine Learning);
13. Bachelor of Technology in Information Science and Engineering (Artificial Intelligence and Robotics), abbreviated as B.Tech. Information Science and Engineering (Artificial Intelligence and Robotics); and
14. Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) abbreviated as B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning);

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

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

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

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

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

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

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

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

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

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

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply

these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

8.2 Program Specific Outcomes (PSOs):

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

PSO 01: Problem Analysis: Identify and analyze complex engineering problems, particularly those related to IoT, computing, and programming. It stresses using fundamental principles from mathematics, natural sciences, and engineering to arrive at well-reasoned conclusions. The emphasis here is on developing problem-solving skills with a solid grounding in theoretical knowledge.

PSO 02: Design/Development of Solutions: Design effective solutions for complex problems. It emphasizes the application of IoT and programming knowledge to develop systems or processes that address real-world needs. The consideration of public health, safety, cultural, societal, and environmental factors is critical here, ensuring that solutions are sustainable and ethically responsible.

PSO 03: Modern Tool Usage: Utilize modern engineering and IT tools, especially those relevant to IoT, computing, and analytics. The focus is on selecting and applying appropriate techniques and resources for predicting and modelling complex systems. Understanding the limitations of these tools is also important, ensuring that engineers can assess the potential risks and challenges that come with using these technologies.

9 Admission Criteria (as per the concerned Statutory Body)

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

9.1 An applicant who has successfully completed Pre-University course or Senior Secondary School course (+2) or equivalent such as (11+1), 'A' level in Senior School Leaving Certificate Course from a recognized university of India or outside or from Senior Secondary Board or equivalent, constituted or recognized by the Union or by the State Government of that Country for the purpose of issue of qualifying certificate on successful completion of the course, may apply for and be admitted into the Program.

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

Reserved Category as classified by the Government of Karnataka) in these subjects taken together.

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

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

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

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

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

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

10 Lateral Entry / Transfer Students requirements

10.1 Lateral Entry

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

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

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

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

10.1.4 The Course requirements prescribed for the 1st Year of the B.Tech. Program shall be waived for the student(s) admitted through Lateral Entry and the duration of the B.Tech. Program for such students is three (03) years, commencing from the 3rd Semester (commencement of the 2nd Year) of the B.Tech. Program and

culminating with the 8th Semester (end of the 4th Year) of the B.Tech. Program.

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

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

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

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

For instance, if the *Minimum Credit Requirements* for the award of the Bachelor of Technology (B.Tech.) Degree as prescribed by the Regulations for B.Tech. (Computer Science and Engineering-Internet of Things) 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

Table 1: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	20	-	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	3-0-2-4	Percentage	12.50%	12.50 %	15%	10%	30%	20%	-	100 %	Mid-Term & End Term by CoE
		Marks	25	25	30	20	60	40	-	200	
8	2-0-0-2	Percentage	25 %	-	25%	-	50%	-	-	100 %	Mid-Term & End Term by CoE
		Marks	50	-	50	-	100	-	-	200	

*CSE3150-Front End Full stack development
CSE3151-Java Full Stack Development
CSE3152-.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 Clauses 12.6.1 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 Clause 13.3 (As per Academic Regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

13.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 13.3 (As per Academic Regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

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

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

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

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

13.3.7 A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original

Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall 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 Credits from SWAYAM-NPTEL/ other approved MOOC Courses

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

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

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

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**Error! Reference source not found.**), shall not be included in the calculation of the CGPA.

PART B – PROGRAM STRUCTURE

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

The B.Tech. (Computer Science and Engineering-Internet of Things) Program Structure (2024-2028) 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-Internet of Things) 2024-2028: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	Humanities and Social Sciences including Management Courses (HSMC)	10
2	Basic Science Courses (BSC)	19
3	Engineering Science Courses (ESC)	23
4	Professional Core Courses (PCC)	68
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Project Work (PRW)	16
8	Mandatory Courses (MAC)	0
	Total Credits	**160 (Minimum)**

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

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

S.No	Course Code	Course Name	L	T	P	C
1	ENG1002	Technical English	1	0	2	2
2	PPS1001	Introduction to soft skills	0	0	2	1
3	DES1146	Introduction to Design Thinking	1	0	0	1
4	ENG2001/FRLXXXX	Advanced English / Foreign Language courses	1	0	2	2
5	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1
6	MGTXXXX	Managerial Economics and Financial Analysis	3	0	0	3
		Total No. of Credits				**10**

Table 3.2 : List of Basic Science Courses (BSC)

S.No	Course Code	Course Name	L	T	P	C
1	MAT1001	Calculus and Linear Algebra	3	0	2	4
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3
3	MAT1003	Applied Statistics	2	0	0	2
4	MAT2501	Integral Transforms and Partial Differential Equations	3	0	0	3
5	MAT2605	Discrete Mathematics	4	0	0	4
6	MAT2602	Numerical Computations	3	0	0	3
		Total No. of Credits				**19**

Table 3.3 : List of Engineering Science Courses (ESC)						
S.No	Course Code	Course Name	L	T	P	C
1	MEC1006	Engineering Graphics	2	0	0	2
2	CSE1004	Problem Solving using C	1	0	4	3
3	ECE2007	Digital Design	2	0	2	3
4	CIV1008	Basic Engineering Sciences	2	0	0	2
5	CSE1006	Problem Solving using JAVA	1	0	4	3
6	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4
7	ECE2010	Innovative Projects Using Arduino	-	-	-	1
8	CSE1500	Computational Thinking using Python	2	0	2	3
9	CSE2510	Competitive Programming and Problem Solving	0	0	4	2
					Total No. of Credits	**23**

Table 3.4 : List of Professional Core Courses (PCC)						
S.No	Course Code	Course Name	L	T	P	C
1	CSE1508	Data Structures	3	0	0	3
2	CSE1504	Web Technologies	2	0	0	2
3	CSE1506	Data Communications and Computer Networks	3	0	0	3
4	CSE1509	Data Structures Lab	0	0	4	2
5	CSE1505	Web Technologies Lab	0	0	2	1
6	CSE1507	Data Communications and Computer Networks Lab	0	0	2	1
7	CSE1512	Analysis of Algorithms	3	1	0	4
8	CSE2502	Operating Systems	3	0	0	3
9	CSE2514	Operating Systems Lab	0	0	2	1
10	CSE1510	Database Management Systems	3	0	0	3
11	CSE2000	Software Design and Development	3	0	0	3
12	CSE1511	Database Management Systems Lab	0	0	2	1
13	CSE2503	Cryptography and Network Security	3	0	0	3
14	CSE2500	Theory of Computation	3	0	0	3
15	CSE1513	Analysis of Algorithms Lab	0	0	2	1
16	CSE1700	Essentials of AI	3	0	0	3
17	CIT2500	FOG Computing for IoT	3	0	0	3
18	CIT2501	Wireless Communication in IoT	3	0	0	3
19	CIT2502	Privacy and Security in IoT	3	0	0	3
20	CSE2504	Scalable Application Development using Java	3	0	0	3

21	CIT2400	Cyber-Physical systems	3	0	0	3
22	CSE2505	Scalable Application Development using Java Lab	0	0	4	2
23	CSE1701	Essentials of AI Lab	0	0	4	2
24	CSE2506	Cloud Computing	2	0	0	2
25	CIT2401	Blockchain for IoT	3	0	0	3
26	CIT2503	Mobile Application for IoT	3	0	0	3
27	CIT2504	AI and Deep Learning for IoT	3	0	0	3
28	CSE2507	Cloud Computing Lab	0	0	2	1
		Total No. of Credits				**68**

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

S.No	Course Code	Course Name	L	T	P	C
1	CSE7000	Internship				2
2	CSE7100	Mini Project				4
3	CSE7300	Capstone Project	-	-	-	10
		Total No. of Credits				**16**

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

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, are simply assigned the number of Credits based on the quantum of work / effort required to fulfill the learning objectives and outcomes prescribed for the concerned Courses. Such courses are referred to as Non-Teaching Credit Courses (NTCC). These Courses are designed to provide students with hands-on experience and skills essential for their professional development. These courses aim to equip students with abilities in problem identification, root cause analysis, problem-solving, innovation, and design thinking through industry exposure and project-based learning. The expected outcomes are first level proficiency in problem solving and design thinking skills to better equip B.Tech. graduates for their professional careers. The method of evaluation and grading for the Practical / Skill based Courses shall be prescribed and approved by the concerned Departmental Academic Committee (refer Annexure A of the Academic Regulations). The same shall be prescribed in the Course 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 18.4.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

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

Table 3.6 : Professional Electives Courses/Specialization Tracks – Minimum of 12 credits is to be earned by the student in a particular track and overall 18 credits.

Track 1- **Security and Industry Applications Basket**

S.No	Course Code	Course Name	L	T	P	C
1	CIT3410	Secure IoT	3	0	0	3
2	CIT3412	IoT for Healthcare and Wearable Technology	3	0	0	3
3	CIT3413	Industrial IoT (IIoT)	3	0	0	3
4	CIT3414	Energy-Efficient IoT Systems	3	0	0	3

Track 2 - **Networking and Infrastructure Basket**

S.No	Course Code	Course Name	L	T	P	C
1	CIT3400	Architecting Smart IoT Devices	3	0	0	3
2	CIT3401	Intelligent Sensors and Systems	3	0	0	3
3	CIT3402	IoT Architecture and Protocols	2	0	2	3
4	CIT3405	Edge and Fog Computing for IoT	3	0	0	3
5	CIT3406	Cloud Computing for IoT	3	0	0	3

Track 3 - **AI-Driven IoT Intelligence Basket**

S.No	Course Code	Course Name	L	T	P	C
1	CIT3411	Big Data Analytics for IoT	2	0	2	3
2	CIT3403	Embedded Systems for IoT	3	0	0	3
3	CIT3404	IoT System Design and Development	3	0	0	3
4	CIT3407	IoT Data Analytics and Machine Learning	3	0	0	3
5	CIT2504	AI and Deep Learning for IoT	3	0	0	3
6	CIT3408	Digital Twins and Simulation in IoT	3	0	0	3
7	CIT3409	Autonomous Systems and Robotics with IoT	3	0	0	3

Track 04-Artificial Intelligence and Machine Learning

1	CAI3400	Expert Systems	2	0	2	3
2	CAI3401	Explainable AI	2	0	2	3
3	CAI3402	Responsible AI	2	0	2	3
4	CAI3425	AI for energy consumption optimization	2	0	2	3
5	CAI3426	AI Chatbots without Programming	2	0	2	3
6	CAI3427	Language Models for Text Mining	2	0	2	3
7	CAI3428	Practical Deep Learning with Tensor Flow	2	0	2	3
8	CAI3429	Deep Learning for Computer Vision	2	0	2	3

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

Table 3.7: Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 6

Sl. No.	Course Code	Course Name	L	T	P	C	Type of Skill / Focus	Course Caters to	Prerequisites/ Corequisites	Antirequisites	Future Courses that need this as a Prerequisite	Course Category
Chemistry Basket												
1	CHE1003	Fundamentals of Sensors	3	0	0	3	SD	ES	-	-		OEC
2	CHE1004	Smart materials for IOT	3	0	0	3	SD	ES	-	-		OEC
3	CHE1006	Introduction to Nano technology	3	0	0	3	SD	ES	-	-		OEC
4	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	SD	ES	-	-		OEC
5	CHE1013	Chemistry for Engineers	3	0	0	3	SD	ES	-	-		OEC
6	CHE1014	Surface and Coatings technology	3	0	0	3	SD	ES	-	-		OEC
7	CHE1016	Forensic Science	3	0	0	3	SD	HP	-	-		OEC
Civil Engineering Basket												
1	CIV1001	Disaster mitigation and management	3	0	0	3	SD	ES / HP	-	-		OEC
2	CIV1002	Environmental Science and Disaster Management	3	0	0	3	FC	ES	-	-		OEC
3	CIV2001	Sustainablility Concepts in	3	0	0	3	SD	ES	-	-		OEC

		Engineering										
4	CIV2002	Occupational Health and Safety	3	0	0	3	SD		-	-		OEC
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	SD / EM	ES	-	-		OEC
6	CIV2004	Integrated Project Management	3	0	0	3	SD / EM / EN	HP / GS	-	-		OEC
7	CIV2005	Environmental Impact Assessment	3	0	0	3	EM / EN	ES	-	-		OEC
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EM / EN	ES	-	-		OEC
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3	SD / EM	ES	-	-		OEC
10	CIV2045	Environmental Meteorology	3	0	0	3	SD	ES	-	-		OEC
11	CIV3046	Project Problem Based Learning	3	0	0	3	SD	ES	-	-		OEC
12	CIV3059	Sustainability for Professional Practice	3	0	0	3	EN	ES	-	-		OEC
Commerce Basket												
1	COM2007	Basics of Accounting	3	0	0	3	FC	-	-	-		OEC
Computer Science Basket												
1	CSEXXXX	Problem Solving Using C	2	0	0	2						ESC
2	CSEXXXX	Problem Solving Using C Lab	0	0	2	1						ESC
3	CSExxxx	Problem Solving using JAVA	2	0	0	1	2					ESC
4	CSExxxx	Problem Solving	0	0	2	2	2					

		using JAVA Lab										
5	CSE2003	Social Network Analytics	3	0	0	3	SD	GS	-	-		OEC
6	CSE2005	Web design fundamentals	2	0	2	3	SD / EM / EN	-	-	-		OEC
7	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	0	0	3	SD / EM / EN	-	-	-		OEC
8	CSE3112	Privacy And Security In Online Social Media	3	0	0	3	SD / EM / EN	-	-	-		OEC
9	CSE3113	Computational Complexity	3	0	0	3	SD / EM / EN	-	-	-		OEC
10	CSE3114	Deep Learning for Computer Vision	3	0	0	3	SD / EM / EN	-	-	-		OEC
11	CSE3115	Learning Analytics Tools	3	0	0	3	SD / EM / EN	-	-	-		OEC
Design Basket												
1	DES2001	Design Thinking	3	0	0	3	SD		-	-		OEC
2	DES2080	Art of Design Language	3	0	0	3	SD		-	-		OEC
3	DES2081	Brand Building in Design	3	0	0	3	SD		-	-		OEC
4	DES2085	Web Design Techniques	3	0	0	3	SD		-	-		OEC
5	DES2089	3D Modeling for Professionals	1	0	4	3	SD		-	-		OEC
6	DES2090	Creative Thinking	3	0	0	3	SD		-	-		OEC

		for Professionals										
7	DES2091	Idea Formulation	3	0	0	3	SD		-	-		OEC
Electrical and Electronics Engineering Basket												
1	EEE1002	IoT based Smart Building Technology	3	0	0	3	SD	-	-	-		OEC
2	EEE1003	Basic Circuit Analysis	3	0	0	3	SD	-	-	-		OEC
3	EEE1004	Fundamentals of Industrial Automation	3	0	0	3	SD	-	-	-		OEC
4	EEE1005	Electric Vehicles & Battery technology	3	0	0	3	SD	-	-	-		OEC
5	EEE1006	Smart Sensors for Engineering Applications	3	0	0	3	SD	-	-	-		OEC
Electronics and Communication Engineering Basket												
1	ECE1003	Fundamentals of Electronics	3	0	0	3	FC	-	-	-		OEC
2	ECE1004	Microprocessor based systems	3	0	0	3	FC	-	-	-		OEC
3	ECE3089	Artificial Neural Networks	3	0	0	3	SD	-	-	-		OEC
4	ECE3097	Smart Electronics in Agriculture	3	0	0	3	FC / EM	-	-	-		OEC
5	ECE3098	Environment Monitoring Systems	3	0	0	3	FC / EM	-	-	-		OEC
6	ECE3102	Consumer Electronics	3	0	0	3	FC / EM	-	-	-		OEC
7	ECE3103	Product Design of Electronic Equipment	3	0	0	3	SD / FC / EM	-	-	-		OEC

							/ EN					
8	ECE3106	Introduction to Data Analytics	3	0	0	3	FC / EM	-	-	-		OEC
9	ECE3107	Machine Vision for Robotics	3	0	0	3	FC / EM	-	-	-		OEC
English Basket												
1	ENG1009	Reading Advertisement	3	0	0	3	SD		-	-		OEC
2	ENG1010	Verbal Aptitude for Placement	2	0	2	3	SD		-	-		OEC
3	ENG1011	English for Career Development	3	0	0	3	SD		-	-		OEC
4	ENG1013	Indian English Drama	3	0	0	3			-	-		OEC
5	ENG1014	Logic and Art of Negotiation	2	0	2	3						OEC
Kannada Basket												
1	KAN1003	Kannada Kaipidi	3	0	0	3	SD	-	-	-		OEC
2	KAN2005	Anuvadha Kala Sahithya	3	0	0	3	SD	-	-	-		OEC
3	KAN2006	Vichara Manthana	3	0	0	3	SD	-	-	-		OEC
4	KAN2007	Katha Sahithya Sampada	3	0	0	3	SD	-	-	-		OEC
5	KAN2008	Ranga Pradarshana Kala	3	0	0	3	SD	-	-	-		OEC
Foreign Language Basket												
1	FRL1009	Mandarin Chinese for Beginners	3	0	0	3	SD	-	-	-		OEC
Law Basket												
1	LAW2014	Introduction to Competition Law	3	0	0	3	FC	HP	-	-		OEC
2	LAW2015	Cyber Law	3	0	0	3	FC	HP	-	-		OEC

Mathematics Basket												
1	MAT2008	Mathematical Reasoning	3	0	0	3	SD	-	-			OEC
2	MAT2014	Advanced Business Mathematics	3	0	0	3	SD	-	-	-		OEC
3	MAT2041	Functions of Complex Variables	3	0	0	3	SD	-	-	-		OEC
4	MAT2042	Probability and Random Processes	3	0	0	3	SD	-	-	-		OEC
5	MAT2043	Elements of Number Theory	3	0	0	3	SD	-	-	-		OEC
6	MAT2044	Mathematical Modelling and Applications	3	0	0	3	SD	-	-	-		OEC
Mechanical Engineering Basket												
1	MEC1001	Fundamentals of Automobile Engineering	3	0	0	3	SD	-	-	-		OEC
2	MEC1002	Introduction to Matlab and Simulink	3	0	0	3	SD / EM	-	-	-		OEC
3	MEC1003	Engineering Drawing	1	0	4	3	SD	-	-	-		OEC
4	MEC2001	Renewable Energy Systems	3	0	0	3	FC	ES	-	-		OEC
5	MEC2002	Operations Research & Management	3	0	0	3	FC	-	-	-		OEC
6	MEC2003	Supply Chain Management	3	0	0	3	SD / EM / EN	-	-	-		OEC
7	MEC2004	Six Sigma for Professionals	3	0	0	3	SD / EM	-	MEC2008	-		OEC
8	MEC2005	Fundamentals of	3	0	0	3	FC	-	-	-		OEC

		Aerospace Engineering										
9	MEC2006	Safety Engineering	3	0	0	3	SD / EM	ES	-	-		OEC
10	MEC2007	Additive Manufacturing	3	0	0	3	FC / EM	-	-	-		OEC
11	MEC3069	Engineering Optimisation	3	0	0	3	SD / EM	-	-	-		OEC
12	MEC3070	Electronics Waste Management	3	0	0	3	FC / SD	ES	-	-		OEC
13	MEC3071	Hybrid Electric Vehicle Design	3	0	0	3	SD / EM	ES	-	-		OEC
14	MEC3072	Thermal Management of Electronic Appliances	3	0	0	3	SD / EM	-	-	-		OEC
15	MEC3200	Sustainable Technologies and Practices	3	0	0	3	SD / EM	-	-	-		OEC
16	MEC3201	Industry 4.0	3	0	0	3	SD / EM	-	-	-		OEC
Petroleum Engineering Basket												
1	PET1011	Energy Industry Dynamics	3	0	0	3	FC / SD / EM	ES	-	-	-	OEC
2	PET1012	Energy Sustainability Practices	3	0	0	3	FC / SD / EM	ES	-	-	-	OEC
Physics Basket												
1	PHY1003	Mechanics and Physics of Materials	3	0	0	3	FC / SD		-	-		OEC
2	PHY1004	Astronomy	3	0	0	3	FC		-	-		OEC
3	PHY1005	Game Physics	2	0	2	3	FC / SD		-	-		OEC
4	PHY1007	Physics of Nanomaterials	3	0	0	3	FC		-	-		OEC
5	PHY2004	Laser Physics	3	0	0	3	FC	ES	-	-		OEC

6	PHY2005	Science and Technology of Energy	3	0	0	3	FC	ES	-	-		OEC
Management Basket												
1	MGT1001	Introduction to Psychology	3	0	0	3	FC	HP	-	-		OEC
2	MGT1002	Business Intelligence	3	0	0	3	EN		-	-		OEC
3	MGT1003	NGO Management	3	0	0	3	SD		-	-		OEC
4	MGT1004	Essentials of Leadership	3	0	0	3	EM / EN	GS / HP	-	-		OEC
5	MGT1005	Cross Cultural Communication	3	0	0	3	SD / EM / EN	HP	-	-		OEC
6	MGT2001	Business Analytics	3	0	0	3	SD / EM / EN		-	-		OEC
7	MGT2002	Organizational Behaviour	3	0	0	3	FC	HP	-	-		OEC
8	MGT2003	Competitive Intelligence	3	0	0	3	SD	-	-	-		OEC
9	MGT2004	Development of Enterprises	3	0	0	3	SD / EM / EN		-	-		OEC
10	MGT2005	Economics and Cost Estimation	3	0	0	3	SD / EM		-	-		OEC
11	MGT2006	Decision Making Under Uncertainty	3	0	0	3	SD		-	-		OEC
12	MGT2008	Econometrics for Managers	3	0	0	3	SD		-	-		OEC
13	MGT2009	Management Consulting	3	0	0	3	SD / EM / EN		-	-		OEC
14	MGT2010	Managing People and Performance	3	0	0	3	SD / EM / EN	HP / GS	-	-		OEC

15	MGT2011	Personal Finance	3	0	0	3	FC		-	-		OEC
16	MGT2012	E Business for Management	3	0	0	3	SD / EM		-	-		OEC
17	MGT2013	Project Management	3	0	0	3	EN / EM	GS / HP / ES	-	-		OEC
18	MGT2014	Project Finance	3	0	0	3	EN / EM	HP	-	-		OEC
19	MGT2015	Engineering Economics	3	0	0	3	SD		-	-		OEC
20	MGT2016	Business of Entertainment	3	0	0	3	EM / EN		-	-		OEC
21	MGT2017	Principles of Management	3	0	0	3	SD / EM / EN		-	-		OEC
22	MGT2018	Professional and Business Ethics	3	0	0	3	SD / EM / EN	HP	-	-		OEC
23	MGT2019	Sales Techniques	3	0	0	3	SD / EM / EN	HP	-	-		OEC
24	MGT2020	Marketing for Engineers	3	0	0	3	SD / EM / EN	HP				OEC
25	MGT2021	Finance for Engineers	3	0	0	3	SD / EM / EN	HP				OEC
26	MGT2022	Customer Relationship Management	3	0	0	3	SD / EM / EN	HP				OEC
27	MGT2023	People Management	3	0	0	3	SD / EM / EN	HP				OEC
Media Studies Basket												
1	BAJ3051	Digital Photography	2	0	2	3	EM	HP				OEC

21. List of MOOC (NPTEL) Courses for Computer Science and Information Technology of 12 weeks

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

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

First Year Cycle 1

Semester I (Physics Cycle)										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	BSC	FC	
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	BSC	FC	
3	MEC1006	Engineering Graphics	2	0	**0**	2	2	ESC	SD	
4	ENG1002	Technical English	1	0	2	2	3	HSMC	SD	
5	PPS1001	Introduction to soft skills	0	0	2	1	2	HSMC	SD	HP
6	CSE1004	Problem Solving using C	1	0	4	3	5	ESC	SD	
7	ECE2007	Digital Design	2	0	2	3	4	ESC	FC/SD	ES
8	DES1146	Introduction to Design Thinking	1	0	0	1	1	HSMC	FC	HP
TOTAL			**12**	**00**	**14**	**19**	**26**			

MAC = Major Course, MIC = Minor Course, MDC = Multidisciplinary Course, AEC = Ability Enhancement Course, SEC = Skill Enhancement Course, VAC = Value Added Course, SI = Summer Internship, RP = Research Project / Dissertation

FC = Foundation Course, SD = Skill Development, EM = Employability, EN = Entrepreneurship

GS = Gender Sensitization, ES = Environment and Sustainability, HP = Human Values and Professional Ethics

Semester I (Basic Engineering Science Cycle)										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	MAT1003	Applied Statistics	2	0	0	2	2	BS	EM	
2	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4	5	ES	FC	
3	ENG1002	Technical English	1	0	2	2	3	HS	SD	
4	PPS1001	Introduction to soft skills	0	0	2	1	2	HS	SD	H
5	CSE1004	Problem Solving Using C	1	0	4	3	5	ES	SD	
6	CIV1008	Basic Engineering Sciences	2	0	0	2	2	ES	SD	
7	CHE1018	Environmental Science	1	0	2	0	3	MC	FC	ES
8	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	0	1	MC	FC	HP
TOTAL			**11**	**00**	**12**	**14**	**23**			

First Year Cycle 2

Semester II (Basic Engineering Cycle)										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	MAT1003	Applied Statistics	2	0	0	2	2	BSC	EM	
2	CHE1018	Environmental Science	1	0	2	0	3	MAC	FC	ES
3	CIV1008	Basic Engineering Sciences	2	0	0	2	2	ESC	SD	
4	CSE1006	Problem Solving using JAVA	1	0	4	3	5	ESC	SD	
5	ENG2001/FRLXXXX	Advanced English / Foreign Language courses	1	0	2	2	3	HSMC	SD	
6	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1	2	HSMC	SD/EM	HP
7	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4	5	ESC	FC	
8	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	0	1	MAC	FC	HP
9	ECE2010	Innovative Projects Using Arduino	-	-	-	1	0	ESC	SD	
		TOTAL	**11**	**00**	**12**	**15**	**23**			

Semester II (Physics Cycle)										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	BS	FC	
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	BS	FC	
3	MEC1006	Engineering Graphics	2	0	0	2	2	ES	SD	
4	CSE1006	Problem Solving using JAVA	1	0	4	3	5	ES	SD	
5	ENG2001 / FRLXXXX	Advanced English / Foreign Language courses	1	0	2	2	3	HS	SD	
6	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1	2	HS	SD/EM	HP
7	DES1146	Introduction to Design Thinking	1	0	0	1	1	HS	FC/SD	ES
8	ECE2007	Digital Design	2	0	2	3	4	ES	FC	HP
9	ECE2010	Innovative Projects Using Arduino	-	-	-	1	0	ES	SD	
		TOTAL	**12**	**00**	**14**	**20**	**26**			

Semester III										
Sl. No.	Course Code	Course Name	Credit Structure				Contact Hours	Type of Course	Type of Skills	Course Addresses To
			L	T	P	C				
1	MAT2501	Integral Transforms and Partial Differential Equations	3	0	0	3	3	BSC	SD	
2	CSE1508	Data Structures	3	0	0	3	3	PCC	SD	
3	CSE1504	Web Technologies	2	0	0	2	2	PCC	SD	
4	CSE1506	Data Communications and Computer Networks	3	0	0	3	3	PCC	SD	
5	MAT2605	Discrete Mathematics	4	0	0	4	4	BSC	SD	
6	CSE1500	Computational Thinking using Python	2	0	2	3	4	ESC	EM	
7	MGTXXXX	Managerial Economics and Financial Analysis	3	0	0	3	3	HSMC	SD/EM/EN	
8	CSE1509	Data Structures Lab	0	0	4	2	4	PCC	SD	
9	CSE1505	Web Technologies Lab	0	0	2	1	2	PCC	SD	
10	CSE1507	Data Communications and Computer Networks Lab	0	0	2	1	2	PCC		
		TOTAL	**20**	**0**	**10**	**25**	**30**			

Semester IV										
Sl. No.	Course Code	Course Name	Credit Structure				Contact Hours	Type of Course	Type of Skills	Course Addresses To
			L	T	P	C				
1	MAT2602	Numerical Computations	3	0	0	3	3	BSC	SD	
2	CSE1512	Analysis of Algorithms	3	1	0	4	4	PCC	SD	
3	CSE2502	Operating Systems	3	0	0	3	3	PCC	SD	
4	CSE2514	Operating Systems Lab	0	0	2	1	2	PCC	SD	
5	CSE1510	Database Management Systems	3	0	0	3	3	PCC	SD	
6	CSE2000	Software Design and Development	3	0	0	3	3	PCC	SD	
7	CSE1511	Database Management Systems Lab	0	0	2	1	2	PCC	SD	
8	CSE2503	Cryptography and Network Security	3	0	0	3	3	PCC	SD	
9	CSE2500	Theory of Computation	3	0	0	3	3	PCC	SD	
10	CSE1513	Analysis of Algorithms Lab	0	0	2	1	2	PCC	SD	
		TOTAL	**21**	**1**	**04**	**25**	**28**			

Semester V										
Sl. No	Course Code	Course Name	Credit Structure				Contact	Type of Course	Type of	Course Address
			L	T	P	C				

.							Hours		Skills	es To
1	CSE1700	Essentials of AI	3	0	0	3	3	PCC	SD	
2	CIT2500	FOG Computing for IoT	3	0	0	3	3	PCC	SD	
3	CIT2501	Wireless Communication in IoT	3	0	0	3	3	PCC	SD	
4	CIT2502	Privacy and Security in IoT	3	0	0	3	3	PCC	SD	
5	CSE2504	Scalable Application Development using Java	3	0	0	3	3	PCC	SD	
6	CITXXXX	Professional Elective – I	3	0	0	3	3	PEC	SD	
7	CIT2400	Cyber-Physical systems	3	0	0	3	3	PCC	SD	
8	CSE7000	Internship	-	-	-	2	0	PRW	SD/EM	
9	CSE2505	Scalable Application Development using Java Lab	0	0	4	2	4	PCC	SD	
10	CSE1701	Essentials of AI Lab	0	0	4	2	4	PCC	SD/EM	
		TOTAL	**21**	**0**	**10**	**27**	**29**			

Semester VI										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	CSE2506	Cloud Computing	2	0	0	2	2	PCC	SD	
2	CIT2401	Blockchain for IoT	3	0	0	3	2	PCC	SD	
3	CIT2503	Mobile Application for IoT	3	0	0	3	3	PCC	SD	
4	CIT2504	AI and Deep Learning for IoT	3	0	0	3	3	PCC	SD	
5	CITXXXX	Professional Elective – II	3	0	0	3	3	PEC	SD/EM	
6	CITXXXX	Professional Elective – III	3	0	0	3	3	PEC	SD/EM	
7	PPSXXXX	Industry Preparedness Program	2	0	0	0	2	MAC	SD/EM /EN	
8	XXXXXXX	Open Elective – II	3	0	0	3	3	OEC	SD/EM	
9	CSE2507	Cloud Computing Lab	0	0	2	1	2	PCC	SD	
10	CSE2510	Competitive Programming and Problem Solving	0	0	4	2	2	ESC	SD	
		TOTAL	**19**	**0**	**12**	**23**	**29**			

Semester VII										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	CITXXXX	Professional Elective – IV	3	0	0	3	3	PEC		

2	CITXXXX	Professional Elective – V	3	0	0	3	3	PEC		
3	CITXXXX	Professional Elective – VI	3	0	0	3	3	PEC		
4	XXXXXXX	Open Elective – II	3	0	0	3	3	OEC		
5	CSE7100	Mini Project				4	0	PRW		
		TOTAL	**12**	**0**	**0**	**16**	**12**			

Semester VIII										
Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**	**Type of Skills**	**Course Addresses To**
			L	**T**	**P**	**C**				
1	CSE7300	Capstone Project	-	-	-	10	0	PRW		
		TOTAL	**12**	**0**	**0**	**16**	**12**			

23. Course Catalogue

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

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

Course Code: MAT1001	**Course Title: Calculus and Linear Algebra** **Type of Course: Basic Sciences Theory**	**L-T- P-C**	**3**	**0**	**2**	**4**
Version No.	3.0					
Course Pre-requisites	Basic Concepts of Limits, Differentiation, Integration					
Anti-requisites	**NIL**					
Course Description	The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software.					
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations. 5) Demonstrate the use of MATLAB software to deal with a variety of mathematical problems.					
Course Content:						
Module 1	**Linear Algebra**				**10 Sessions**	
Review: Types of matrices, elementary transformations, rank of a matrix, normal form, Solution of systems of linear equations: (Homogenous and non-homogenous system) AX = O and AX = B using rank method. **Linear Algebra:** Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.						
Module 2	**Partial Derivatives**				**10 Sessions**	

Review: Differential calculus with single variable.

Partial Derivatives:
Homogeneous functions and Euler's theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor's series for functions of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.
Engineering Applications of partial derivatives.

Module 3	**Advanced Integral calculus**			**12 Sessions**

Review: Integral calculus for single integrals.

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

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

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

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

List of Laboratory Tasks:

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

Targeted Application & Tools that can be used:

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

Tools Used: MatLab, Zylink.

Assignment:

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

Text Book

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

References:

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

E-resources/ Web links:

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

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

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

Course Code: PHY1002	**Course Title: Optoelectronics and Device Physics** **Type of Course: Engineering Sciences** **Theory**		**L-T-P-C**	**2-0-2-3**
Version No.	1.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking, experimental and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: **An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.**			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the concepts of semiconductors, magnetic materials and superconductors. CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices. CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers. CO4: Explain the applications of lasers and optical fibers in various technological fields. CO5: Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. **[Lab oriented].**			
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Optoelectronics and device physics "and attain **Skill Development** through **Experiential Learning** techniques			
Course Content:				
Module 1	**Fundamentals of Materials.**	Assignment	Plotting of magnetization (M) v/s Magnetic field (H) for diamagnetic, paramagnetic and ferromagnetic materials using excel/ origin software.	**7 Sessions**

Topics: Concept of energy bands, charge carriers, carrier concentration, concept of Fermi level, Hall effect, Magnetic materials, Superconductors:

Module 2	**Advanced Devices and applications**	Assignment	Data collection on efficiency of solar cells.	**8 Sessions**

Topics: p-n junctions, Zener diode, transistor characteristics, Optoelectronic devices:, Solar cells, I-V characteristics, and LEDs

Module 3	**Quantum concepts and Applications**	Term paper	Seminar on quantum computers.	**8 Sessions**

Topics: Planck's quantum theory, applications of Quantum theory: de-Broglie hypothesis, matter waves, properties. de-Broglie wavelength associated with an electron. Heisenberg's uncertainty principle. Schrodinger time independent wave equation. Particle in a box

Module 4	**Lasers and Optical fibers**	Term paper	Case study on medical applications of Lasers.	**7 Sessions**

Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling.

Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy.

List of Laboratory Tasks:

Experiment No. 1: Experimental errors and uncertainty using excel

Level 1: Calculation of accuracy and precision of a given data

Level 2: propagation of errors in addition, subtraction, multiplication and division.

Experiment N0 2: To determine the wavelength of semiconductor diode Laser and to estimate the particle size of lycopodium powder using diffraction.

Level 1: Determination of Wavelength of Laser

Level 2: Finding the particle size of lycopodium powder.

Experiment No. 3: To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier.

Level 1: To determine the proportionality of Hall Voltage and magnetic flux density

Level 2: To determine the polarity of Charge carrier.

Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions.

Level 1: To study I –V characteristics of the given Zener diode in reverse bias and to determine break down voltage.

Level 2: To study I –V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance.

Experiment No. 5: To study input and output characteristics of a given Transistor.

Level 1: To determine the input resistance of a given transistor.
Level 2: To determine current transfer characteristics and transistor parameters of a given transistor.

Experiment No. 6: Determination of Fermi energy and Fermi temperature of a given metal and bimetallic wire.

Level 1: Determination of Fermi energy and Fermi temperature of given metal wire.

Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire.

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

Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.
Level 2: To measure the photo-current as a function of the irradiance at constant voltage.

Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance.
Level 1: To study the I-V characteristics
Level 2: I-R characteristics of a solar cell as a function of the irradiance.

Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. .
Level 1: Calculate the numerical aperture.
Level 2: study the losses that occur in optical fiber cable.

Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method.
Level 1: To determine the magnetic susceptibility of a given diamagnetic substance.
Level 2: To determine the magnetic susceptibility of a given paramagnetic substance.

Experiment No. 11: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage.
Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs
Level 2: Determination of knee voltage.

Experiment No. 12: Determination of Stefan's constant and verification of Stefan-Boltzmann Law.
Level 1: Determination of Stefan's constant
Level 2: Verification of Stefan-Boltzmann Law.

Targeted Application & Tools that can be used:

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

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

Assessment Type

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

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

Text Book

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

References:

1. Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002.

2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011.

3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017.

4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012.

5. Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019

E-Resourses:

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

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

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

Course Code: MEC1006	**Course Title: Engineering Graphics Type of Course: Engineering Science & 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: **(1)** Demonstrate competency of Engineering Graphics as per BIS conventionsand standards. **(2)** Comprehend the theory of projection for drawing projections of Points, Lines andPlanes under different conditions. **(3)** Prepare multiview orthographic projections of Solids by visualizing them indifferent positions. **(4)** Prepare pictorial drawings using the principles of isometric projections to visualizeobjects in three dimensions.					
Course Content:						
Module 1	**Introduction to Drawing**	**Assignment**	**Standard technical drawing**		**02 Sessions**	
Topics: Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Lineconventions, 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**		**10 Sessions**	
Topics: Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points inall 4 quadrants. Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only. [10 Hours: Application Level]						
Module 3	**Orthographic Projections of Solids**	**Assignment**	**Multi-view drawing Analysis**		**10 Sessions**	

Topics: Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron 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:** **1. K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.** **2. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.** **3. D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill.** **Web resources:** **https://nptel.ac.in/courses/112103019**				
Topics relevant to "SKILL DEVELOPMENT": Projection in first and third angle for **SKILL DEVELOPMENT** through **Problem Solving methodologies**. This is attained through the assessment component mentioned in the course handout.				

Course Code: ENG1002	**Course Title: Technical English** **Type of Course: Humanities Science / Theory**	**L-T-P-C**	1-0-2-2
Version No.	1.0 V. 3		
Course Pre-requisites	Intermediate Level English		
Course Anti-requisites	NIL		
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.		
Course Objectives	The objective of this course is to develop the learners' **EMPLOYABILITY SKILLS** by using **EXPERIENTIAL LEARNING** and **PARTICIPATIVE LEARNING TECHNIQUES.**		

Course Outcomes	**On successful completion of the course, the students shall be able to:** 1. Develop proficiency in using technical vocabulary and terminology. 2. Apply language skills for better speaking skills in technical fields. 3. Write technical descriptions 4. Demonstrate writing skills in writing technical documents such as reports, manuals, and articles.			
Course Content:				
Module 1	**Fundamentals of Technical Communication**	**Worksheets& Quiz**	**Vocabulary building**	**Classes**
Introduction to Technical English Differences between Technical English and General English Technical Writing Basics Technical Vocabulary				
Module 2	**Technical Presentation**	**Presentations**	**Speaking Skills**	**2 Classes**
Introduction Planning the Presentation Creating the Presentation Giving the Presentation				
Module 3	**Technical Description**	**Assignment**	**Group Presentation**	**2 Classes**
Product Description Process Description User Manuals Transcoding: Diagrams, charts and images				
Module 4	**Technical Writing**	**Assignment**	**Writing Skills**	**2 Classes**
Email Writing Persuasive and Descriptive Language Professional Email Etiquette Writing clear and concise technical emails Communicating technical information effectively Technical Report Writing Types of technical reports (Lab reports, research reports, etc.) Components of technical reports Writing an abstract and executive summary Structure and content organization Transcoding: diagrams, charts and images				
List of Laboratory Tasks: 1. Module-1 Level 1: Worksheets Level 2: Worksheets 2. Module 2 Level 1: Preparing Presentation				

Level 2: Giving Presentation (Individual)
3. Module-3
Level 1: Product Description & User Manual
Level 2: Process Description & Transcoding
4. Module 4
Level 1: Email Writing
Level 2: Report Writing

Targeted Applications & Tools that can be used:

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

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

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

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

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

Text Books

1. Kumar, Sanjay; Pushpalatha. *English Language and Communication Skills for Engineers.* Oxford University Press. 2018.

2. Brieger, Nick and Alison Paul. *Technical English Vocabulary and Grammar*. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf

Reference Book:

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

Web Resources:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307.
2. https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdcb8f4a5%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih
3. Last,Suzan, et. al. ***Technical Writing Essentials.*** University of Victoria, British Columbia, 2019 (E- Book)
4. Wambui, Tabita Wangare, et al. ***Communication Skills- Volume 1,*** LAP LAMBRET, USA, 2012 (E Book)

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

<table>
<tr><td>Course Code:
PPS 1001</td><td colspan="3">Course Title: Introduction to Soft Skills
Type of Course: Practical Only Course</td><td>L- T-P-C</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="7">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">Students are expected to understand Basic English.
Students should have desire and enthusiasm to involve, participate and learn.</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.</td></tr>
<tr><td>Course Objective</td><td colspan="7">The objective of the course is to familiarize the learners with the concepts of “Soft Skills” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="7">On successful completion of this course the students shall be able to:
CO1: Recognize significance of soft skills
CO2: Illustrate effective communication while introducing oneself and others

CO3: List techniques of forming healthy habits
CO4: Apply SMART technique to achieve goals and increase productivity</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td colspan="2">INTRODUCTION TO SOFT SKILLS</td><td colspan="3">Classroom activity</td><td colspan="2">04 Hours</td></tr>
<tr><td colspan="8">Topics: Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality</td></tr>
<tr><td>Module 2</td><td colspan="2">EFFECTIVE COMMUNICATION</td><td colspan="3">Individual Assessment</td><td colspan="2">10 Hours</td></tr>
<tr><td colspan="8">Topics: Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email- writing, Resume Building- Digital, Video, Traditional.</td></tr>
<tr><td>Module 3</td><td colspan="2">HABIT FORMATION</td><td colspan="3">Worksheets & Assignment</td><td colspan="2">4 Hours</td></tr>
<tr><td colspan="8">Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right</td></tr>
<tr><td>Module 4</td><td colspan="2">Goal setting & Time Management</td><td colspan="3">Goal sheet</td><td colspan="2">8 Hours</td></tr>
<tr><td colspan="8">A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity</td></tr>
<tr><td colspan="8">Targeted Application & Tools that can be used: LMS</td></tr>
<tr><td colspan="8">Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</td></tr>
</table>

1) Individual Assessment 2) LMS MCQ
The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE1004	**Course Title: Problem Solving Using C** **Type of Course:** **School CoreLab** **Integrated.**		**L- T-P-C**	1	0	4	3
Version No.	1.0						
Course Pre-requisites	**NIL**						
Anti-requisites	**NIL**						
Course Description	The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs and applications in C. ACAlso by learning the basic programming constructs they can easily switch over to any other language in future.						
Course Object	The objective of the course is to familiarize the learners with the concepts of Problem SolvingUsing C and attain Employability through Problem Solving Methodologies.						
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Write algorithms and to draw flowcharts for solving problems 2. Demonstrate knowledge and develop simple applications in C programmingconstructs 3. Develop and implement applications using arrays and strings 4. Decompose a problem into functions and develop modular reusable code 5. Solve applications in C using structures and Union 6. Design applications using Sequential and Random Access File Processing.						
Course Content:							
Module 1	Introduction to C Language	Quiz	Problem Solving	**9 Hrs.**			
Topics: Introduction to Programming – Algorithms – Pseudo Code - Flow Chart – Compilation – Execution – Preprocessor Directives (#define, #include, #undef) - Overview of C – Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making and Looping.							
Module 2	Introduction to Arrays and Strings	Quiz	Problem Solving	**9 Hrs.**			
Topics: **Arrays:** Introduction – One Dimensional Array – Initialization of One Dimensional Arrays – Example Programs – Sorting (Bubble Sort, Selection Sort) – Searching (Linear Search) - Two Dimensional Arrays – Initialization of Two Dimensional Arrays. Example Programs – Matrix operations. **Strings:** Introduction – Declaring and Initializing String Variables – Reading Strings from Terminal – Writing String to Screen – String Handling Functions.							
Module 3	Functions and Pointers	Quiz	Problem Solving	**9 Hrs.**			
Topics: **Functions:** Introduction – Need for User-defined functions – Elements of User-Defined Functions: declaration, definition and function call–Categories of Functions – Recursion. **Pointers:** Introduction – Declaring Pointer Variables – Initialization of Variables – Pointer Operators – Pointer Arithmetic – Arrays and Pointers – Parameter Passing: Pass by Value, Pass by Reference.							
Module 4	Structures and Union	Quiz	Problem Solving	**9 Hrs.**			

Topics: **Structures:** Introduction – Defining a Structure – Declaring Structure Variable – Accessing Structure Members – Array of Structures – Arrays within Structures – **Union:** Introduction – Defining and Declaring Union – Difference Between Union and Structure.				
Module 5	File handling	Case Study	Problem Solving	**9 Hrs.**
Topics: Files: Defining and Opening a File – Closing a File – Input / Output Operations on File – Random Access Files				
List of Practical **Tasks Lab Sheet** **1 (Module I)** Programs using IO Statements, Conditional Statements and Looping Statements **Lab Sheet 2 (Module II)** **Programs using Arrays and Strings** **Lab Sheet 3 (Module III)** **Programs using Functions and Pointers** **Lab Sheet 4 (Module IV)** **Programs using Structures and Unions** **Lab Sheet 5 (Module V)** **Programs using Files**				
Text Book(s): **1. E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316- 513-0.**				
Reference Book(s): **1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.** **2. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.** **3. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015** **4. Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014.** **5. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.**				
Web Links and Video Lectures: **1. https://nptel.ac.in/courses/106/105/106105171/** **2. https://archive.nptel.ac.in/courses/106/104/106104128/**				

Course Code: ECE2007	**Course Title: Digital Design Type of Course: Theory &Integrated Laboratory**	**L- T-P- C**	**2**	**0**	**2**	**3**
Version No.	2.0					
Course Pre-requisites	**[1] Elements of Electronics/Electrical Engineering, 2] Basic concepts of number representation, Boolean Algebra**					
Anti-requisites	**NIL**					

<table>
<tr><td>Course Description</td><td colspan="4">The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. The course emphasizes on minimization techniques for making canonical and low-cost digital circuit implementations. This course deals with analysis and design of digital electronic circuits. The course also creates a foundation for future courses which includes Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc.
The course enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.</td></tr>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
i. Describe the concepts of number systems, Boolean algebra and logic gates.
ii. Apply minimization techniques to simplify Boolean expressions.
iii. Demonstrate the Combinational circuits for a given logic
iv. Demonstrate the Sequential and programmable logic circuits
v. Implement various combinational and sequential logic circuits using gates.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Number systems- Boolean algebra and digital logic</td><td>Application Assignment</td><td>Data Analysis task</td><td>06 classes</td></tr>
<tr><td colspan="5">Topics:
Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don’t care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations. Introduction to HDL.</td></tr>
<tr><td>Module 2</td><td>Boolean function simplification</td><td>Application Assignment</td><td>Data Analysis task</td><td>08 Classes</td></tr>
<tr><td colspan="5">Topics:
Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders, HDL Models of combinational circuits.</td></tr>
<tr><td>Module 3</td><td>Combinational Logic circuits:</td><td>Application Assignment</td><td>Programming Task & Data Analysis task</td><td>08 Classes</td></tr>
<tr><td colspan="5">Topics:
Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters. HDL Models of Sequential circuits.</td></tr>
<tr><td colspan="5">List of Laboratory Tasks:
Experiment N0 1: Verify the Logic Gates truth table</td></tr>
</table>

Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

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

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

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

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

Experiment No. 6: Study of Flip flops

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

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

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

Targeted Application & Tools that can be used:

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

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

Text Book(s):

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

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

Reference(s):
Reference Book(s):

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

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

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

1. **eBook1**: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education.
2. {[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download

}

3. **eBook2:**Floyd "DIGITAL LOGIC DESIGN" fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.
4. NPTEL Course- NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits
5. Digital Logic Design PPT Slide 1 (iare.ac.in)
6. Lab Tutorial: Multisim Tutorial for Digital Circuits - Bing video

CircuitVerse - Digital Circuit Simulator online

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

Digital Design 5: LOGISIM Tutorial & Demo

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

E-content:

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

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

<table>
<tr><td>Course Code:
DES1146</td><td colspan="2">Course Title:
Introduction to Design Thinking
Type of Course:
Theory</td><td>L-T-P- C</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="7">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">The course aims to introduce students to the fundamental principles and processes of Design Thinking and will learn to apply Design Thinking methodologies to real-world challenges. The course emphasizes empathy, creativity, and collaboration, equipping students with essential skills for successful engineering practice.</td></tr>
<tr><td>Course Objective</td><td colspan="7">This course is designed to develop and familiarize the learners with the concepts of creating thinking and attain Entrepreneurship by using Participative Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On successful completion of the course the students shall be able to:
1) Understand the concept and importance of Design Thinking.
2) Differentiate between traditional problem-solving and Design Thinking.
3) Identify the core stages of the Design Thinking process.</td></tr>
<tr><td>Course Content:</td><td colspan="7">All assignments and projects must be developed using the reference materials available from the PU e-resource database – JSTOR, EBSCO, Library OPAC, NPTEL Videos, etc.</td></tr>
<tr><td>Module 1</td><td>Introduction to Design Thinking</td><td>Visual journal, book of essays, context - specific assignment/project</td><td></td><td colspan="3">Visual output generation, by Visual Journal and narrative development.</td><td>3 hours</td></tr>
<tr><td colspan="8">Topic
1) Definition and Introduction to Design Thinking
2) Understand the Design Thinking Process</td></tr>
<tr><td>Module 2</td><td>Design Thinking in Action</td><td>Visual journal, book of</td><td></td><td colspan="3">Visual output generation, by visual journal and narrative development.</td><td>12 hours</td></tr>
</table>

		essays, context - specific assignment/project			

Topics:

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

Targeted Application & Tools that can be used:

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

Text Book

Thinking Design by S Balaram. New Delhi [India]: Sage Publications Pvt. Ltd. 2010. eBook., Database: eBook Collection (EBSCOhost)
https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=6&sid=18ab1f43-1f92-4d02-ae2e-a9c06dc06d8c%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=354920&db=nlebk

References

Design Thinking by Clarke, Rachel Ivy. Series: Library Futures, Vol. 4. Chicago: ALA Neal-Schuman. 2020. eBook., Database: eBook Collection (EBSCOhost)
https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=4&sid=c80a7d79-eda4-4b7e-a0d6-afafe437962b%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=2433506&db=nlebk

The Pocket Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions by Bruce Hanington; Bella Martin. Minneapolis: Rockport Publishers. 2017. eBook., Database: eBook Collection (EBSCOhost)
https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=11&sid=f086b8c2-260e-4caa-8c48-d732c21a7724%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1638693&db=nlebk

What Is Design Thinking and Why Is It Important? By Rim Razzouk and Valerie Shute - Review of Educational Research, Vol. 82, No. 3 (September 2012), pp. 330-348 (19 pages), Published by: American Educational Research Association
https://puniversity.informaticsglobal.com:2054/stable/23260048?Search=yes&resultItemClick=true&searchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3Acb1be24976e25734cb5fc13a8af6fdfb&seq=1#metadata_info_tab_contents

Abductive Thinking and Sensemaking: The Drivers of Design Synthesis by John Kolko, Design Issues, Vol. 26, No. 1 (Winter, 2010), pp. 15-28 (14 pages), Published by: The MIT Press https://puniversity.informaticsglobal.com:2054/stable/20627839?Search=yes&resultItemClick=true&searchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3A0b89336ea274d63c010536b01316d7bb&seq=1#metadata_info_tab_contents Designerly Ways of Knowing: Design Discipline versus Design Science by Nigel Cross, Design Issues, Vol. 17, No. 3 (Summer, 2001), pp. 49-55 (7 pages), Published by: The MIT Press https://puniversity.informaticsglobal.com:2054/stable/1511801?Search=yes&resultItemClick=true&searchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3A0d5b607b163f60876ca973ed90e22b1c&seq=1#metadata_info_tab_contents

Course Code: **MAT1003**	**Course Title:** **Applied Statistics** **Type of Course:** School Core	**L-T-P-C**	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "**Applied Statistics" and attain **Skill Development Through Problem Solving techniques**.					
Expected Outcome:	At the end of this course, students will be in a position to 1. apply the techniques of descriptive statistics effectively 2. interpret the ideas of probability and conditional probability 3. demonstrate the knowledge of probability distributions 4. Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.					
Module 1	**Descriptive**	Assignment	ding needed			**10 classes**

	Statistics			
Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson's Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression **.**				
Module 2	**Probability**			**6 classes**
Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye's theorem with examples				
Module 3	**Random Variables and Probability Distributions**		ding needed	**14 classes**
Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, **Negative Binominal (Self Study)**, Poisson, Normal and Exponential distributions				
Module 4	**Sampling Theory**		ding needed	**15 classes**
Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and **Difference of Means (Self Study)**, Small Sample Tests: Student's t-Test for Single Mean and **Difference of Means,** F-Test, Chi-Square Test.				

Targeted Application & Tools that can be used:

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

Tools used: R Software / MS-Excel

Text Book

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

References

1. James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018.

2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020.

3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019.

4. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018.

5. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018.

6. Kishor S Trivedi, Probability and Statistics with reliability, Queuing and Computer Science Applications, John Wiley & Sons, 2008.

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

Course Code: CHE1018	**Course Title:** Environmental Science **Type of Course:** School Core- Theory and Lab	**L- T- P- C**	1	0	2	0
		Contact hours	1	0	2	3
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education. **This course is designed to cater to Environment and Sustainability**					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Environmental Science" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.**					

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

Topics:

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

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

	Module 5	**Environmental Pollution and Health**	Case study		**03 Classes**

Topics:

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

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

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

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

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

Topics:

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

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

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

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

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

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

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

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

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

List of laboratory tasks : Any eight experiments will be conducted

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

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

Project work/Assignment:

Assessment Type

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

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

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

Text Book

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

Reference Books

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

E-resources:

7. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_18126**
8. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_8761**
9. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AJ_1_02082022_3333**
10. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_3063**
11. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_20719**
12. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_16824**
13. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_3954**
14. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO AB_1_06082022_491**
15. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CU STOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488**
16. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CU STOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583**
17. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SP RINGER_INDEST_1_171**
18. **https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129**
19. **https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979**

20.https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TE_XTBOOK_LIBRARY01_06082022_395&xIndex=4
21.https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf

Course Code: CIV1008	**Course Title:** Basic Engineering Sciences **Type of Course:** Theory Only	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering.					
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Recognize the significance of various disciplines in Civil Engineering 2] Discuss the recent evolutions in Civil Engineering 3] Explain various energies, energy generating machineries and energy consumption machineries 4] Describe the fundamental concept and terminology associated with the Petroleum Industry 5] Distinguish between conventional and modern manufacturing techniques.					
Course Content:						

Module 1	**Introduction to various fields in Civil Engineering**	Assignment	Case studies on different Civil Engineering Projects	**essions**
Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure.				
Module 2	**Current Trends and Evolution in Civil Engineering**	Assignment	Article Review	**essions**
Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities.				
Module 3	**Power Production and Consumption Machinery**	Assignment & Quiz	Data Collection	**essions**
Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications.				
Module 4	**Overview of Petroleum Engineering**	Assignment & Quiz	Article Review	**essions**
Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering				
Module 5	**Industry 4.0**	Assignment & Quiz	Data Collection	**essions**
Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process. Modern Manufacturing process: 3D Printing / Additive Manufacturing.				
Targeted Application & Tools that can be used: Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities				
Project work/Assignment:				
Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering Assignment 2: Review Articles on current evolutions in Civil Engineering. Assignment 3: Collect data related to renewable energy generation (Wind, Solar) Assignment 4: Prepare an energy consumption chart for a compressor or pumps. Assignment 5: Prepare a report on role of 3D printing across various industries. Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.				
Text Book: T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers T2. Elements of Mechanical Engineering, by VK Manglik				

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

References

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

Web-resources:

1. Basic Civil Engineering

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

2. Post-parametric Automation in Design and Construction

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

3. Smart Cities : Introducing Digital Innovation to Cities

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

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

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

5. Mechanical Engineering

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705

6. Additive Manufacturing: Opportunities, Challenges, Implications

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live

7. Society of Petroleum Engineers (SPE)

https://www.spe.org/en/

8. PetroWiki: A comprehensive online resource created by the Society of Petroleum Engineers that provides information on various aspects of petroleum engineering.

https://petrowiki.spe.org/PetroWiki

9. Rigzone: A resource for news and information about the oil and gas industry, including job postings and industry trends.

https://www.rigzone.com/

Topics relevant to the development of SKILLS:

Engines-Turbines and their applications.

Mechanization in Construction.

Digitization in Petroleum Industries

Course Code: CSE1006	**Course Title:** Problem Solving using JAVA **Type of Course: Lab Integrated**	**L- T-P-C**	1	0	4	3
Version No.	2.0					
Course Pre-requisites	CSE1004 – Problem-Solving Using C					
Anti-requisites	Nil					
Course Description	This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real-time secure applications by applying these concepts and also for effective problem-solving. The students interpret and understand the need for object-oriented programming to build applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques					
Course Out Comes	**On successful completion of the course, the students shall be able to:** **C.O. 1:** Describe the basic programming concepts. [Knowledge] **C.O. 2:** Apply the concept of classes, objects and methods to solve problems. [Application] **C.O. 3:** Apply the concept of arrays and strings. [Application] **C.O. 4:** Implement inheritance and polymorphism in building secure applications. [Application] **C.O. 5:** Apply the concepts of interface and error handling mechanism. [Application]					
Course Content:						
Module 1	**Basic Concepts of Programming and Java**	Assignment	Data Collection/Interpretation		**12 Sessions**	
Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.						
Module 2	**Classes, objects, methods and Constructors**	Case studies / Case let	Case studies / Case let		**12 Sessions**	
Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods. Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.						
Module 3	**Arrays, String and String buffer**	Quiz	Case studies / Case let		**14 Sessions**	
Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi–Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in						

String Buffer.				
Module 4	**Inheritance and Polymorphism**	Quiz	Case studies / Case let	**14 Sessions**
Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.				
Module 5	**Input & Output Operation in Java**	Quiz	Case studies / Case let	**14 Sessions**
Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Objects, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.				
List of Laboratory Tasks: **P1 - Problem Solving using Basic Concepts.** **P2 - Problem Solving using Basic Concepts and Command Line Arguments.** **P3 - Programming assignment with class, objects, methods and Constructors.** **P4 - Programming assignment with method overloading.** **P5 - Programming assignment with constructor overloading.** **P6 - Programming assignment with Static members and static methods.** **P7 - Programming assignment with Nested classes.** **P8 - Programming assignment using Arrays.** **P9 - Programming assignment using Strings.** **P10 - Programming assignment using String Builder.** **P11 - Programming assignment using Inheritance and super keyword.** **P12 - Programming assignment using Method overriding and Dynamic method invocation.** **P13 - Programming assignment using Final keywords.** **P14 - Programming assignment using Abstract keywords.** **P15 - Programming assignment using Interface.** **P16 - Programming assignment using Interface.** **P17 - Programming assignment CharacterStream Classes** **P18 - Programming assignment Read/Write Operations with File Channel**				
Targeted Application & Tools that can be used : JDK /eclipse IDE/ net Beans IDE.				
Text Book **T1** Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education.				
References **R1**: Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Pearson **R2:** James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers. **E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf** **E book link R2:** Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub)				

Web **resources** ps://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q ps://puniversity.informaticsglobal.com:2229/login.aspx
Topics relevant to the development of "Skill Development": 1. Static Polymorphism 2. Method overloading, constructors 3. constructor overloading 4. this keyword 5. static keyword and Inner classes 6. Inheritance and Polymorphism. for **Skill Development** through **Experiential Learning** techniques. This is attained through the assessment component mentioned in the course handout.

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

- The Myth of Multitasking
- A Guide to Writing Essays Speculating about Causes or Effects
- Is Google Making Us Stupid (Self Study)

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

Topics:
- Planning the presentation
- Creating the presentation
- Giving the presentation

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

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

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

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

Course Content: Practical Sessions

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

1. Reading and Analyzing

Level 1 – Annotation

Level 2 - Assumptions

2. Writing Narrative Essays

Level 1 – Draft 1

Level 2 – Draft 2

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

3. Fishbowl

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

Level 1 – within group

Level 2 – Among 2 group

4. Technical Group Presentation

Module 3	**Writing Reviews**	**4 Classes**

5. Practice Worksheets

Level 1 – Eliminating the Passive Voice

Level 2 – Simple, compound and complex sentences

6. Writing Short Film Reviews

Module 4	**Starting your Career**	**6 Classes**

7. Collaborative Project

Job search and writing report

Writing Resume

Module 1-4	**Academic Journal**	**2 Classes**

8. Academic Journal Writing

Level 1- Mid Term

Level 2 – End Term

Targeted Application & Tools that can be used: Writing reports, Review writing, Group Discussion, Dyadic interviews, Grammarly.com

Project work/Assignment:

Academic Journal – Assignment

In Academic Journal (CIJ), students compile task and activities completed in each module and submit to the instructor at the middle and end of the semester.

References

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

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

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

<table>
<tr><td>Course Code:
PPS1012</td><td colspan="3">Course Title: Enhancing Personality through Soft Skills

Type of Course: Practical Only Course</td><td>L- T - P- C</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">• Students are expected to understand Basic English.
• Students should have desire and enthusiasm to involve, participate and learn.</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of “Personality Development through Soft Skills” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">successful completion of this course the students shall be able to:
1 Identify the stages of team formation (Remember)
CO 2 Demonstrate effective presentation skills (Apply)

CO3 Prepare professional social media profile (Apply)</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="3">Team Building</td><td colspan="3">Classroom and outbound team building activities.</td><td colspan="2">6 Hours</td></tr>
<tr><td colspan="9">Topics: Importance of team, stages of Team Formation, Trust and collaboration, Virtual Team.

Activity: Team Building outbound activity</td></tr>
<tr><td>Module 2</td><td colspan="3">Art of Questioning</td><td colspan="3">Role plays</td><td colspan="2">4 Sessions</td></tr>
</table>

Topics: Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions

Module 3	Presentation Skills	Practice and evaluation of individual / group presentation	**10 Sessions**

Topics: Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges.

Activity: Individual presentations and team presentation

Module 4	Professional Brand Building	Brand Framework Activity	4 Sessions

Topics: Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies.

Activity: Create a basic online profile

Module 5	Recap / Revision /Feedback Session		1 Session

rgeted Application & Tools that can be used:

1. TED Talks
2. You Tube Links
3. Activities

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

3) Presentation Evaluation

Targeted Application & Tools that can be used:

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

Assignments proposed for this course

1. Evaluation on Presentation
2. Assignment on LinkedIn Post

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

References

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

Web links:

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

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

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

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

Course Code: EEE1007	**Course Title: Basics of Electrical and Electronics Engineering.** **Type of Course: Engineering Science - Theory & Integrated Laboratory**	**L-T-P-C**	3	0	2	4
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This is a fundamental Course which is designed to know the use of basics of electrical and electronics engineering principles occurs in various fields of Engineering. The course emphasis on the characteristics and applications of Electrical and Electronics devices, working, analysis and design of electrical circuits using both active & passive components, fundamentals of electrical machines and basics of transistors and its application. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance, using both hardware and simulation tools.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Basics of Electrical and Electronics Engineering and attain **Skill Development** through **Experiential Learning** techniques.					

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
1. Explain basic laws of Electrical Engineering to compute voltage, currents and other parameters in the circuits.
2. Discuss various fundamental parameters appearing in the characteristics of semiconductor devices and their applications.
3. Summarize the operations of different biasing configurations of BJTs and amplifiers.
4. Summarizethe performance characteristics and applications of various electrical Machines.
5. Demonstrate the working of electrical machines to observe performance characteristics
6. Demonstrate the working of electronic circuits to obtain the V-I Characteristics of various semiconductor devices.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to Electrical Circuits</td><td>Assignment/ Quiz</td><td>Numerical solving Task</td><td>10 Sessions</td></tr>
<tr><td colspan="5">DC Circuits: Concept of Circuit and Network, Types of elements, Network Reduction Techniques- Series and parallel connections of resistive networks, Star–to-Delta Transformations, Mesh Analysis, Numerical examples.
AC Circuits: Fundamentals of single phase circuits - Series RL, RC and R-L-C Circuits, Concept of active power, reactive power and Power factor, Numerical examples.
Introduction to three phase system and relation between line and phase values in Star & Delta connection, Numerical examples.</td></tr>
<tr><td>Module 2</td><td>Semiconductor and Diode applications</td><td>Assignment/ Quiz</td><td>Memory Recall based Quizzes</td><td>11 Sessions</td></tr>
<tr><td colspan="5">Mass Action Law, Charge densities in a semiconductor, Types of SC, Junction diodes -Ideal and practical behaviour, Modelling the Diode Characteristic, and Diode applications like rectifiers, Clipping and clamping circuits. Zener diode, characteristics and its applications like voltage regulator.</td></tr>
<tr><td>Module 3</td><td>Fundamentals of Electrical Machines</td><td>Assignment/ Quiz</td><td>Memory Recall-based Quizzes</td><td>12 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 4</td><td>Transistors and its Applications</td><td>Assignment/ Quiz</td><td>Numerical solving Task</td><td>12 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">List of Laboratory Tasks:
Experiment No 1: Verification of KVL and KCL for a given DC circuit.</td></tr>
</table>

Level 1: Study and Verify KVL and KCL for the given electrical Circuit.
Level 2: For the same circuit considered in level 1, perform the simulation using NI LabVIEW/Multisim/MATLAB.

Experiment No 2: Analyse AC series circuits – RL, RC and RLC .
Level 1: Conduct an experiment to perform and verify the impedance, current and power of Series RL and RC circuits
Level 2:

Experiment No 3: Calculation of power and power factor of the given AC Circuit.
Level 1: Conduct an experiment to measure the power and power factor for given resistive load.
Level 2: Conduct an experiment to measure the power and power factor for given inductive load.

Experiment No 4: Perform the experiments on given Transformer.
Level 1: Verify the EMF equation of a transformer and compute the voltage transformation ratio.
Level 2: Study the effect of load on the secondary side of the transformer and verify the EMF equation under load conditions.

Experiment 5: Load test on DC shunt motor
Level 1: Conduct load test on DC shunt motor and find its efficiency at different loads
Level 2: Conduct load test on DC shunt motor and plot the performance characteristics.

Experiment 6: Study of PN-Junction Diode Characteristics in Forward and Reverse Bias Conditions.
Level 1: Carry out an experiment to plot VI Characteristics and hence find the cut-in voltage on forward characteristics for the Silicon P-N Junction diode.
Level 2: Carry out an experiment to plot VI Characteristics of Zener diode and hence find the zener voltage on reverse characteristics for the Silicon P-N Junction zener diode.

Experiment 7: To observe the output waveform of half wave and full wave rectifier circuit and compute ripple factor and efficiency
Level 1: Identify the components required for a rectifier circuit, rig up the circuit, and sketch the output waveforms without filter.
Level 2: Rig up the rectifier circuit with RC filter, observe the output waveforms, determine the efficiency and ripple factor.

Experiment 8: To construct clipping and clamping circuits for different reference voltages and to verify the responses.
Level 1: Identify the components required for building a Clipper / Clamper circuit. Rig up the circuit according to the circuit diagram given and sketch the output waveform.
Level 2: Given a sinusoidal input of 10 V p-p, implement a positive / negative clipper with output clipped at 2 V.

Experiment 9: To calculate various parameters of emitter follower circuit using BJT
Level 1: Identify the components required to implement an emitter follower circuit. Rig up the circuit and observe the variations in output waveform with respect to the variations in input waveform.
Level 2: Determine the values of Z_{in} input impedance and Z_{out} output impedance for Emitter Follower.

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

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

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

Targeted Application & Tools that can be used:

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

Professionally Used Software: Matlab/Multisim/ PSpice

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

Text Book(s):

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

Reference Book (s):

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

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

1. https://presiuniv.knimbus.com/user#home
2. https://www.digimat.in/nptel/courses/video/108105112/L01 "Fundamentals of Electrical Engineering-Basic Concepts, Examples"
3. Seminar Topic: https://nptel.ac.in/courses/108/105/108105153/ "Electrical Measurements"
4. Video lectures on "Electronic Devices" by Prof.Dr. A. N. Chandorkar, IIT Bombay http://www.satishkashyap.com/2013/03/video-lectures-on-electron-devices-by.html
5. Video lectures on "Analog Electronics" by Prof. S.C. Dutta Roy, IIT Delhi https://nptel.ac.in/courses/108/102/108102095/
6. Video lectures on "Diodes", by Prof.ChitralekhaMahanta, IIT Guwahati, https://nptel.ac.in/courses/117/103/117103063/
7. "Introduction to Electrical Machines https://nptel.ac.in/courses/108/102/108102146/"
8. M. -Y. Kao, H. Kam and C. Hu, "Deep-Learning-Assisted Physics-Driven MOSFET CurrentVoltageModeling," in IEEE Electron Device Letters, vol. 43, no. 6, pp. 974-977, June 2022, doi: 10.1109/LED.2022.3168243

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

9. F. Bonet, O. Aviñó-Salvadó, M. Vellvehi, X. Jordà, P. Godignon and X. Perpiñà, "Carrier Concentration Analysis in 1.2 kV SiCSchottky Diodes Under Current Crowding," in IEEE Electron DeviceLetters, vol. 43, no. 6, pp. 938-941, June 2022, doi: 10.1109/LED.2022.3171112. https://ieeexplore-ieeeorg- presiuniv.knimbus.com/document/9764749

10. M. Chanda, S. Jain, S. De and C. K. Sarkar, "Implementation of Subthreshold Adiabatic Logic for Ultralow-Power Application," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. .23, no. 12, pp. 2782-2790, Dec. 2015.
https://ieeexplore.ieee.org/document/7018053

11. R. Raut and O. Ghasemi, "A power efficient wide band trans-impedance amplifier in submicron
CMOS integrated circuit technology," 2008 Joint 6th International IEEE Northeast Workshop on Circuits and Systems and TAISA Conference, 2008, pp. 113-116, doi: 0.1109/NEWCAS.2008.4606334. https://ieeexplore.ieee.org/document/4606334

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

Course Code: CSE1006	**Course Title:** Problem Solving using JAVA **Type of Course: Integrated**	**L- T-P- C**	1	0	4	3
Version No.	2.0					
Course Pre-requisites	CSE1004 – Problem Solving Using C					
Anti-requisites	Nil					
Course Description	This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real time secure applications by applying these concepts and also for effective problem solving. The students interpret and understand the need for object oriented programming to build applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques					
Course Out Comes	**On successful completion of the course the students shall be able to:** **C.O. 1:** Describe the basic programming concepts. [Knowledge] **C.O. 2:** Apply the concept of classes, objects and methods to solve problems. [Application] **C.O. 3:** Apply the concept of arrays and strings. [Application] **C.O. 4:** Implement inheritance and polymorphism building secure applications. [Application] **C.O. 5:** Apply the concepts of interface and error handling mechanism. [Application]					
Course Content:						

Module 1	**Basic Concepts of Programming and Java**	Assignment	Data Collection/Interpretation	**12 Sessions**
Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.				
Module 2	**Classes, objects, methods and Constructors**	Case studies / Case let	Case studies / Case let	**12 Sessions**
Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods. Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.				
Module 3	**Arrays, String and String buffer**	Quiz	Case studies / Case let	**14 Sessions**
Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer.				
Module 4	**Inheritance and Polymorphism**	Quiz	Case studies / Case let	**14 Sessions**
Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.				
Module 5	**Input & Output Operation in Java**	Quiz	Case studies / Case let	**14 Sessions**
Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File 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.				
List of Laboratory Tasks: P1 - Problem Solving using Basic Concepts. P2 - Problem Solving using Basic Concepts and Command Line Arguments. P3 - Programming assignment with class, objects, methods and Constructors. P4 - Programming assignment with method overloading. P5 - Programming assignment with constructor overloading. P6 - Programming assignment with Static members and static methods. P7 - Programming assignment with Nested classes. P8 - Programming assignment using Arrays. P9 - Programming assignment using Strings. P10 - Programming assignment using String Builder. P11 - Programming assignment using Inheritance and super keyword. P12 - Programming assignment using Method overriding and Dynamic method invocation. P13 - Programming assignment using Final keywords. P14 - Programming assignment using Abstract keywords. P15 - Programming assignment using Interface. P16 - Programming assignment using Interface. P17 - Programming assignment CharacterStream Classes P18 - Programming assignment Read/Write Operations with File Channel				

Targeted Application & Tools that can be used : JDK /eclipse IDE/ net Beans IDE.
Text Book **T1** Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education.
References **R1**: Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Pearson **R2:** James W. Cooper, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers. **E book link R1:** http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf **E book link R2:** Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub) Web **resources** https://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q https://puniversity.informaticsglobal.com:2229/login.aspx
Topics relevant to development of "Skill Development": 2. Static Polymorphism 3. Method overloading, constructors 4. constructor overloading 5. this keyword 6. static keyword and Inner classes 7. Inheritance and Polymorphism. for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: FRL1002	**Course Title:** Basic French **Type of Course:** Open Elective	**L- T-P- C**	2-0-0-2
Version No.	4.0		
Course Pre-requisites	Not Applicable		
Anti-requisites	Not Applicable		
Course Description	This Course is for beginners and gives an introduction of the French Language (basic grammar, conjugation, daily used vocabulary words, and basic conversations) and French culture. This Course is designed to build up all of the basic skills of French listening, reading, speaking, and writing introduced in the lessons. Besides, this Course offers an access to the French world, helping students to break cultural boundaries and raise cultural literacy.		
Course Objective	This course is designed to improve the learners Employability skills by using participative learning techniques to develop students' language proficiency and cross-cultural competence by active and participatory teaching methods.		

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of the course the students shall be able to:
1) Identify the basics of French Grammar, vocabulary and Conjugation
2) Apply the basics strategies of listening, reading, speaking and writing skills
3) Use of French on everyday topics such as greetings, personal information, time and schedule
4) Practice conversations in French language with peer speakers in different situations</td></tr>
<tr><td>Course Content:</td><td colspan="4">Learning of Basic French skills</td></tr>
<tr><td>Module 1</td><td>Greetings and Introducing yourself</td><td></td><td>[Remember]</td><td>6 Periods</td></tr>
<tr><td colspan="5">Chapter 1. Greetings
Objectives: Greetings, introducing yourself, how to welcome someone,
Grammar: Construction of a sentence, the days of the weeks and the months

Chapter 2. Introducing yourself
Objectives: Introduce oneself / ask for someone’s personal information.
Grammar: Mas or Fem noun, adjectives, present tense of the 1st group
Usage of audio visual files</td></tr>
<tr><td>Module 2</td><td>Expressing likes/dislikes and introducing someone</td><td></td><td>[Apply]</td><td>6 Periods</td></tr>
<tr><td colspan="5">Chapter 3. Expressing likes and dislikes
Objectives: How to expressing what you like and dislike.
Grammar: Negative form, singular and plural.
Culture: The polite way to address people in French
Assignment

Chapter 4. Introducing someone
Objectives: How to describe someone,
Grammar: Vocabulary of the family, Demonstrative adjectives,
Present tense of verbs of the 2nd and 3rd group</td></tr>
<tr><td>Module 3</td><td>Inviting someone and asking questions</td><td></td><td>[Apply]</td><td>9 Periods</td></tr>
<tr><td colspan="5">Chapter 5. Inviting someone
Objectives: How to invite someone, accept or refuse the invitation, Read the time,
Grammar: Future tense, Interrogation.
Culture: The art of accepting and declining an invitation politely in French
Internal
Chapter 6. Asking for information,
Objectives: How to ask for information, giving information</td></tr>
<tr><td>Module 4</td><td>Making a reservation and giving directions</td><td></td><td>[Apply]</td><td>9 Periods</td></tr>
</table>

Chapter 7: Making a Reservation Objectives: How to make a reservation, future tense Chapter 8 : Giving directions Objectives: How to ask for directions, Imperative tense Group discussions
Targeted Application & Tools that can be used
Project work /Assignments 1) Assignment (Essay writing / presentation) 2) Internal 3) Group work / Group discussions
Text Book L'Atelier 1 - - Méthode de Français--- Niveau A1 (Didier – 2019) Festival 1- - Méthode de Français--- Niveau A1 (CLE International – 2005)
References Learning materials designed by the instructor
Topics relevant to development of 'Employability Skills' through participative learning techniques: Foreign language proficiency and cross-cultural competence by active and participatory teaching methods.

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

Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switches and actuators, sensor interface with Arduino.
Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications.
Introduction to online Simulators: Working with Tinkercad Simulator.

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

Targeted Application & Tools that can be used:

Application Area:

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

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

Project work/Assignment:

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

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

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

Textbook(s):

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

References

Reference Book(s)

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

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

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

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

E-content:

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

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

3. R. Maheswar, P. Jayarajan, S. Vimalraj, G. Sivagnanam, V. Sivasankaran and I. S. Amiri, "Energy Efficient Real Time Environmental Monitoring System Using Buffer Management Protocol," 2018, pp. 1-5, doi: 10.1109/ICCCNT.2018.8494144. **https://ieeexplore.ieee.org/document/8494144**.
4. Yaser S Shaheen,Hussam., " Arduino Mega Based Smart Traffic Control System ," December 2021 Asian Journal of Advanced Research and Reports 15(12): 43-52, 2021(15(12): 43-52, 2021):15(12): 43-52, 2021.

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

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

Two-dimensional Laplace's equation – various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems).

Targeted Application & Tools that can be used:
The objective of the course is to familiarize students with a variety of numerical techniques and the theoretical concepts of probability and statistics to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.

Assignment:

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

Text Book

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

References:

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

E-resources/ Web links:

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

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

Course Code: CSE1508	**Course Title:** Data Structures **Type of Course: Theory**	**L-T- P- C**	3	0	0	3
Version No.						
Course Pre-requisites						
Anti-requisites						
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development .This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language .With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques					
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1 :**Describe the concept of basic data structure, stacks, queues, and arrays and their operations. **[Understand]** **CO2:** Utilize linked lists for real-time scenarios. **[Apply]** **CO3:** Apply an appropriate non-linear data structure for a given scenario. **[Apply]** **CO4:** Demonstrate different searching and sorting techniques. **[Apply]**					
Course Content:						
Module 1	**Introduction to Data Structure and Linear Data Structure –Stacks and Queues**	Assignment	Program activity			**9 Hours**
Introduction –Introduction to Data Structures, Types and concept of Arrays . **Stack -**Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. **Queues -**Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.						
Module 2	**Linear Data Structure -Linked List**	Assignment	Program activity			**12 Hours**
Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list. **Recursion** - Recursive Definition and Processes.						

Module 3	**Non-linear Data Structures - Trees**	Assignment	Program activity	**12 Hours**
pics: 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.Heaps , Expression Tree ,Red Black Tree - AVL Trees ,Binary Serach Tree ,				
Module 4	**Non-linear Data Structures - Graphs and Hashing**	Assignment	Program activity	**Hours**
Topics: Graphs: Basic Concept of Graph Theory and its Properties, Representation of Graphs . ADT, Elementary graph operations, Minimum Cost spanning trees, Shortest path and Transitive closure. **Hashing**: Introduction, Static Hashing, Dynamic Hashing				
Module 5	**Searching & Sorting**	Assignment	Program activity	**6 Hours**
Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort, Quick sort, Merge Sort, Bubble sort.				

List of Laboratory Tasks:

Lab sheet -1

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

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

Lab sheet -2

Level 1: Programming Exercises on Stack and its operations

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

Lab sheet -3

Level 1: Programming on Stack application infix to postfix Conversion

Level 2: -

Lab sheet -4

Level 1: Programming on Stack application – Evaluation of postfix

Lab sheet -5

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

Level 2: -

Lab sheet -6

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

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

Lab sheet -7

Level 1: Programming Exercises on Circular Linked list and its operations.
Level 2: Programming Exercises on Circular Linked list and its operations with various positions

Lab sheet -8
Level 1: Programming Exercises on factorial of a number
Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9
Level 1: -
Level 2: Programming the tower of Hanoi using recursion

Lab sheet -10
Level 1: Programming Exercise on Doubly linked list and its operations
Level 2: -

Lab sheet -11
Level 1: Program to Construct Binary Search Tree and Graph
Level 2: Program to traverse the Binary Search Tree in three ways)in-order, pre-order and post-order(and implement BFS and DFS

Lab sheet -12
Level 1: Program to Implement the Linear Search & Binary Search
Level 2: Program to Estimate the Time complexity of Linear Search

Lab sheet -13
Level 1: Program to Implement and Estimate the Time complexity of Selection Sort
Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort

Lab sheet -14 (Beyond syllabus activity)
Level 1: Program to Construct AVL Tree
Level 2:

Lab sheet -15 (Beyond syllabus activity)
Level 1: Program to Construct RED BLACK Tree

Targeted Application & Tools that can be used

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

Project work/Assignment:

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

Text Book

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

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

ferences

R1 Data structures and program design in C by Robert Kruse, Tondo C L, Bruce Leung,

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

Course Code: CSE1504	**Course Title: Web Technology** **Type of Course: Program core** **Theory Only**		**L- T-P- C**	2-0-0-2
Version No.	2.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	This course highlights the basic 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 leading trends in the web domain, enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia. The focus is on popular key technologies that will help students to build Internet- and web-based applications that interact with other applications and with databases.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.**			
Course Outcomes	**On successful completion of this course the students shall be able to:** **CO1:** Implement web-based application using client-side scripting languages. **(Application level)** **CO2**: Apply various constructs to enhance the appearance of a website. **(Application level)** **CO3**: Illustrate java-script concepts to demonstration dynamic web site **(Application level)** **CO4:** Apply server-side scripting languages to develop a web page linked to a database. **(Application level)**			
Course Content:				
Module 1	**Introduction to XHTML**	Quizzes and Assignments	Quizzes on various features of XHTML, simple applications	**8 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**	Quizzes and assignments	Comprehension based Quizzes and assignments; Application of CSS in designing webpages	**8 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**	Quizzes and assignments	Application of JavaScript for dynamic web page designing	**7 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**	Quizzes and assignments	Application of PHP in web designing	**7 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.				
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): 1] Robert. W. Sebesta, "*Programming the World Wide Web*", Pearson Education, 8th Edition, 2015. 2] *CSS Notes for Professionals*, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022) 3] Deitel, Deitel, Goldberg,"*Internet & World Wide Web How to Program*", Fifth Edition, Pearson Education, 2021.				
References 1] Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st. Edition.2016. 2] Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.				
Topics related to development of "FOUNDATION": 1. Web, WWW, Web browsers, Web servers, Internet. 2. CSS, PHP. 3. Designing for healthcare. **for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**				

E-References pu.informatics.global, https://sm-nitk.vlabs.ac.in/

Course Code: CSE1506	Course Title: Data Communications and Computer Networks Type of Course: Theory & Integrated Laboratory	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	ECE2007 - Digital Design					
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.					
Course Outcomes	**On successful completion of this course, the students shall be able to:** **CO1**: Illustrate The Basic Concepts Of Data Communication And Computer Networks. (Apply) **CO2:** Analyze the functionalities of the Data Link Layer. (Analyse) **CO3**: Apply the Knowledge of IP Addressing and Routing Mechanisms in Computer Networks.(Apply) **CO4:** Demonstrate the working principles of the Transport layer and Application Layer. (Apply)					
Course Content:						
Module 1	**Introduction and Physical layer-CO1**	Assignments	Problem Solving	**17 Sessions (L9 + P8)**		
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.						
Module 2	**Data Link Layer –CO2**	Assignments	Problem Solving	**20 Sessions (L12 + P08)**		
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						
Module 3	**Network Layer –CO3**	Assignments	Problem Solving	**21 Sessions (L13 + P8)**		
Network Layer Services - Network Layer Services, Switching Techniques, IP Addressing methods-IPv4 IPV6 – Subnetting. Routing, - Distance Vector Routing, Link State Routing, RIP, OSPF, BGPV4.						
Module 4	**Transport and Application Layer - CO4**	Assignments	Problem Solving	**17 Sessions (L11 + P6)**		

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.
Targeted Application & Tools that can be used: Cisco Packet Tracer, Wireshark, and NS2 Simulator.
Project work/Assignment: Choose and analyse a network from any organization/Assignment proposed for this course in CO1-CO4
Topics related to **1. Problem Solving: Choose and appropriate devices and implement various network concepts.** **2. Employability: Simulation of any network using Cisco Packet Tracer/NS2.**
Textbook(s): **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.**
References **1. R1. "Computer Networking: A Top-Down Approach", Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.** **2. 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** **E-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/** **4. http://www.nptelvideos.com/course.php?id=393** **5. https://www.digimat.in/keyword/106.htmlhttps://puniversity.informaticsglobal.com/login**

Course Code: MAT2605	**Course Title: Discrete Mathematics** **Type of Course:1] School Core**	**L-T-P-C**	**4**	**0**	**0**	**4**
Version No.	1.0					
Course Pre-requisites	Linear Algebra					
Anti-requisites	**NIL**					

Course Description		The course explores the study of mathematical structures that are fundamentally discrete (not continuous), focusing on concepts like set theory, logic, graph theory, combinatorics, and number theory, with applications primarily in computer science fields like algorithms, software development, and cryptography; it covers topics such as propositional logic, proof techniques, relations, functions, counting principles, and basic graph algorithms, providing a foundation for analyzing discrete problems and structures within computer science.
Course Objective		The main objective of the course is that students should learn a particular set of mathematical facts and how to apply them. It teaches students how to think logically and mathematically through five important themes: mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking, and applications and modeling. A successful discrete mathematics course should carefully blend and balance all five themes.
Course Outcomes		On successful completion of the course the students shall be able to: CO1 - Explain logical sentences through predicates, quantifiers and logical connectives. CO2 - Deploy the counting techniques to tackle combinatorial problems CO3 - Comprehend the basic principles of set theory and different types of relations. CO4 - Apply different types of structures of trees for developing programming skills
Course Content:		

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

Kruskal algorithm and Prim's algorithm.
Targeted Application & Tools that can be used: Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.
Assignment:
4. Assignment 1: Logic Equivalences and Predicate calculus. **5. Assignment 2: Equivalence Relations and Lattices** **6. Assignment 3: Recurrence Relations**
Text Book 1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill,s 8th Edition,2019. 2. Harary – Graph Theory, Addison-Wesley Publishing Company.
References: 1. Arthur Gill, "Applied Algebra for Computer Science", Prentice Hall. 2. K.D. Joshi, "Discrete Mathematics", Wiley Eastern Ltd. 3. Ralph. P. Grimaldi., "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia. **E-resources/ Web links:** 10. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_54588 11. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_375 12. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 13. https://www.scu.edu.au/study-at-scu/units/math1005/2022/ 14.
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Course Code: **CSE1500**	**Course Title: Computational Thinking Using Python** **Type of Course: Integrated**	**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 the essential skills of **computational thinking** and their practical application through the **Python programming language**. By combining problem-solving strategies with coding, students will learn to decompose complex challenges, identify patterns, abstract general principles, and design algorithms to build functional programs					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computational Thinking and use the Computational Thinking Principles to solve the computational Problems using Python Language					

<table>
<tr><td>Course Outcomes</td><td colspan="4">Upon successful completion of this course, students will be able to:

• Explain and apply the core principles of computational thinking:
  ○ Decomposition
  ○ Pattern Recognition
  ○ Abstraction
  ○ Algorithm Design
• Use Python to implement solutions to real-world problems.
• Write and debug Python code using functions, loops and conditions
• Design simple programs and algorithms to automate repetitive or complex tasks.
• Collaborate effectively and communicate problem-solving approaches using pseudocode and Python.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Pillars of Computational Thinking</td><td>Comprehension</td><td></td><td>9 Sessions</td></tr>
<tr><td colspan="5">What is computational thinking? Why is it important? Pillars of computational thinking: decomposition; pattern recognition; data representation and abstraction; algorithms
Applying computational thinking to case studies</td></tr>
<tr><td>Module 2</td><td>Algorithm Design & Problem-Solving Strategies</td><td>Application</td><td></td><td>9 Sessions</td></tr>
<tr><td colspan="5">Introduction to Algorithms, Introduction to Problem Solving techniques: Brute Force, Divide and conquer, Common algorithms: find-max, linear search, binary search and other simple Algorithms</td></tr>
<tr><td>Module 3</td><td>Applied Computational Thinking using Python</td><td>Application</td><td></td><td>12 Sessions</td></tr>
<tr><td colspan="5">Introduction to Python, Data representation: variables, lists, Conditionals, Loops and Iteration
Basic Example programs to illustrate the programming constructs</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Google Colab, Python</td></tr>
<tr><td colspan="5">Text Book
1. "Computational Thinking for the Modern Problem Solver" – David D. Riley & Kenny A. Hunt

2. “Mastering Python 3 Programming: Ultimate Guide to Learn Python Coding Fundamentals and Real-World Applications” Subburaj Ramaswamy, BPB publications</td></tr>
<tr><td colspan="5">References

1. • Sweigart, Al.
Automate the Boring Stuff with Python: Practical Programming for Total Beginners.
No Starch Press, 2015.</td></tr>
</table>

https://automatetheboringstuff.com

- **Severance, Charles.**

Python for Everybody: Exploring Data Using Python 3.
CreateSpace Independent Publishing, 2016.
https://www.py4e.com

- **Wing, Jeannette M.**

"Computational Thinking." *Communications of the ACM*, vol. 49, no. 3, 2006, pp. 33–35.
https://doi.org/10.1145/1118178.1118215

- **Downey, Allen B.**

Think Python: How to Think Like a Computer Scientist.
Green Tea Press, 2015.
http://greenteapress.com/wp/think-python-2e/

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E-Resources

https://edu.google.com/resources/programs/exploring-computational-thinking

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

Course Code: CSE1509	**Course Title:** Data Structures Lab **Type of Course:Lab**	**L-T- P-C**	0	0	4	2
Version No.						
Course Pre-requisites						
Anti-requisites						
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development .This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language .With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques					
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1 :**Describe the concept of basic data structure, stacks, queues, and arrays and their operations. **[Understand]** **CO2:** Utilize linked lists for real-time scenarios. **[Apply]** **CO3:** Apply an appropriate non-linear data structure for a given scenario. **[Apply]** **CO4:** Demonstrate different searching and sorting techniques. **[Apply]**					
Course Content:						
Module 1	**Introduction to Data Structure and Linear Data Structure –Stacks and Queues**	Assignment	Program activity		**9 Hours**	
Introduction –Introduction to Data Structures, Types and concept of Arrays . **Stack -**Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. **Queues -**Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.						
Module 2	**Linear Data Structure -Linked List**	Assignment	Program activity		**12 Hours**	

Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list.

Recursion - Recursive Definition and Processes.

Module 3	**Non-linear Data Structures - Trees**	Assignment	Program activity	**12 Hours**

pics: 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.Heaps , Expression Tree ,Red Black Tree - AVL Trees ,Binary Serach Tree ,

Module 4	**Non-linear Data Structures - Graphs and Hashing**	Assignment	Program activity	**6 Hours**

Topics: Graphs: Basic Concept of Graph Theory and its Properties, Representation of Graphs . ADT, Elementary graph operations, Minimum Cost spanning trees, Shortest path and Transitive closure.

Hashing: Introduction, Static Hashing, Dynamic Hashing

Module 5	**Searching & Sorting**	Assignment	Program activity	**6 Hours**

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

List of Laboratory Tasks:

Lab sheet -1

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

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

Lab sheet -2

Level 1: Programming Exercises on Stack and its operations

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

Lab sheet -3

Level 1: Programming on Stack application infix to postfix Conversion

Level 2: -

Lab sheet -4

Level 1: Programming on Stack application – Evaluation of postfix

Lab sheet -5

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

Level 2: -

Lab sheet -6

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

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

Lab sheet -7

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

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

Lab sheet -8

Level 1: Programming Exercises on factorial of a number

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9

Level 1: -

Level 2: Programming the tower of Hanoi using recursion

Lab sheet -10

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

Level 2: -

Lab sheet -11

Level 1: Program to Construct Binary Search Tree and Graph

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

Lab sheet -12

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

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

Lab sheet -13

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

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

Lab sheet -14 (Beyond syllabus activity)

Level 1: Program to Construct AVL Tree

Level 2:

Lab sheet -15 (Beyond syllabus activity)

Level 1: Program to Construct RED BLACK Tree

Targeted Application & Tools that can be used

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

Project work/Assignment:

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

Text Book

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

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

References

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

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

Web resources:

3. For theory :https://onlinecourses.nptel.ac.in/noc20_cs85/preview
4. https://puniversity.informaticsglobal.com/login

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

Course Code: CSE1505	**Course Title: Web Technologies Lab** **Type of Course: Program core lab course**	**L-T-P- C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Database Management Systems-CSE3156					
Anti-requisites	**NIL**					
Course Description	This course highlights the comprehensive introduction to scripting languages that are used for creating web-based applications. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** **CO1:** Implement web-based application using client-side scripting languages. **(Apply)** **CO2**: Apply various constructs to enhance the appearance of a website. **(Apply)** **CO3:** Apply server-side scripting languages to develop a web page linked to a database. **(Apply)**					
Course Content:						

List of Laboratory Tasks:

Experiment No. 1: Demonstration of XHTML features

Level 1: Demonstration of various XHTML Tags (Level 1)
Level 2: Design and develop static web pages for an online Book store (Level 2).

Experiment No. 2: Application of CSS in web designing

Level 1: Design a document using XHTML and CSS to create a catalog of items for online electronic shopping.
Level 2: Create and save XML document for students' information and display the same using cascaded style sheet.

Experiment No. 3: Application of PHP in web designing.

Level 1: Write a PHP program to read the personal information of a person such as first name, last name, age, permanent address, and pin code entered by the user into a table created in MySQL. Read the same information from the database and display it on the front end.
Level 2: Using PHP develop a web page that accepts book information such as ISBN number, title, authors, edition, and publisher and store information submitted through the web page in MySQL database.

Experiment No. 4: Building a website.

Build a website for organizing an International Conference. The conference website must be able to collect the author's details and upload a file.

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):

1. Robert. W. Sebesta, "*Programming the World Wide Web*", Pearson Education, 9th Edition, 2016.
2]Paul Deitel, Harvey Deitel, Abbey Deital,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education, 2021.
3]CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)
4]Deitel, Deitel, Goldberg,"*Internet & World Wide Web How to Program*", Fifth Edition, Pearson Education, 2021.

Reference Book(s):

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.

Additional web-based resources

W1. W3schools.com
W2. Developer.mozilla.org/en-US/docs/Learn
W3. docs.microsoft.com
W4. informit.com/articles/ The Relationship Between Web 2.0 and Social Networking
https://presiuniv.knimbus.com/user#/home

Topics related to development of "FOUNDATION":

1. Web, WWW, Web browsers, Web servers, Internet.
2. CSS, PHP.

3. Designing the website for healthcare.
The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.

Course Code: **CSE1507**	**Course Title: Data Communication and Computer Networks Lab** **Type of Course: Lab**	**L-T-P-C**	0	0	2	1
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This lab course is to get practical knowledge of working principles of various communication protocols. Analyse structure and formats of TCP/IP layer protocols using network tools such as Wireshark and network simulators. Implementing various network algorithms such as error control, error detection, routing, and security related algorithms.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Networks and attain Skill Development through Participative Learning techniques					
Course Out Comes	On successful completion of the course the students shall be able to: • To understand the working principle of various communication protocols. • To understand the network simulator environment and visualize a network topology and observe its performance. • To analyze the traffic flow and the contents of protocol frames. • To analyze data flow in wired and wireless environment					
Course Content						
Module 1	**Introduction to Computer Networks**	**7 Sessions**				
Learn to use commands like tcpdump, netstat, ifconfig, nslookup, ARP, NbtStat-n, Route, GETMAC, SYSTEMINFO and traceroute – Capture ping and traceroute PDUs using a network protocol analyzer and examine - Configuration and logging to a CISCO Router and introduction to the basic user Interfaces. Introduction to the basic router configuration and basic commands.						
Module 2	**Physical And Data Link Layer**	**8 Sessions**				

	Configuration of IP addressing for a given scenario for a given set of topologie – Connecting devise – Configuration of Hub, Router, Switch and Repeaters using cisco packet tracer- Configure the privilege level password and user authentication in switch.					
Module 3	**Network Layer** **Transport Layer**					**7 Sesions**
	Configure the DHCP Server and wireless router and check the connectivity - Configure the static routing using cisco packet tracer- Configure the Dynamic Routing routing (RIP Routing) using cisco packet tracer					
Module 4	**Application Layer and Security in Computer Networks**	Assignment	Problem Solving			**08 Classes**
	Configure the Static NAT using cisco packet tracer - Configure the Dynamic NAT using cisco packet tracer. - Configure the DNS Server using cisco packet tracer - Configure the telnet protocol using cisco packet tracer - Wireshark Tool - Three Node Point To Point Network Using NS2 Simulator - Transmission of Ping Message Using NS2 Simulator - Ethernet LAN Using N-Nodes Using NS2 Simulator - Ethernet LAN Using N-Nodes With Multiple Traffic					
	Targeted Application & Tools that can be used: Cisco Packet Tracer, Wireshark, NS2					
	Case Study/Assignment: Assignment proposed for this course in CO1-CO4 **1.** Assume that a computer sends a frame at the transport layer to another computer and the destination port address is not running. According to what you read from chapter 2, what will happen to that process? **2.** Determine the possible bit rate and the number of levels over a channel for these cases? a. B = 2.4K Hz, noiseless channel with L = 16. b. B= 2.4K Hz, SNR = 20 dB. c. B = 3.0K Hz, SNR = 40 db. **3.** Using CISCO Packet Tracer Configuring Static and Default Routes Objectives • Configure static routes on each router to allow communication between all clients. • Test connectivity to ensure that each device can fully communicate with all other devices. **4.** Getting familiar with Wireshark software by installing it I your system, and perform following task: 1. List out the packets which are having DNS protocols 2. List of IP address present in the cache along with its MAC addresses 3. Display all the packets which are having the DNS or HTTP protocol					
5.	6. Problem Solving: Choose and appropriate devices and implement various network concepts.					

	Text Book 1. CCNA Routing and Switching Study Guide – Todd Lammle, 2013, Sybex. 2. Wireshark Network Analysis: The Official Wireshark Certified Network Analyst Study Guide – Laura Chappell, 2012, Wireshark University. 3. Computer Network Simulation Using NS2 – Ajit Kumar Nayak, Rajlaxmi Rai, Rakesh Mall, 2020, Routledge.
	References **R1:** Alberto Leon-Garcia and IndraWidjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004. **R2:** William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007. **R3:** "Computer Networking: A Top-Down Approach" – James F. Kurose and Keith W. Ross, 7th Edition, 2016, Pearson. Web Based Resources and E-books: W1: https://gaia.cs.umass.edu/kurose_ross/wireshark.php W2: https://www.youtube.com/watch?v=x7EJSY0bOK4&ab_channel=ChrisGreer W3: https://tutorials.ptnetacad.net/
	Topics relevant to "SKILL DEVELOPMENT": Application Layer, Transport Layer, Network Laryer for **Skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: MAT2602	**Course Title: Numerical Computations**	**L-T- P-C**	**3**	**0**	**0**	**3**
Version No.		1.0				
Course Pre-requisites		Calculus, Linear Algebra, Differential Equations				
Anti-requisites		**NIL**				
Course Description		The course explores mathematical techniques used to approximate solutions to complex problems that are difficult to solve analytically, often utilizing computers to perform calculations, including methods for root finding, interpolation, numerical differentiation and integration, solving systems of linear equations, and approximating solutions to differential equations, with applications across various scientific and engineering fields. It focuses on understanding the theoretical basis behind these methods, their implementation in programming languages, and analyzing their accuracy and stability.				
Course Objective		The objective of the course is to equip students with understanding and ability to apply various numerical techniques to approximate solutions to complex mathematical problems that are difficult or impossible to solve analytically, particularly focusing on areas like solving systems of				

		equations, finding roots of functions, interpolation, numerical differentiation, and integration, often utilizing computational tools to implement these methods.		
Course Out Comes		On successful completion of the course the students shall be able to: CO1 - Calculate errors induced in the values by truncation of a series expansion. CO2 - Demonstrate the applications of numerical methods to find the roots of polynomial equations and eigen values of real symmetric matrices. CO3 - Apply the knowledge of numerical methods in modelling of various physical and engineering phenomena. CO4 - Apply various numerical methods for solving linear Ordinary & Partial differential equations arising in engineering field.		
Course Content:				
Module 1	**Solution of Linear Systems of Equation**			**(12 Classes)**
Numerical Computation: Motivation and Objectives, Number Representation, Machine Precision, Round-of Error, Truncation Error, Random Number Generation. Solution of algebraic and transcendental equations: Various types of errors - Bisection method, Regula-Falsi method, Newton-Raphson method, Graffe's method - Bairstow's method - Newton's method for solving f(x,y) = 0 and g(x,y) = 0, secant method, Fixed point iteration method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel, Sufficient conditions for convergence - LU decomposition method, Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.				
Module 2	**Interpolation and Approximation**		**Assignment**	**(8 Classes)**
Interpolation with equal intervals, Newton's forward and backward difference formulae, Interpolation with unequal intervals, Lagrange's interpolation, Newton's divided difference interpolation, Cubic Splines, Difference operators and relations.				
Module 3	**Numerical Differentiation and Integration**			**(10 Classes)**
Numerical differentiation, Approximation of derivatives using interpolation polynomials, Numerical integration using Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule, Romberg's Method, Two point and three point Gaussian quadrature formulae, Evaluation of double integrals by Trapezoidal rule and Simpson's one-third rule				
Module 4	**Initial & Boundary Value Problems for Ordinary & Partial Differential Equations**		**Assignment**	**(15 Classes)**
Single step methods — Taylor's series method, Modified Euler's method, Fourth order Runge-Kutta method for solving first order equations, Multi step methods, Milne's and Adams, Bash forth predictor corrector methods for solving first order equations. Finite difference methods for solving second order, two-point linear boundary value problems, Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain, One-dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods, One-dimensional wave equation by explicit method.				
Targeted Application & Tools that can be used: The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design. Tools Used: Python.				
Assignment:				

7. Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.
Text Book 1. C.F.Gerald and P.O.Wheatley", Applied Numerical Analysis", McGraw-Hill, 1981. 2. Cheneg and Kincaid, "Introduction to Numerical Computing", Tata McGraw-Hill, 1998.
References: 1. SRK Iyengar & RK Jain, Numerical Methods, New Age Internationals. 2. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition 3. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers. **E-resources/ Web links:** 1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_135224 2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_141727 3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_217628 4. http://.ac.in/courses.php?disciplineID=111 5. http://www.class-central.com/subject/math(MOOCs) 6. http://academicearth.org/ 7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 8. https://www.scu.edu.au/study-at-scu/units/math1005/2022/
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Course Code: **CSE1512**	**Course Title: Analysis of Algorithms** **Type of Course: THEORY Only**	**L- T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**CSE2001 - Data Structures and Algorithms.**					
Anti-requisites	Nil					
Course Description	This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. This course discusses the classic approaches for algorithm design such as Divide and Conquer, Dynamic Programming, Greedy method. This course also describes other basic strategies					

	searching solution space. The core concepts of analyzing algorithms and classifying them into various complexity classes is covered in the end.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Analysis of Algorithms** and attain **Skill Development** through **Problem Solving** Methodologies.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Compute efficiency of a given algorithm.[Applying] 2. Apply divide and conquer technique for searching and sorting Problems.[Applying] 3. Apply the Dynamic Programming technique for a given problem. [Applying] 4. Apply greedy technique for solving a Problem.[Applying] 5. Demonstrate Back tracking technique and limitations of Algorithms.[Applying]			
Course Content:				
Module 1	**Introduction**	Assignment	Simulation/Data Analysis	**10 Sessions**
Introduction, Asymptotic Notations and its properties, Best case, worst case and average case-Sequential search, Sorting; Mathematical analysis for Recursive and Non-recursive algorithms: Substitution method and Master's Theorem.				
Module 2	**Divide-and-conquer**	Assignment	Simulation/Data Analysis	**08 Sessions**
Introduction. Insertion Sort; Merge sort, Quick sort, Binary search.				
Module 3	**Dynamic programming**	Term paper/Assignment	Simulation/Data Analysis	**10 Sessions**
Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Chain Matrix Multiplication.				
Module 4	**Greedy technique**	Term paper/Assignment	Simulation/Data Analysis	**09 Sessions**
Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm				
Module 5	**Complexity Classes**	Term paper/Assignment	Simulation/Data Analysis	**08 Sessions**
Complexity Classes- P,NP- NP Hard and NP Complete - Boolean Satisfiability Problem (SAT). Branch and Bound: Knapsack problem; Backtracking, - N-Queens problem.				
Text Book 1. Anany Levitin, *"Introduction to the Design and Analysis of Algorithms*", 3rd edition, Pearson Education, 2018.				

2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, *"Introduction to Algorithms*", 4th edition, MIT Press, 2022.

References

1. J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005.
2. Tim Roughgarden, *"Algorithms Illuminated"* (books 1 through 3), "Operating Systems Design and Implementation", Soundlikeyourself Publishing, 2017-2019.
3. AV Aho, J Hopcroft, JD Ullman, *"The Design and Analysis of Algorithms"*, Addison-Wesley, 1974.
4. Donald E. Knuth, "*The Art of Computer Programming",* Volumes 1and 3 Pearson.

Web-Resources

1. NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. Coursera: Analysis of Algorithms by Princeton University
3. Algorithms Specialization in Coursera by Stanford University(Group of 4 courses).
4. Algorithms Coding Contest Links maintained by Prof Gerth Stølting Brodal of Aarhus University

Topics relevant to "SKILL DEVELOPMENT": knapsack, prim's, kruskal's algorithm, quick sort, binary search for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: CSE2502	**Course Title: Operating Systems** **Type of Course: Program Core and Theory Only**	**L-T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE2009- Computer Organization, Problem solving using C Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended.					
Anti-requisites	**NIL**					
Course Description	This course introduces the concepts of operating system operations, operating system structure and its design and implementation. It covers the classical operating systems internal algorithms such as process scheduling, synchronization, deadlocks detection and recovery and memory management. The course also enhances the problem solving, systems programming ability and case studies.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain **Employability** through **Problem Solving** Methodologies.					

Course Out Comes	On successful completion of the course the students shall be able to: Describe the fundamental concepts of operating Systems and case studies. [**Knowledge**] 2] Demonstrate various CPU scheduling algorithms. .[**Application**] Apply various tools to handle synchronization problems.[**Application**]4] Demonstrate deadlock detection and recovery methods **[Application]** 5] Illustrate various memory management techniques.[**Application**]			
Course Content:				
Module 1	Introduction to Operating System	Assignment	Programming	**9 Hours**
Topics: Introduction to OS , Operating-System Operations, Operating System Services, , System Calls and its types, Operating System Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source operating system				
Module 2	Process Management	Assignment/Case Study	Programming/Simulation	**11 Hours**
Topics: Process Concept, Operations on Processes, Inter Process Communication, Communication in client-server systems (sockets, RPC, Pipes), Introduction to threads - Multithreading Models, Thread Libraries, Threading Issues, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR and Priority.				
Module 3	Process Synchronization and Deadlocks	Assignment	Programming	**11 Hours**
Topics: The Critical-Section Problem- Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization with Semaphore Solution- Producer-Consumer Problem, Reader-Writer problems, Dining Philosopher's Problem, . Introduction to Deadlocks, Necessary conditions for deadlock, Resource allocation Graph, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation, Deadlock detection & Recovery from Deadlock.				
Module 4	Memory Management	Assignment	Programming/Simulation	**10 Hours**
Topics: Introduction to Memory Management, Basic hardware-Base and Limit Registers, Memory Management Unit(MMU), Dynamic loading and linking, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Virtual Memory and Demand Paging – Page Faults and Page Replacement Algorithms, Copy-on-write, Allocation of Frames, Thrashing Introduction to File system management: File System Interface (access methods, directory structures), File system implementation.				
Targeted Application: **Application area is traffic management system, banking system, health care and many more systems where in there are resources and entities that use and manage the resources.** **Software Tools:** 1. Oracle Virtual Box/VMWare Virtualization software [Virtual Machine Managers]. Used to install andwork on multiple guest Operating Systems on top of a host OS. 2. Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.				
Project work/Assignment				

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].**
Text Book 1. Silberschatz A, Galvin P B and Gagne G , "Silberschatz's Operating System Concepts", Paperback, Global Edition Wiley, 2019 2.
References 1. Silberschatz A, Galvin P B and Gagne G, "Operating System Concepts", 10th edition Wiley, 2018. 2. William Stallings, "Operating Systems",Ninth Edition, By Pearson Paperback ,1 March 2018. 3. Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, " Cracking the Operating System skills", Dreamtech, paperback, 2020 4. Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , "Operating Systems: Three Easy Pieces, Amazon digital Services", September 2018. **E-resources/Weblinks** 5. https://www.os-book.com/OS9/ 6. https://pages.cs.wisc.edu/~remzi/OSTEP/ 7. https://codex.cs.yale.edu/avi/os-book/OS10/index.html

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

	3] Apply various tools to handle synchronization problems using semaphores and shared memory. [**Apply**] 4] Demonstrate memory management and file system concepts using simulation or scripting. **[Apply]**
Course Content:	

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

Software Tools:

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

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

of Laboratory Tasks:

sheet -1

L1: Write a program to demonstrate the use of fork() and exec() system calls in process creation.

L2: A system has limited memory and high-priority real-time processes. Design a scheduling algorithm that ensures responsiveness while preventing starvation.

sheet -2

L1: Implement First-Come-First-Serve (FCFS) process scheduling using C or Python.

L2: You are designing a server that handles thousands of client connections. Compare multithreading and multiprocessing for this task and implement a basic server model.

sheet -3

L1: Implement Round Robin Scheduling with a fixed time quantum.

L2: In a banking system, concurrent access to accounts leads to data corruption. Design a synchronization solution to avoid race conditions.

sheet -4

L1: Write a program to create threads using Pthreads or Python's threading module.

L2: You're tasked with building a file access tracker in an OS. Implement a system to log file access patterns and identify frequent accesses.

sheet -5

L1: Demonstrate inter-process communication (IPC) using pipes.

L2: A simulation tool needs to emulate process suspension and resumption. Design and implement such a mechanism using signals or condition variables.

sheet -6

L1: Simulate the Producer-Consumer problem using semaphores.

L2: You're developing a system where sensor devices (producers) generate temperature readings,

and data processors (consumers) store and process these readings. To prevent race conditions and ensure buffer safety, implement a synchronization mechanism using semaphores.

sheet -7

L1: Implement Dining Philosophers Problem using threads and synchronization.

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

sheet -8

L1: Write a program to simulate First Fit, Best Fit, and Worst Fit memory allocation strategies.

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

sheet -9

L1: Demonstrate paging using a simple page table simulation.

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

sheet -10

L1: Write a program to simulate page replacement algorithms like FIFO and LRU.

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

sheet -11

L1: Simulate file directory structure (single level/two level).

L2: A university campus computer lab has limited memory space available for each student login session. When students open files or run programs, memory pages are loaded into available memory frames. Due to the limited number of frames, some pages must be replaced when new ones are needed. The lab system uses page replacement algorithms to decide which pages to evict when memory is full..

sheet -12

L1: Write a shell script to demonstrate file handling commands in Linux.

L2: Design a command-line mini shell that can run background and foreground processes and handle basic built-in commands like cd, pwd, exit.

Project work/Assignment

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

Text Book

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

References

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

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

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

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

E-resources/Weblinks

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

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

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

Course Code: CSE1510	**Course Title: Database Management Systems** **Type of Course: 1) Program Core & Theory only**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Foundational understanding of data types, data structures, basic programming knowledge, familiarity with operating systems and file management. Basic knowledge of set theory, logic, and discrete mathematics to understand relational algebra and query formulation.					
Anti-requisites	NIL					
Course Description	This course introduces the foundational principles of database management systems, including data models, schemas, and architectures. This course provides a solid foundation on the relational model of data and the use of relational algebra. It develops skills in SQL for data definition, manipulation, and control, enabling students to construct and execute complex queries. The course also introduces the concept of object oriented and object relational databases and modern database technologies like **NoSQL.** The also course allows the students to gain insights into data storage structures and indexing strategies for optimizing query performance.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe the fundamental elements of relational database management systems. [Understand] 2. Examine databases using SQL query processing and Optimization. [Apply] 3. Design simple database systems applying the normalization constraints and demonstrate the database transaction processing, recovery, and security. [Apply] 4. Interpret the concept of advanced databases and its applications. [Apply]					

Course Content:

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

Topics:

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

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

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

Topics:

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

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

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

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

Topics:
Relational database design: Problems in schema design, redundancy and anomalies, Normal Forms based on Primary Keys-(1NF,2NF, 3NF), Boyce-Codd Normal Form, Multi valued Dependency (Fourth Normal Form), Join Dependencies (Fifth Normal Form), lossy and lossless decompositions, Database De-normalization.
Transaction Management: The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; The write-ahead log protocol; Check pointing; Recovering from a System Crash; Media Recovery; Other approaches and interaction with concurrency control.

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

Topics:
Advanced topics: Object oriented database management systems, Deductive database management systems, Spatial database management systems, Temporal database management systems, Constraint database management systems.
New database applications and architectures such as Data warehousing, Multimedia, Mobility, NoSQL, Native XML databases (NXD), Document-oriented databases, Statistical databases.

Targeted Application & Tools that can be used:
Application Area: Relational database systems for Business, Scientific and Engineering Applications.
Tools/Simulator used: MySQL DB for student practice.
Also demonstration of ORACLE DB on object-relational database creation and JDBC connection.

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

Text Books:
T1. Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.
T2. RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.
T3. W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.

References
R1 Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.
R2 M. Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly, 2017.

Topics relevant to development of "FOUNDATION SKILLS": S - Skill Development: Relational database design using ER- Relational mapping, Implementation of given database scenario using MYSQLDB.
Topics relevant to development of Employability: Develop, test and implement computer databases, creatingsophisticated, interactive and secure database applications
Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil

Course Code: CSE2503	**Course Title: Cryptography and Network Security**	**L- T-P- C**	3	0	0	3
Version No.						
Course Pre-requisites	"Data Communications and Computer Networks".					

Anti-requisites	.			
Course Description	The Course covers the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet. **Topics**: The cryptographic tools such as shared key encryption, public key encryption, key exchange, and digital signature are explored. The use and utilization of the internet protocols and applications such as SSL/ TLS, IPSEC, Kerberos, PGP, and S/ MIME, SET are reviewed. System security issues such as viruses, intrusion and firewalls are also explored.			
Course Objective	The objective of the course is **SKILL DEVELOPMENT** of student by using **PARTICIPATIVE LEARNING** techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: **CO1:** Identifies the basic concept of Cryptography **(Knowledge)** **CO2:** Express the different types of Cryptographic Algorithms. **(Comprehension)** **CO3:** Recognize the Public key Cryptographic Techniques for various applications. **(Comprehension)** **CO4:** Apply the network security concepts during their implementation of network security application developments. **(Application)**			
Course Content:				
Module 1	**Introduction to Cryptography**	Assignment	Identify the Concepts	08 Sessions
Topics: Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: active attacks, passive attacks, services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution Ciphers : Caesar, Mono alphabetic, Polyalphabetic, Play-fair and Hill Cipher, Introduction to Block Cipher and Stream Cipher, Festal Structure.				
Module 2	**Private Key Cryptography and Number Theory**	Assignment	Analysis of requirement of complexity in cryptography	13 Sessions
Topics: Symmetric Encryption Algorithms : Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, brief about primality testing and factorization, Discrete Logarithmic Problem, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese Remainder Theorem				
Module 3	**Public Key Cryptography and its Applications**	Assignment	Recognize the importance of various security concepts to achieve sufficient solutions	10 Sessions

	Topics: Overview of Public Key Cryptography, RSA, Diffie - Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Discussion on real time practices of Cryptography.			
Module 4	**Network Security**	Assignment	Implement the advanced network security algorithms in recent applications.	07 Sessions

Topics:

Network Security fundamentals, Network Security applications: Authentication: Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, Network Security applications: IP Security: IP Sec architecture, Network Security applications: Web Security.

Targeted Application & Tools that can be used:

Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages.

Assignment:

Assignment 1: Solve the problems of basic encryption techniques.

Assignment 2: Solve and analyze the problems on symmetric and asymmetric encryption.

Textbooks:

1.William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall, 8th Edition, 2019.

2. Wade Trappe and Lawrence C Washington, “Introduction to Cryptography with Coding Theory”, Pearson, 2020.

Reference Books:

1.Behrouz A Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security”, McGraw Hill, third edition, 2010.

2. R.Rajaram, “Network Security and Cryptography” SciTech Publication.3rd Edition, 2014.

3. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2nd Edition, 2019.

4. BruceSchneier, “Applied Cryptography", John Wiley and Sons Inc. Second Edition, 2015.

Web references:

1.https://onlinecourses.nptel.ac.in/noc22_cs90/preview

2.e-pgpathshala UGC lecture series : E-Series and Self learning Materials.

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ==

3. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=10133&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security

4.http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5875&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security.

Topics relevant to “Skill Development”: Symmetric and Asymmetric Encryption Algorithms and its problems.

Course Code: CSE2000	**Course Title: Software Design and Development** **Type of Course: School Core [Theory Only]**		**L-T- P-C**	**3-0-0-3**
Version No.	1.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles. The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course covers software quality, configuration management and maintenance.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Software Engineering and attain Skill Development through Participative Learning techniques.			
Course Out Comes	On successful completion of this course the students shall be able to: 1] Describe the Software Engineering principles, ethics and process models(Knowledge) 2] Identify the requirements, analysis and appropriate design models for a given application(Comprehension) 3] Understand the Agile Principles(Knowledge) 4] Apply an appropriate planning, scheduling, evaluation and maintenance principles involved in software(Application)			
Module 1	**Introduction to Software Engineering and Process Models (Knowledge level)**	Quiz		**10 Hours**
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 (Comprehension level)**	Assignment	Development of SRS documents for a given scenario	**12 Hours**
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 (Knowledge level)**	Quiz		**10 Hours**

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 (Application Level)**	Assignment	Apply the testing concepts using Programing	**13 Hours**
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.				
Targeted Application & Tools that can be used: Selenium, GitHub, CASE Tools				
Text Book 1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", VII Edition, McGraw-Hill, 7. 2. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGraw-Hill, 8.				
References 1. Rajib Mall, "Fundamentals of Software Engineering", VI Edition, PHI learning private limited, 2015. 2. Ian Sommerville, "Software Engineering", IX Edition, Pearson Education Asia, 2011. 3. Agile Software Development Principles, Patterns and Practices.1st Edition, Wiley, 2002				
Topics Relevant to "Skill Development: Balck box Testing, White box Testing, Automated Testing for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout				

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

Course Out Comes	On successful completion of the course the students shall be able to: 5. Demonstrate the database concepts, practice, and SQL queries. [Apply] 6. Design and implement database schemas while applying normalization techniques to optimize structure. [Apply]] 7. Develop and implement stored procedures, triggers, and views for automation and efficiency. [Apply] 8. To Design and build database applications for real world problems. [Apply]

Course Content:

List of Laboratory Tasks:

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

Labsheet-1 [3 Practical Sessions]

Experiment No 1: [1 Session]

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

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

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

Experiment No. 2: [2 Sessions]

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

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

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

Labsheet-2 [3 Practical Sessions]

Experiment No. 3: [1 Session]

3. Implement complex queries in SQL.

Level 1: Implement the conjugate of GROUP BY, ORDER BY and aggregate functions on Banking Database.

Level 2: Implement MySQL DB queries on library database using appropriate clauses and aggregate functions. Also order the data either in ascending and descending order using corresponding clause. [Library databases].

Experiment No. 4: [2 Session]

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

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

Labsheet-3 [2 Practical Sessions]

Experiment No. 5: [2 sessions]

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

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

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

Labsheet-4 [2 Practical Sessions]

Experiment No. 6: [2 Sessions]

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

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

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

Labsheet-5 [2 Practical Sessions]

Experiment No. 7: [2 Sessions]
7. To study and implement Functions, and Triggers in MySQL DB.
Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.
Level 2: Determine the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-6 [4 Practical Sessions]
Experiment No. 8: [2 Sessions]
8. To implement the concept of forms and reports.
Level 1: Implement the concept of forms and reports.
Level 2: Examine the schema relationship.

Experiment No. 9: [2 Sessions]
9. Create the database using the given schema. (Flight Management)
Level 1: Implement a relational database based on the provided schema for the Flight Management system, including the creation of tables, relationships, and constraints.
Level 2: Demonstrate schema relationships by defining primary and foreign keys to ensure data integrity within the Flight Management database.

Labsheet-7 [4 Practical Sessions]
Experiment No. 10: [2 Sessions]
10. Create the database using the given schema. (Company database)
Level 1: Implement the database schema by defining tables, relationships, and constraints according to the given Company Database schema.
Level 2: Demonstrate the schema's relationships and data integrity by creating and linking tables as per the specified requirements.
Experiment No. 11: [2 Sessions]
11. Create the database using the given schema. (Student Library)
Level 1: Implement forms and reports based on the provided Student Library database schema, ensuring effective data entry and reporting mechanisms.
Level 2: Demonstrate the schema relationships within the Student Library database, demonstrating how these relationships influence the creation and functionality of forms and reports.

Labsheet-8 [1 Sessions]
12. Design a mini project based on the databases such as Inventory Management System, University Management System, Hospital Management System, etc.
Level 1: Implement the real time database.
Level 2: Analyze the working of database in real time.

Course Code: CSE2500	**Course Title: Theory of Computation** **Type of Course: Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	The students should have the Knowledge on Set Theory					
Anti-requisites	Nil					

Course Description	The course deals with introduction of formal languages and the correspondence between language classes and the automata that recognize them. Topics include: Formal definitions of grammars and acceptors, Deterministic and Nondeterministic systems, Grammar ambiguity, finite state and push-down automata; normal forms; Turing machines and its relations with algorithms.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Theory of Computation as mentioned above** and attain **Skill Development** through **Problem Solving** Methodologies.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe various components of Automata. (Knowledge) 2. Illustrate Finite Automata for the given Language. (Application) 3. Distinguish between Regular grammar and Context free grammar. (Comprehension) 4. Construct Push down Automata. (Application) 5. Construct Turing machine for a Language. (Application)			
Course Content:				
Module 1	**Introduction to automata theory**	Assignment	Problems on Strings and Language operations	**06 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				
Module 2	**Finite Automata**	Assignment	Problems on DFA, NFA's	**13 Sessions**
Topics: Basic concepts of Finite automata, DFA- definitions of DFA, Deterministic Accepters Transition Graphs and Languages and DFA's, 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.				
Module 3	**Regular Expressions & Context Free Grammar**	Assignment	Problems on RE, CFG, PT, PL and Ambiguity	**12 Sessions**
Topics: 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 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.				
Module 4	**Push down Automata**	Assignment	Problems on pushdown Automaton	**08 Sessions**
Topics: 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 5	**Turing Machine**	Assignment	Problems on Turning Machine	**07 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
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. It's interactive educational software written in Java to experiment topics in automata theory. 2. Turing machine Online simulators.
Text Book 1. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publications 6th Ed, 2018.
References 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** NPTEL course – https://onlinecourses.nptel.ac.in/noc21_cs83/preview
Topics relevant to "SKILL DEVELOPMENT": Deterministic and Non-Deterministic Automaton, Regular Expressions, CFGs, Turning Machine and Pushdown automaton for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: **CSE1513**	**Course Title:** **Analysis of Algorithms Laboratory** **Type of Course: Integrated**	**L- T-P- C**	0	0	2	1
Version No.	1					
Course Pre-requisites	**CSE2001 - Data Structures and Algorithms.**					
Anti-requisites	NIL					
Course Description	This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. This course discusses the classic approaches for algorithm design such as Divide and Conquer, Dynamic Programming, Greedy method. This course also describes other basic strategies searching solution space. The core concepts of analyzing algorithms and classifying them into various complexity classes is covered in the end.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Analysis of Algorithms** and attain **Skill Development** through **Experiential Learning** Methodologies.					

Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Compute efficiency of a given algorithm. [Applying] 2. Apply divide and conquer technique for searching and sorting Problems.[Applying] 3. Apply the Dynamic Programming technique for a given problem. [Applying] 4. Apply greedy technique for solving a Problem.[Applying] 5. Demonstrate Back tracking technique and limitations of Algorithms.[Applying]	
Course Content		
Module 1	**Introduction**	**3 Sessions**
Measuring running time of an algorithm, Compare running time of algorithms, Implement sorting algorithms such as bubble sort, selection sort		
Module 2	**Divide-and-conquer**	**3 Sessions**
Compare searching algorithms: Linear Search, Binary Search; Compare Sorting algorithms: Insertion Sort, Merge Sort, QuickSort.		
Module 3	**Dynamic programming**	**3 Sessions**
Introduction and memorization: Factorial; Coin Change Problem ; Floyd-Warshall's Algorithm.		
Module 4	**Greedy technique**	**3 Sessions**
Fractional Knapsack Problem; Minimal Spanning Tree Algorithms-Prim's Algorithm, Kruskal's algorithm		
Module 5	**Complexity Classes**	**3 Sessions**
Branch and Bound: Knapsack problem; Backtracking, - N-Queens problem.		
	List of Laboratory Tasks: **1. Measuring running time of an algorithm** **Objective: To experimentally determine the running time of basic algorithms for input size n=10, 100, 1000, etc. by taking difference of starting time and ending time.** **2. Compare running time of algorithms** **Objective: To execute two algorithms to solve the same problem, and to comparatively evaluate the better algorithm for large values of N.** **3. Implement sorting algorithms such as bubble sort, selection sort** **Objective: To implement comparison based sorting strategies.** **4. Compare searching algorithms** **Objective: To implement two searching strategies and compare their performance.** **5. Compare Sorting algorithms** **Objective: To implement searching strategies that follow top down design approach(Insertion sort, merge sort).** **6. Quick Sort**	

	Objective: To demonstrate Quick sort and its variants, and their impact on running time. **7. Dynamic Programming** **Objective: To demonstrate Dynamic Programming approach with the help of Factorial algorithm.** **8. Coin Change Problem** **Objective: To implement an efficient algorithm for the Coin Change problem.** **9. Floyd-Warshall's Algorithm** **Objective: To demonstrate how dynamic programming is used with the help of Floyd-Warshall's algorithm.** **10. Fractional Knapsack Problem** **Objective: To demonstrate how greedy method can be used to solve the Fractional Knapsack Problem.** **11. Minimal Spanning Tree Algorithm** **Objective: To implement greedy strategy to solve the Minimal Spanning Tree problem using Prim's Algorithm.** **12. Kruskal's Minimal Spanning Tree Algorithm** **Objective: To implement greedy strategies to solve the Minimal Spanning Tree problem using Kruskal's Algorithm.** **13. Knapsack Problem** **Objective: To implement Knapsack problem using branch and bound technique.** **14. N-Queen's Problem** **Objective: To demonstrate backtracking method with the help of N-Queen's problem.** **15. Case Study** **Objective: To demonstrate how various techniques can be used to solve the same problem with the help of Knapsack problem.**
	Targeted Application & Tools that can be used 1. PyTorch/Jupyter Notebook – For Python programming
	Text Book **T1** Anany Levitin, *"Introduction to the Design and Analysis of Algorithms*", 3rd edition, Pearson Education, 2018. **T2** Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, *"Introduction to Algorithms*", 4th edition, MIT Press, 2022.

	References R1. J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005. R2. Tim Roughgarden, *"Algorithms Illuminated"* (books 1 through 3), "Operating Systems Design and Implementation", Soundlikeyourself Publishing, 2017-2019. R3. AV Aho, J Hopcroft, JD Ullman, *"The Design and Analysis of Algorithms"*, Addison-Wesley, 1974. R4. Donald E. Knuth, "*The Art of Computer Programming",* Volumes 1and 3 Pearson. Web Based Resources and E-books: W1. NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs47/preview W2. Coursera: Analysis of Algorithms by Princeton University W3. Algorithms Specialization in Coursera by Stanford University(Group of 4 courses). W4. Algorithms Coding Contest Links maintained by Prof Gerth Stølting Brodal of Aarhus University
	Topics relevant to "EMPLOYABILITY SKILLS": The lab experiments and assessments enable the student to acquire Skill Development through Experiential Learning techniques

Course Code: CSE1700	**Course Title:** Essentials of AI **Type of Course:** Theory		**L- T-P- C**	3	**0**	0	**3**
Version No.	2.0					
Course Pre-requisi Data **tes**	Basic knowledge of programming, mathematics, understanding of data handling					
Anti-requisites	**NIL**					
Course Description	This course is a comprehensive introductory course designed to equip learners with the fundamental Python programming skills necessary to work with artificial intelligence (AI) technologies. This course is aimed at individuals who are new to AI but have a basic understanding of programming concepts. It combines Python programming fundamentals with hands-on experience in implementing AI techniques such as machine learning, neural networks, and natural language processing.					
Course Objective	The objective of the course is to Understand Python Programming Fundamentals, Manipulate and Process Data with Python, Implement Machine Learning Algorithms and Build and Train Neural Networks for AI Applications.					
Course Outcomes	On successful completion of the course the students shall be able to: CO 1: Apply Python Programming to AI Projects CO 2: Build and Train Machine Learning Models CO 3: Develop Deep Learning Models with Neural Networks CO 4: Deploy AI Solutions and Understand Ethical Implications					
Course Content:						
Module 1	Introduction to Python Programming for AI	Assignment	Implementation			**10 Sessions**

Topics:
Python Basics: Variables, Data Types, Operators, and Control Flow Functions, Loops, and Conditionals statements, Data Structures: Lists, Tuples, Dictionaries, Sets ,Introduction to Libraries: NumPy and Pandas for data manipulation, Basic Input/Output and File Handling
Introduction to Python for AI: Libraries and Frameworks Overview

Module 2	Data Processing, Visualization	Assignment	Implementation	10 Sessions

Topics:
cleaning and preprocessing with Pandas,Handling missing data, outliers, and duplicates, Data transformation (Normalization, Encoding), Introduction to Matplotlib and Seaborn for Data Visualization, Exploratory Data Analysis (EDA), Visualizing datasets to understand patterns and relationships.

Module 3	Introduction to Machine Learning	Mini - Project	Implementation	10 Sessions

Topics:
What is Machine Learning? Types of ML algorithms Supervised Learning: Regression, Classification, Unsupervised Learning: Clustering, Key ML Algorithms: Linear Regression, Decision Trees, K-Means ,Introduction to Scikit-learn library
Model evaluation (Accuracy, Precision, Recall, Confusion Matrix)

Module 4	Neural Networks and Deep Learning	Quiz	Implementation	10 Sessions

Topics:
Introduction to Neural Networks and Deep Learning, Perceptron Model and Backpropagation
Deep Neural Networks and Activation Functions, Introduction to TensorFlow and Keras, Building and Training Neural Networks for Image and Text Classification, Overview of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs)

Targeted Application & Tools that can be used:
Applications:

1. **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.
2. **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
3. **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
4. **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).
5. **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

Tools:

- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine

learning tasks. • **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models. • **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models. **NLTK**: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging. **spaCy**: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing. **Transformers (by Hugging Face)**: A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.
Text Book(s): T1: **Essentials of Python for Artificial Intelligence and Machine Learning** by Pramod Gupta and Anupam Bagchi
Reference(s): • "Artificial Intelligence with Python" – Prateek Joshi • "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili • "Hands-On Artificial Intelligence with Python" – Teet Straus • "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

Course Code: CIT2500	Course Title: Fog Computing for IoT Type of Course: **Theory Only Course**	L- T -P- C	3	0	0	3
Version No.						
Course Pre-requisites	Innovative Projects using Aurdino					
Anti-requisites						
Course Description	The course will provide a solid base for understanding the challenges and problems underlying the design and development of fog computing systems and applications. Thus, this course will teach how to specify, design, program, analyze and implement such systems and applications. Fog computing is a decentralized computing infrastructure in which data, compute, storage and applications are located somewhere between the data source and the cloud. Like edge computing, fog computing brings the advantages and power of the cloud closer to where data is created and acted upon. Many people use the terms fog computing and edge computing interchangeably because both involve bringing intelligence and processing closer to where the data is created. This is often done to improve efficiency, though it might also be done for security and compliance reasons.					

<table>
<tr><td>Course Objectives</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Network Slicing, Big Data Analytics and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of this course the students shall be able to:
1] Describe the basic principles and concepts of fog computing systems and their relation to other models such as Cloud Computing and Near-Far computing. [Understand]
2] Identify the challenges of developing fog-based applications and middleware, and the possible solutions. [Apply]
3] Solve various issues related to fog computing, programming model and Software Defined Network. [Apply]
4] Apply best approach for a particular problem regarding the design and development of a fog computing system.[Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>INTRODUCTION TO FOG COMPUTING</td><td>Assignment</td><td>Programming activity</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Fog Computing, Characteristics, Application Scenarios, Issues and challenges. Fog Computing, Internet of Things-Pros and Cons-Myths of Fog Computing -Need and Reasons for Fog Computing Fog Computing and Edge Computing-IoT , FOG, Cloud Benefits.</td></tr>
<tr><td>Module 2</td><td>FOG ARCHITECTURE</td><td>Assignment</td><td>Programming activity</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Fog Computing Communication Technologies: Introduction, IEEE 802.11,4G,5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.</td></tr>
<tr><td>Module 3</td><td>MANAGEMENT AND ORCHESTRATION</td><td>Assignment</td><td>Programming activity</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds.</td></tr>
<tr><td>Module 4</td><td>FOG INTEGRATION TECHNOLOGIES WITH IOT</td><td>Assignment</td><td>Programming activity</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:
IoT Integration, Security Management for Edge Cloud Architectures. Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation. Case Study: Intelligent Traffic Lights Management (ITLM) System, Fog Computing for Smart Transportation Applications, Fog-IoT: architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, security and privacy issues.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used: Case Study: Wind Farm - Smart Traffic Light System, Wearable Sensing Devices, Wearable Event Device ,Wearable System, Demonstrations , Post</td></tr>
</table>

Application Example . . Event Applications Example.

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

1] Problem Solving: Choose an appropriate set of visualization elements and design for a dashboard.

2] Programming: Implementation of the chosen dashboard

Text Book

1. Abbas, Assad, Samee U. Khan, and Albert Y. Zomaya, eds. *Fog Computing: Theory and Practice*. John Wiley & Sons, 2020. https://www.wiley.com/en-us/Fog+Computing%3A+Theory+and+Practice
2. Buyya, Rajkumar, and Satish Narayana Srirama, eds. *Fog and edge computing: principles and paradigms*. John Wiley & Sons, 2019. https://www.wiley.com/en-us/Fog+and+Edge+Computing%3A+Principles+and+Paradigm
3. Misra, Sudip, Subhadeep Sarkar, and Subarna Chatterjee. Sensors, cloud, and fog: the enabling technologies for the Internet of Things. CRC Press, 2019. https://www.routledge.com/Sensors-Cloud-and-Fog-The-Enabling-Technologies-for--the-Internet-of-Things/Misra-Sarkar-Chatterjee

Reference Books:

1. Mahmood, Zaigham, ed. Fog computing: concepts, frameworks and technologies. Springer, 2018. https://link.springer.com/book/10.1007/978-3-319-94890-4
2. Tanwar, Sudeep, and Tanwar. Fog computing for Healthcare 4.0 environments. Springer International Publishing, 2021. https://www.sciencedirect.com/science/article/pii/S0045790618303860
3. Tomar, R., Katal, A., Dahiya, S., Singh, N., & Choudhury, T. (Eds.). (2022). Fog Computing: Concepts, Frameworks, and Applications (1st ed.). Chapman and Hall/CRC. https://www.taylorfrancis.com/books/edit/10.1201/9781003188230/fog-computing-ravi-tomar-avita-katal-susheela-dahiya-niharika-singh-tanupriya-choudhury

Web Based Resources and E-books:

1. https://www.codecademy.com/learn/learn-c-sharp
2. https://dotnet.microsoft.com/en-us/learn/csharp
3. https://www.learncs.org/
4. https://www.codechef.com/learn/course/c-sharp
5. https://csharp-station.com/

Topics relevant to "SKILL DEVELOPMENT": Network Slices in 5G, Big Data Analytics, Fog, Prototypes and Evaluation for developing Skills through PARTICIPATIVE LEARNING techniques. This is attained through assessment component mentioned in the course handout.

Course Code: CIT2501	**Course Title: Wireless communication in IOT**	**L-T-P-C**	3 -0-0-3
Version No.	1.0		

Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	Wireless communication system is the essential part for IoT infrastructure, which acts as the bridge for dual directional communication for data collection and control message delivery. The purpose of this course is to expose the students to understand the fundamentals of wireless network and problems related to real-world scenarios. This course is both conceptual and analytical in nature.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Wireless communication in IOT** and attain **Skill Development** through **Participative Learning** techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. To understand the fundamentals of wireless networks 2. Analyze the standards of IoT which employed for wireless networks 3. Explain the use of various wireless technologies in IoT 4. Design and develop various applications of IoT			
Course Content:				
Module 1	Cellular standards	Assignment	Programming Task	**9 Sessions**
Topics: Cellular carriers and Frequencies, Channel allocation, Cell coverage, Cell Splitting, Microcells, Picocells, Handoff, 1st, 2nd, 3rd and 4th Generation Cellular Systems (GSM, CDMA, GPRS, EDGE,UMTS), Mobile IP, WCDMA				
Assignment: Case study on generation cellular systems.				
Module 2	Radio Frequency (RF) Fundamentals	Assignment	Data Collection/Excel	**10 Sessions**
Topics: Introduction to RF & Wireless Communications Systems, RF and Microwave Spectral Analysis, Communication Standards, Understanding RF & Microwave Specifications. Spectrum Analysis of RF Environment, Protocol Analysis of RF Environment, Units of RF measurements, Factors affecting network range and speed, Environment, Line-of-sight, Interference, Defining differences between physical layers- OFDM. **Assignment:** Determination of RF and Microwave spectral Analysis				
Module 3	WLAN: Wi-Fi Organizations and Standards	Assignment	Programming/Data analysis task	**9 Sessions**
Topics: IEEE, Wi-Fi Alliance, WLAN Connectivity, WLAN QoS & Power-Save, IEEE 802.11 Standards,802.11- 2007,802.11a/b/g, 802.11e/h/I,802.11n				

Assignment: Protocols on WLAN connectivity				
Module 4	Wi-Fi Hardware & Software	Assignment	Programming/Data analysis task	**10 Sessions**

Topics:

Access Points, WLAN Routers, WLAN Bridges, WLAN Repeaters, Direct-connect Aps, Distributed connect Aps, PoE Infrastructure, Endpoint, Client hardware and software, Wi-Fi Applications

Targeted Protocols & Tools that can be used:

Bluetooth, ZigBee, LoRa, NBIoT, WiFi, and Thread

Text Book

T1: Wireless Communications – Principles and Practice; by Theodore S Rappaport, Pearson Education Pte. Ltd.

T2: Wireless Communications and Networking; By: Stallings, William; Pearson Education Pte. Ltd.

References

R1:Bluetooth Revealed; By: Miller, Brent A, Bisdikian, Chatschik; Addison Wesley Longman Pte Ltd., Delhi 4. R2:Wilson , "Sensor Technology hand book," Elsevier publications 2005. 5.

R3: Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005

Weblinks:

W1: https://pianalytix.com/wireless-communication-protocols-in-iot/

W2: https://behrtech.com/blog/6-leading-types-of-iot-wireless-tech-and-their-best-use-cases/

Topics relevant to "SKILL DEVELOPMENT":

GSM, CDMA for developing **Skill Development** through **Participative Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: CIT2502	**Course Title: Privacy and Security in IoT**	**L- T-P- C**	**3-0-0-3**
Version No.	**1.0**		
Course Pre-requisites	The primary prerequisite is a working knowledge of basic algebraic number theory, which includes number fields, rings of integers, factorization of ideals into primes A working knowledge of basic algebraic number theory. Basic concepts of cryptography like encryption decryption, Signature generation and verifications.		
Anti-requisites	NIL		

Course Description	The purpose of this course is to enable the students to appreciate the need for cryptography and to identify the applications of cryptography in Internet of Things (IoT). The course is both conceptual and analytical in nature and needs fair knowledge of mathematics and computing. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Privacy and Security in IoT and attain Skill Development through Problem Solving Methodologies.			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. **Explain** benefits of modern cryptographic algorithms 2. **Apply** the Elliptic curve Diffie Hellman and digital signature algorithms to encrypt-decrypt , generate and verify the signatures 3. **Estimate** the performance of ECC with other traditional cryptography algorithms.			
Course Content:				
Module 1	**Introduction to Elliptic Curves**	Quiz	Comprehension based Quizzesand assignments;	**15 Classes**
Topics: **Elliptic Curve Cryptosystems (ECC):** Introduction to ECC, Method of Diophantus, Elliptic curves in Cryptography, Discrete Logarithms in Finite Fields, Elliptic Curve on a finite set of Integers, Definition of Elliptic curves,General form of a EC, Weierstrass Equation, Points on the Elliptic Curve (EC),The Abelian Group, Operations on ECC- Point addition, Point doubling.				
Module 2	**Elliptic Curve Cryptosystems**	Quizzes and assignments	Comprehension based Quizzes and assignments;	**15 Classes**
Topics: E**lliptic Curve Cryptosystems (ECC):** Public-Key Cryptosystems, Public-Key Cryptography, What Is Elliptic Curve Cryptography (ECC)?,Using Elliptic Curves In Cryptography, Generic Procedures of ECC, Example – Elliptic Curve Cryptosystem Analog to El Gamal, Diffie-Hellman (DH) Key Exchange, ECC Diffie-Hellman, Example – Elliptic Curve Diffie-Hellman Exchange, Elliptic Curve Digital Signature Algorithm (ECDSA) Why use ECC?, Security of ECC, Applications of ECC, Benefits of ECC.				
Module 3	IOT Protocols	Assignment and Labprojects with presentation	Project implementations insoftware, batch wise presentations	**10 Classes**
Topics: **IoT Communication model and Protocols :** Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (COAP), Advanced Message Queuing Protocol (AMQP), Extensible Messaging andPresence Protocol (XMPP), Introduction, Principle of RFID, Components of an RFID system.				
Targeted Application & Tools that can be used: **Application areas are to secure crypto currency- Bitcoin, Ethereum and Ripple using ECC in key agreement, digital signatures.** **Professionally Used Software:** elliptic2 : https://www.graui.de/code/elliptic2/				
Project work/Assignment:				
Each batch of students (self-selected batch mates) will identify projects from searching on Google, and implement with the most suitable 2 or 3 NIST /SECP curves **Project Assignment:**				

Assignment: 1] Collect the running time of ECC on different standard NIST curves. **Assignment 2: Prepare a compressive report on the efficiency of NIST Vs SECP curves.**
Textbook(s): **1. I. Blake, G. Seroussi, N. Smart, Elliptic Curves in Cryptography , Cambridge University 2020** **2. Arshdeep Bagha, Vijay Madisetti, "Internet of Things - A hands on approach", Universities Press, 2021.**
References **1. Joseph H Silver man The Arithmetic of Elliptic Curves: Springer; 2nd Edition April 2016** **2. Darrel Hankerson, Scott Vanstone, Alfred J. Menezes Guide to Elliptic Curve Cryptography Springer 2018**
Topics related to development of "SKILL DEVELOPMENT": IOT Protocols, Elliptic Curve Cryptosystem, for Skill Development through Participative Learning Techniques. This is attained through assessment components as **mentioned in the course handout.**

urse Code: T2400	**Course Title: Cyber-Physical Systems** **pe of Course: Theory**	**P- T-C**		**)**	**0**	**3**
rsion No.						
urse Pre-requisites	Nil					
ti-requisites	L					
urse Description	This course introduces students to an industrial viewpoint of Cyber-Physical Systems which includes sensors and actuators, computing and communication systems. It will also include networking protocols, security and various CPS/IoT applications. This course helps to make students industry-ready and equip them with the domain knowledge needed to take up projects in Cyber-Physical Systems Topics include Computational foundation of Cyber Physical Systems, Cyber Physical System Design and system requirements Physical System Platforms Embedded Systems vs Internet of Things vs Cyber Physical System and Concurrent Models of computation					
urse Outcomes	On successful completion of this course the students shall be able to: 1. Describe the need and purpose of the different components of Cyber Physical Systems. (Understand). 2. Scribe the ability to interact with Cyber Physical System (Understand). 3. Demonstrate a new system and with which a product can be made. (Apply). 4. Classify common methods used to secure cyber-physical systems. (Understand)					
Course Content:						
)dule 1	**roduction**	signment			**2 Sessions**	

pics:

sors and Actuators, Embedded Processors and Memory Models, Input/Output and Device Interfaces, Finite State Machines in Hardware, Hybrid Systems: Modal Models, Concurrency Models: Synchronous-Reactive, Timed, Dataflow, Hierarchical State Machines, Multitasking and Threads, Message Passing and Synchronization, Deadlocks and Race Conditions, Timed Automata, Design Case Study

dule 2	**undations of CPS**	signment		**1 Sessions**

pics:

Introduction to Cyber-Physical Systems (CPS), CPS Characteristics and Applications, Reactive Systems and Concurrency, Synchronous Models: Components, Inputs/Outputs, Extended State Machines, Finite-State and Nondeterministic Systems, Composition of Components, Modeling Behaviors: Traces and Execution, Continuous-Time Models & Newtonian Mechanics, Linear and Non-linear Dynamics, Overview of Model-Based Design

dule 3	**Scheduling, Real-Time Systems, and Verification**	signment		**2 Sessions**

Topics:

Real-Time Constraints and Requirements, Periodic Job Models, Rate Monotonic Scheduling, Earliest Deadline First Scheduling, Multiprocessor Scheduling, Mutual Exclusion and Resource Sharing, Temporal Logic (LTL), Safety and Invariant Properties, Model Checking (Reachability & Liveness), Symbolic Techniques & BDDs, Formal Verification Tools Overview

dule-4	**Applications**	signment		**10 Sessions**

Topics:

Hybrid Systems and Zeno Behavior, Stability and Controller Design, Feedback and PID Controllers, Simulation and Numerical Methods, Distributed Coordination and Consensus, Leader Election and Reliable Messaging, CPS Security Principles, Software and Network Security in CPS, Fault Tolerance and Robustness, Case Study: Automotive or Medical CPS

ject work/Assignment:

1. **Assignment 1 on (Module 1 and Module 2)**
2. **Assignment 2 on (Module 3 and Module 4)**

REFERENCE MATERIALS:

TEXTBOOKS

1. Rajeev Alur, ”Principles of Cyber Physical Systems”, MIT Press, 2023, ISBN: 9780262548922
2. E. A. Lee, Sanjit Seshia , "Introduction to Embedded Systems – A Cyber–Physical Systems Approach", Second Edition, MIT Press, 2017, ISBN: 978-0-262-53381-2

REFERENCES

1. Pedro H. J. Nardelli, “Cyber-physical Systems: Theory, Methodology, and Applications”, wiley publications, 2022,
2.

JOURNALS/MAGAZINES

I. IEEE Transactions on Industrial Cyber-Physical Systems
https://www.ieee-ies.org/pubs/transactions-on-industrial-cyberphysical-systems

II. ACM Transactions on Cyber-Physical Systems

https://dl.acm.org/journal/tcps

III. IET Cyber-Physical Systems: Theory & Applications
https://ietresearch.onlinelibrary.wiley.com/journal/23983396

SWAYAM/NPTEL/MOOCs:

1. NPTEL - Foundations of Cyber Physical Systems
2. Coursera – Cyber-Physical Systems: Modelling and Simulation
3. TCS - Cyber-Physical Systems

<table>
<tr><td>Course Code: CSE3146</td><td colspan="3">Course Title: Scalable Application Development using Java
Type of Course: 1] Program Core</td><td>L- T-P- C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td></td><td colspan="6">1.0</td></tr>
<tr><td></td><td></td><td colspan="6"></td></tr>
<tr><td>Course Pre-requisites</td><td></td><td colspan="6">[1] Problem Solving Using Java (CSE1001)
[2] Database Management System (CSE3156)</td></tr>
<tr><td></td><td></td><td colspan="6"></td></tr>
<tr><td>Anti-requisites</td><td></td><td colspan="6">NIL</td></tr>
<tr><td>Course Description</td><td></td><td colspan="6">The purpose of this course is to provide students with an in-depth understanding of advanced concepts and techniques in Java development. The course is both conceptual and analytical and is understood with JDK 21 software & Eclipse IDE. This course involves essential core java concepts like multithreading, file handling, annotations, generics, lambda expressions etc. This course also develops critical thinking skills by augmenting the student's ability to develop web application for various modern management systems like banking management system, student information management system, , Library Management System etc. with the necessary API for communication with database.</td></tr>
<tr><td>Course Objectives</td><td></td><td colspan="6">The objective of the course is to familiarize the learners with the concepts of Advanced Java Programming and attain Employability Skills through Experiential Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td></td><td colspan="6">On successful completion of this course the students shall be able to:
CO1. Apply Concurrent Programming using Java Multi-Threading. [Apply]
CO2. Practice the access mechanism to read/write file systems using Java I/O Operations. [Apply]
CO3. Interpret Communication/Connection mechanisms of Java with DBMS. [Apply]
CO4. Implement Generics, Annotations & Lambda expressions using Java Programs.
[Apply]
CO5. Develop & Test Web application using Servlet & JSP. [Apply]</td></tr>
<tr><td>Course Content:</td><td></td><td colspan="6"></td></tr>
<tr><td colspan="2">Module 1</td><td colspan="2">Multi-Threading</td><td>Assignment</td><td colspan="2">Multi-Threading</td><td>9 Sessions</td></tr>
<tr><td></td><td colspan="7">Multi-Threading in Java: Understanding Threads , Needs of Multi-Threaded Programming ,Thread Life-Cycle, Thread Priorities , Synchronizing Threads, Inter Communication of Threads , Dead lock, Concurrency Framework .</td></tr>
<tr><td colspan="2">Module 2</td><td colspan="2">Input / Output & File Handling</td><td>Assignment</td><td colspan="2">File Operations</td><td>9 Sessions</td></tr>
</table>

	Java I/O Operations : Input/ Output Operation in Java(java.io Package), Streams and the new I/O Capabilities ,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.			
Module 3	Collection and Database programming using JDBC	Assignment	Collection & Connection to DB	**9 Sessions**
	Collection – Enum, Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, Use of Array List & Vector, Comparable and Comparator Interfaces. **Database Programming using JDBC**- Introduction to JDBC, JDBC Drivers & Architecture, CRUD operation Using JDBC, Connecting to non-conventional Databases.			
Module 4	Modern Java Features	Assignment	Advanced Java Features	**9 Sessions**
	Annotation : Basics, Type and Repeating Annotation - Generics : Generic Class, Bounded Types using wild card arguments, Generic Methods, Generic Interfaces- Lambda Expressions : Block Lambda, Generic functional Interfaces, Passing Lambda expressions as arguments, Lambda Expressions & Exceptions, Variable Capture, Method & constructor references, Reflection			
Module 5	Distributed Programming with Servlet	Assignment	Distributed Programming	**9 Sessions**
	Web Application Basics: Introduction to Servlet & JSP, Servlet life cycle, Developing and Deploying Servlets, create and compile servlet source code, Web Server, servlet API, Handling HTTP Requests and Responses: Handling HTTP GET requests and POST request, Using Cookies, Session Tracking, Simple Servlet Program to fetch database records			
	Text Books 1] Herbert Schildt, *"Java 2: The Complete Reference"*, Tata McGraw-Hill Education, 12th Edition,2021.			
	References 1] Y.Daniel Liang, "Introduction to Java programming Comprehensive Version", Pearson Education, 10th Edition, 2018. 2] Cay S Horstmann and Gary Cornell, "CORE JAVA volume II-Advanced Features, 9th Edition,2016. 3] Core and Advanced Java Black Book, Dream Tech Press. **e-Resources** 1. https://docs.spring.io/spring-framework/reference/core.html 2. https://docs.oracle.com/javaee/7/api/javax/servlet/Servlet.html 3. https://docs.oracle.com/javaee/5/tutorial/doc/bnajo.html 4. https://docs.oracle.com/javase/tutorial/jdbc/basics/index.html			

Course Code: CSE3146	Course Title: Scalable Application Development using Java Lab Type of Course: 1] Laboratory Program Core	L- T-P-C	0	0	4	2

Version No.		1.0
Course Pre-requisites		[1] Problem Solving Using Java (CSE1001) [2] Database Management System (CSE3156)
Anti-requisites		NIL
Course Description		The purpose of this course is to provide students with an in-depth hands-on on implementing the advanced concepts and techniques in Java development. This course is implemented with JDK 21 & Eclipse IDE. This course involves implementation of essential core java concepts like multithreading, file handling, annotations, generics, lambda expressions etc. In this course the students also implements development of web application for various modern management systems like banking management system, student information management system, , Library Management System etc. with the necessary API for communication with database.
Course Objectives		The objective of the course is to implement the the concepts of Advanced **Java Programming** and attain **Employability Skills** through **Experiential Learning techniques.**
Course Outcomes		On successful completion of this course the students shall be able to: CO1. Implement Concurrent Programming using Java Multi-Threading. [Apply] CO2. Develop the access mechanism to read/write file systems using Java I/O Operations. [Apply] CO3. Develop the Communication/Connection mechanisms of Java with DBMS. [Apply] CO4. Implement Generics, Annotations & Lambda expressions using Java Programs. [Apply] CO5. Develop, Test and Deploy Web application using Servlet, JSP and Web Servers. [Apply]
Course Content:		

Module 1	Multi-Threading	Assignment	Multi-Threading	**6 Sessions**
Multi-Threading in Java: Implementation of Multi-Threaded Programming , Constructing Program to demo Thread Life-Cycle and Thread Priorities , Develop program on Synchronizing Threads and Inter Communication of Threads , Implement Dead lock and Concurrency Framework .				
Module 2	Input / Output & File Handling	Assignment	File Operations	**6 Sessions**
Java I/O Operations : Develop program on Input/ Output Operation in Java(java.io Package), Constrcut program with Streams and the new I/O Capabilities , Implement File Object, File I/O Basics to Read and Write to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Implement Serialization & De-Serialization. Construct program using Observer and Observable				

Interfaces.				
Module 3	Collection and Database programming using JDBC	Assignment	Collection & Connection to DB	**6 Sessions**
Collection – Implementing Collections Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Hashing, Developing program by using Array List & Vector, Comparable and Comparator Interfaces. **Database Programming using JDBC**- Implementation of **Connecting to MySQL database using JDBC and fetch records.** Developing program for performing CRUD operation Using JDBC.				
Module 4	Modern Java Features	Assignment	Advanced Java Features	**6 Sessions**
Annotation : Implementation of Annotation, Generics, Lambda Expressions & Exceptions and Reflection				
Module 5	Distributed Programming with Servlet	Assignment	Distributed Programming	**6 Sessions**

Web Application Basics: Development of Simple Servlet Program to perform CRUD operations, Implementation of Session Tracking, Development of Basic Web Application using Servlet & JSP

List of Laboratory Tasks:

Labsheet -1

Level 1 – Demonstration of Thread Class and Runnable Interface.

Level 2 – Implementation of Producer-Consumer Problem.

Level 2 – Implementation of inter-thread communication.

Labsheet -2

Level 1 – Develop java programs to utilize Java.io.* package.

Level 2 – Practice java programs to perform fiile operations with a case study.

Level 2 – Implement Serialize / De-serialize the objects

Labsheet – 3

Level 1 – Create classes using Collections to perform add, remove, sort operations.

Level 1 – Implement JDBC Connection to Database to perform basic CRUD Operation

Level 2 – Implement Student Information Management (Standalone). [Group wise]

Labsheet – 4

Level 2 – Create a custom annotation `@MinValue` that enforces a minimum value on integer fields in a class. Use reflection to validate the annotated fields at runtime.

Level 2 – Implement a generic class `Pair<T, U>` that stores two values of different types.

Add methods to swap values and print the pair.

Level 2 – Implement a list of employees (`name, salary`). Use lambda expressions to sort by salary and name.

Level 2 – Create a User class with a method `greetUser()`. Use reflection to

	dynamically invoke the method at runtime. Labsheet – 5 Level 1 – Web page creation using HTML, Dynamic web page using java.servlet and JDBC Level 2 – Implementation of Student Information Management (WEB based). [Group wise] Labsheet – 6 Develop web application as mini-project for any management system using Spring Framework
	Targeted Application & Tools that can be used: Java 8 / MYSQL 8 / Eclipse /IntelliJ (IDE)
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	Build a Standalone database application using Java Swing as Front End. Indicative areas include; TimeTable Management, Student Expense Tracker, Important Mail Fetcher, etc. Build a real time database application using J2EE as Front End. Indicative areas include; health care, education, industry, Library, Transport and supply chain, etc.
	Text Books 2] Herbert Schildt, *"Java 2: The Complete Reference"*, Tata McGraw-Hill Education, 12th Edition,2021.
	References 4] Y.Daniel Liang, "Introduction to Java programming Comprehensive Version", Pearson Education, 10th Edition, 2018. 5] Cay S Horstmann and Gary Cornell, "CORE JAVA volume II-Advanced Features, 9th Edition,2016. 6] Core and Advanced Java Black Book, Dream Tech Press. **e-Resources** 1. https://docs.spring.io/spring-framework/reference/core.html 2. https://docs.oracle.com/javaee/7/api/javax/servlet/Servlet.html 3. https://docs.oracle.com/javaee/5/tutorial/doc/bnajo.html 4. https://docs.oracle.com/javase/tutorial/jdbc/basics/index.html

Course Code: **CSE1701**	**Course Title:** Essentials of AI LAB **Type of Course:** Lab	**L- T-P- C**	0	0	4	2
Version No.	2.0					
Course Prerequisites	Basic Java Programming Knowledge, Mathematics: Linear Algebra and Probability, Basic Data Structures and Algorithms, Familiarity with Libraries and Tools, Understanding of Basic Machine Learning Concepts.					
Anti-requisites	**NIL**					
Course Description	This course introduces students to the essential concepts and techniques of Artificial Intelligence (AI) with a focus on practical implementation using Python. Students will explore core AI topics such as search algorithms, knowledge representation, machine learning, and neural networks, while gaining proficiency in using popular Python libraries like NumPy, pandas, scikit-learn, and TensorFlow. Through a series					

	of lab exercises and projects, students will apply AI principles to solve real-world problems, develop intelligent applications, and understand how AI systems function at a foundational level.
Course Objective	The primary objectives of the course are to Gain Proficiency in AI Concepts and Python Implementation, Develop and Implement Machine Learning Models, Understand and Build Neural Networks, Apply AI to Real-World Problems
Course Outcomes	On successful completion of the course the students shall be able to: 1. Proficiency in Implementing AI Algorithms Using Python 2. Ability to Build and Evaluate Machine Learning Models 3. Hands-on Experience with Neural Networks and Deep Learning 4. Practical Application of AI to Solve Real-World Problems
Course Content:	

Module 1	Introduction to AI and Python for AI	ssignment	mplementation	**8 Sessions**

Lab Assignment 1: Setting Up the Python Environment

- **Objective:** Get familiar with setting up a Python environment for AI projects.
- **Tasks:**
  1. Install Python, Anaconda, and Jupyter Notebook.
  2. Set up a virtual environment for AI development.
  3. Install essential Python libraries: numpy, pandas, matplotlib, and scikit-learn.
  4. Write and execute simple Python code to verify installation (e.g., print a "Hello AI" message).

Lab Assignment 2: Basic Python Programming for AI

- **Objective:** Understand and practice the basic Python syntax and data structures used in AI.
- **Tasks:**
  1. Write Python code to work with basic data types (integer, float, string, boolean).
  2. Implement and manipulate Python lists, tuples, sets, and dictionaries.
  3. Create basic control flow structures: if-else, for loops, while loops.
  4. Use functions and lambda functions to solve small AI-related problems, such as calculating factorial or Fibonacci numbers.

Lab Assignment 3: Data Exploration and Preprocessing

- **Objective:** Learn how to work with data for AI models.
- **Tasks:**
  1. Load a dataset (e.g., Titanic or Iris dataset) using pandas.
  2. Clean the dataset by handling missing values, removing duplicates, and converting data types if needed.
  3. Explore the dataset by visualizing it using matplotlib and seaborn.
  4. Perform basic data preprocessing tasks such as feature scaling, encoding categorical variables, and splitting data into training and testing sets.

Module 2	Data Processing, Visualization	Assignment	Implementation	8 Sessions
Lab Assignment 1: Data Preprocessing with Pandas				

Objective:
Learn the fundamentals of data preprocessing, including cleaning, handling missing values, and performing basic transformations using **Pandas**.
Tasks:

1. **Load and Inspect the Dataset:**
    - Load a dataset (e.g., **Iris**, **Titanic**, **Wine Quality** dataset) using pandas.read_csv() or pandas.read_excel().
    - Inspect the first few rows of the dataset using .head() and check basic information using .info().
2. **Handle Missing Values:**
    - Identify missing values in the dataset using .isnull() or .isna().
    - Handle missing data by imputing with mean, median, or mode using SimpleImputer from sklearn, or remove rows with missing data using .dropna().
3. **Data Transformation:**
    - Convert categorical variables to numerical values using one-hot encoding or label encoding.
    - Normalize/standardize numerical columns using StandardScaler or MinMaxScaler from sklearn.
4. **Subset and Filter Data:**
    - Create subsets based on certain conditions (e.g., select rows where a specific feature value is greater than a threshold).
    - Filter outliers from numerical data using interquartile range (IQR).

Lab Assignment 2: Data Aggregation and Grouping with Pandas

Objective:
Master aggregation and grouping techniques using **Pandas** for summarizing data.
Tasks:

1. **Group Data by Category:**
    - Group data by one or more categorical features (e.g., "class" in the Iris dataset or "embarked" in Titanic dataset).
    - Use .groupby() to calculate aggregate statistics such as mean, median, sum, and count.
2. **Pivot Tables:**
    - Create a pivot table to summarize data (e.g., aggregate the average age of passengers in the Titanic dataset by class and gender).
    - Use .pivot_table() to perform multi-dimensional aggregation.
3. **Data Aggregation and Custom Functions:**
    - Apply custom aggregation functions to the grouped data (e.g., calculate custom metrics or perform complex transformations within each group).
4. **Sorting and Ranking Data:**
    - Sort the dataset by multiple columns (e.g., sorting by "age" or "fare").
    - Rank data based on specific metrics (e.g., assign ranks to passengers by fare in the Titanic dataset).

Lab Assignment 3: Data Visualization with Matplotlib and Seaborn

Objective:
Learn to visualize datasets using **Matplotlib** and **Seaborn** for better understanding and insights.
Tasks:

1. **Basic Plotting with Matplotlib:**
    - Create simple plots like line plots, bar plots, and histograms using **Matplotlib**.
    - Customize the plots by setting titles, labels, and legends.
    - Create scatter plots to visualize relationships between two variables.
2. **Advanced Plotting with Seaborn:**
    - Use **Seaborn** to create advanced visualizations like pair plots, heatmaps, box plots, and violin plots.
    - Customize visualizations with color palettes, styling, and themes.
    - Create a correlation heatmap to visualize correlations between features in the dataset.
3. **Distribution Visualizations:**
    - Plot distributions of continuous variables using **Seaborn's** distplot() or kdeplot().
    - Create bar plots for categorical variables to understand their frequency distribution.
4. **Multi-Plot Grid Layouts:**
    - Use **Matplotlib's** subplots() function to create multiple plots in a grid layout for comparison (e.g., scatter plot and histogram in the same figure).

Lab Assignment 4: Visualizing Relationships and Feature Importance

Objective:
Understand how to visualize relationships between features and evaluate feature importance for predictive models.
Tasks:

1. **Scatter Plot Matrix:**
    - Use **Seaborn's** pairplot() to create a scatter plot matrix to visualize the relationships between multiple features.
    - Analyze the pairwise relationships between features and identify any patterns or correlations.
2. **Heatmap of Correlation Matrix:**
    - Use **Pandas** to calculate the correlation matrix of numeric features.
    - Visualize the correlation matrix using **Seaborn's** heatmap() to understand feature correlations and multicollinearity.
3. **Feature Importance from Models:**
    - Train a decision tree or random forest model using **scikit-learn** on a dataset (e.g., **Iris** or **Titanic**).
    - Visualize feature importance using a bar chart to understand which features have the most impact on the model.
4. **Visualizing Predictions vs. Actual Values:**
    - For regression tasks, visualize the predicted values against the actual values using a scatter plot.
    - For classification tasks, visualize the classification results with a confusion matrix.

Lab Assignment 5: Time Series Data Visualization and Processing

Objective:
Learn how to process and visualize time series data, which is common in AI applications like forecasting and trend analysis.
Tasks:

1. **Load and Preprocess Time Series Data:**
    - Load a time series dataset (e.g., stock market data, weather data).
    - Parse dates properly and set the date column as the index using pd.to_datetime() and .set_index().
2. **Plot Time Series Data:**
    - Plot a time series line chart using **Matplotlib** to visualize trends over time.
    - Create rolling averages (e.g., 7-day, 30-day) to smooth out short-term fluctuations in the time series data.
3. **Seasonal Decomposition of Time Series:**
    - Use **statsmodels** to decompose a time series into seasonal, trend, and residual components.
    - Visualize the decomposed components to understand seasonal variations.
4. **Forecasting with Simple Models:**
    - Use simple forecasting models (e.g., moving average, ARIMA) to predict future values.
    - Visualize the forecasted data along with actual historical data.

Module 3	Introduction to Machine Learning	Assignments	Implementation	8 Sessions

Lab Assignment 3: Implementing Linear Regression

- **Tasks:**
    1. Load a real-world dataset (e.g., **Boston Housing Price** dataset).
    2. Train a **Linear Regression** model using LinearRegression() from scikit-learn.
    3. Evaluate the model using **Mean Squared Error (MSE)** and **R-squared Score**.
    4. Visualize the regression line using Matplotlib.

Lab Assignment 4: Logistic Regression for Classification

- **Tasks:**
    1. Load the **Iris** or **Breast Cancer** dataset.
    2. Preprocess the dataset (handle missing values, encode categorical variables, scale data).
    3. Train a **Logistic Regression** model using LogisticRegression().
    4. Evaluate performance using **Accuracy, Precision, Recall, F1-score**.
    5. Plot the **Confusion Matrix** and **ROC Curve**.

Lab Assignment 5: Implementing K-Nearest Neighbors (KNN)

- **Tasks:**
    1. Load the **Iris dataset** and split it into training and testing sets.
    2. Train a **KNN classifier** using KNeighborsClassifier().
    3. Experiment with different values of **K** and evaluate performance.
    4. Visualize decision boundaries using a **scatter plot**.

Lab Assignment 6: Decision Trees and Random Forests

- **Tasks:**
    1. Train a **Decision Tree classifier** on the Titanic dataset.
    2. Visualize the tree structure using plot_tree().
    3. Train a **Random Forest classifier** and compare performance with the decision tree.
    4. Determine the **feature importance** using feature_importances_.

Module 4	Neural Networks and Deep Learning	Quiz	Implementation	6 Sessions

Lab Assignment 7: Introduction to Perceptron and Activation Functions

Tasks:

1. Implement a **single-layer perceptron** using NumPy.
2. Train the perceptron to classify **AND, OR, XOR** gates.
3. Experiment with different **activation functions** (Sigmoid, ReLU, Tanh).
4. Visualize decision boundaries.

Lab Assignment 8: Building a Simple Neural Network with Keras

Tasks:

1. Load the **MNIST dataset** from keras.datasets.
2. Preprocess the data (normalize pixel values, reshape input).
3. Create a **fully connected neural network** using Sequential API.
4. Train and evaluate the model using **categorical cross-entropy loss** and **accuracy**.

Lab Assignment 9: Implementing CNN from Scratch

Tasks:

1. Load the **CIFAR-10 dataset**.
2. Build a CNN with **Conv2D, MaxPooling2D, Flatten, Dense, Dropout** layers.
3. Use **Adam optimizer** and **categorical cross-entropy loss**.
4. Train and visualize loss/accuracy curves.

Lab Assignment 10: Image Augmentation & Regularization

Tasks:

1. Apply **data augmentation** (rotation, zoom, flipping) using ImageDataGenerator.
2. Add **dropout and batch normalization** to prevent overfitting.
3. Compare model performance with and without augmentation.

Lab Assignment 11: Transfer Learning with Pre-trained Models

Tasks:

1. Use **VGG16 or ResNet50** pre-trained on ImageNet.

2. Replace the output layer to classify **new images**.
3. Freeze earlier layers and fine-tune deeper layers.
4. Evaluate the model on a custom **dataset (e.g., Cats vs. Dogs)**.

Lab Assignment 12: Implementing RNN for Text Classification

Tasks:

1. Load **IMDB movie reviews dataset** from keras.datasets.
2. Preprocess text (tokenization, padding sequences).
3. Build an **RNN** with **Embedding, SimpleRNN, Dense** layers.
4. Train and evaluate the model.

Lab Assignment 13: Building an LSTM for Time Series Prediction

Tasks:

1. Load a **time series dataset** (e.g., stock prices, temperature data).
2. Preprocess the data (normalize, reshape).
3. Build an **LSTM-based model**.
4. Predict future values and visualize trends.

Targeted Application & Tools that can be used:

Applications:

22. **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.

- **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
- **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
- **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).
- **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

Tools:

- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine

learning tasks.

- **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models.
- **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models.

NLTK: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging.

spaCy: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing.

Transformers (by Hugging Face): A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.

Text Book(s):

T1: ***Essentials of Python for Artificial Intelligence and Machine Learning*** *by Pramod Gupta and Anupam Bagchi*

Reference(s):

1. "Artificial Intelligence with Python" – Prateek Joshi
2. "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili
3. "Hands-On Artificial Intelligence with Python" – Teet Straus
4. "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

Course Code: **CSE7000**	**Course Title:** **Internship** **Type of Course:**	**L- T-P- C**	-	-	-	2
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**					
Anti-requisites	**NIL**					
Course Description	Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and					

	rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems.
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques.
Course Outcomes	On successful completion of this course the students shall be able to: 1. Identify the engineering problems related to local, regional, national or global needs. (Understand) 2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply) 3. Design the experiments as per the standards and specifications. (Analyze) 4. Interpret the events and results for meaningful conclusions. (Evaluate)

Course Code: CSE2506	**Course Title: Cloud Computing** **Type of Course: Theory**	**L- T-P- C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	**Data Communication and Computer Networks (CSE2011)**					
Anti-requisites	Nil					
Course Description	Cloud Computing provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **CLOUD COMPUTING** and is designed to improve the learners' **SKILL DEVELOPMENT** through **PARTICIPATIVE LEARNING TECHNIQUES.**					

<table>
<tr><td>Course Out Comes</td><td colspan="5">On successful completion of the course the students shall be able to:

1. Describe the fundamental components and layers of Cloud Computing Architecture. [Remember]

2. Identify appropriate Virtualization techniques to virtualize infrastructures [Understand]

3. Summarize various Cloud mechanisms to optimize the QoS parameters [Understand]

4. Apply cloud platforms to develop various applications [Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="5"></td></tr>
<tr><td>Module 1</td><td>Introduction to Cloud services</td><td>Assignment</td><td>Theory</td><td></td><td>L: 10</td></tr>
<tr><td colspan="6">Evolution of cloud computing, Computing Platforms and Technologies, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Cloud Computing Environments. [Understanding]</td></tr>
<tr><td>Module 2</td><td>Virtualization Techniques</td><td>Assignment</td><td>Theory</td><td></td><td>L: 10</td></tr>
<tr><td colspan="6">Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization. [Understanding]</td></tr>
<tr><td>Module 3</td><td>Cloud QoS and Management</td><td>Assignment</td><td>Theory</td><td></td><td>L: 10</td></tr>
<tr><td colspan="6">Cloud Infrastructure Mechanisms- Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Ready-Made Environment, SLAs, Specialized Cloud Mechanisms- Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Cloud Security Mechanisms. [Understanding]</td></tr>
<tr><td>Module 4</td><td>Cloud Application development in Cloud</td><td>Assignment</td><td>Theory</td><td></td><td>L: 10</td></tr>
<tr><td colspan="6">Programming Models for Cloud Computing – MapReduce, CGL Mapreduce, Cloud Haskell, Development environments for
service development (Demonstration using AWS Cloud/Saturn Cloud); Dockers and Containers. [Apply]</td></tr>
<tr><td colspan="6">Targeted Application & Tools that can be used :
Applications:
Cloud Platform, Use of cloud technology in different applications like healthcare, agriculture etc.
Tools:
1. Google App Engine
2. AWS, Saturn Cloud etc.</td></tr>
<tr><td colspan="6">Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</td></tr>
<tr><td colspan="6">• Students can design and implement dynamic resource allocation for virtual machine using cloud computing environment.
• Design and Implementation of a Scalable Cloud-Based Data Storage System
• Development of a Multi-Cloud Management Platform</td></tr>
</table>

Text Book

1. **Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, 2013 edition.**

2. **John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press, 2010 edition.**

References

1. **Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", PHI publisher 2013 edition.**

2. **K. Chandrasekaran, "Essentials of CLOUD COMPUTING", CRC Press, 2015 edition.**

3. **David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press, 2018 edition.**

4. **Manvi, Sunilkumar, and Gopal K. Shyam. "Cloud Computing: Concepts and Technologies". CRC Press, 2021.**

Web Based Resources and E-books:
W1. IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519 W2. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc
W3. CloudSim Resources
https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html
W4. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer- applications

Topics relevant to "Skill Development": AWS, Azure, APIs, Aneka Cloud Platform, Virtualization, Cloud Platforms in Industry, EC2, Installation of VM Workstation, Cloud Infrastructure and Challenges for Skill Development through
Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CIT2401	**Course Title:** BlockChain for IoT **Type of Course:** **Program Core -Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	NIL					

Anti-requisites	NIL			
Course Description	The rapid expansion of the Internet of Things (IoT) has introduced security and privacy challenges due to the interconnected nature of devices and the vast amounts of data they generate. This course explores how blockchain technology can enhance the security, integrity, and trustworthiness of IoT systems. Students will gain insights into blockchain fundamentals, consensus mechanisms, cryptographic techniques, and smart contracts, as well as their application in securing IoT networks. The course will also cover real-world case studies, research trends, and implementation strategies.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Wireless Communication for IoT and attain Skill Development through Participative Learning techniques			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand the fundamentals, various attacks and importance of Security aspects in IoT. 2. Explain blockchain architecture, cryptographic principles, and consensus mechanisms. 3. Understand the operations of Bitcoin blockchain, crypto-currency as application of blockchain technology. 4. Analyze the role of blockchain in securing IoT networks			
Course Content				
Module 1	Introduction to Blockchain and security in IoT	Assignment	Problem Solving	**12 Classes**
Introduction to Blockchain: Blockchain, Trust, Types of Blockchain, Blockchain implementation, Blockchain in practice, Technology use cases: Distributed storage, distributed computing, decentralized communications, financial service use cases				
Module 2	Fundamental of IoT and Security	Assignment	Problem Solving	**10 Classes**
Fundamentals of IoT and Security and its need, Prevent Unauthorized Access to Sensor Data, Block ciphers, Introduction to Blockchain, Introduction of IoT devices, IoT Security Requirements, M2M Security, Message integrity, Modeling faults and adversaries, Difference among IoT devices, computers, and embedded devices.				
Module 3	Basic cryptocurrency system	Assignment	Problem Solving	**12 Classes**
Basic cryptocurrency system, Public and Private Keys in Cryptocurrency Systems, The UTXO Model, Transactions, Signing and Validating Transactions, Bitcoin Transaction Security, Wallet Types: Custodial Versus Noncustodial, Lightweight wallets, Hierarchical deterministic wallets, Permissioned and Permissionless Consensus, Proof-of-Work, Proof-				

of-Stake, Proof of Burn, Proof of Elapsed Time, Bitcoin Miner, Mining Difficulty				
Module 4	Authentication Techniques	Assignment	Problem Solving	**11 Classes**
Introduction to Authentication Techniques Secure IoT Lower Layers, Bitcoin P2P network, Ethereum and Smart Contracts, Bandwidth efficiency, Data Trustworthiness in IoT Secure IoT Higher Layers, Distributed consensus, Smart Contract Languages and verification challenges data analytics in IoT - simple data analyzing methods.				
Targeted Application & Tools that can be used:				
Text Book 1. Lorne Lantz & Daniel Cawrey, Mastering Blockchain Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'REILLY Publications 2. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press, 2016.				
References R1. . B. Russell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing, 2016. R2. FeiHU, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, 2016. **Web Based Resources and E-books:** W1. https://www.coursera.org/learn/blockchain-basics W2. https://www.iota.org/				
Topics relevant to "SKILL DEVELOPMENT": AI and Deep Learning for IOT for **Skill development** through **Participative Learning techniques**. This is attained through the assessment component mentioned in the course handout.				

Course Code: CIT2503	**Course Title: Mobile Application for IoT**		**L-T-P-C**	3-0-0-3
Version No.	1.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	Mobile Application is the essential part for IoT infrastructure, which helps in understanding the architectural overview of IOT. The purposeof this course is to expose the students to understand the IoT Reference Architecture and Real World Design Constraints along with various IOT protocols. This course is both conceptual and analytical in nature that would help the student to predict the effects of forces andits motion while carrying out creative design functions.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Mobile and Application for IoT** and attain **Skill Development** through **Participative Learning** techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. understand the application areas of IOT 2. realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks 3. understand building blocks of Internet of Things and characteristics. 4. Learn about android application development			
Course Content:				
Module 1	Overview	Assignment	Programming Task	**9 Sessions**
Topics: IoT-An Architectural Overview Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2Mand IoT Analytics, Knowledge Management				
Assignment: Case study on Business processes in IoT.				
Module 2	Basic Design	Assignment	Data Collection/Excel	**10 Sessions**

Topics:

Introduction Basics of embedded systems design Embedded OS - Design constraints for mobile applications, both hardware and software related Architecting mobile applications user interfaces for mobile applications touch events and gestures Achieving quality constraints performance, usability, security, availability and modifiability.

Assignment: Recent trends In mobile application development

Module 3	IOT mobile apps	Assignment	Programming/Data analysistask	**9 Sessions**

Topics:

IoT Mobile App Development Trends In 2020 - Role of Mobile Apps in revolutionizing the world of IoT - UX / UI design for IoT Mobile apps - challenges of UX/UI design for IoT applications - practice tips on design forIoT mobile apps IoT App Design Solutions

Assignment: Challenges faced during mobile application development

Module 4	TECHNOLOGY I-ANDROID	Assignment	Programming/Data analysistask	**10 Sessions**

Topics:

Introduction Establishing the development environment Android architecture Activities and views Interacting with UI Persisting data using SQLite Packaging and deployment Interaction with server side applications Using Google Maps, GPS and Wifi Integration with social media applications.

Targeted Protocols & Tools that can be used:

Bluetooth, ZigBee, LoRa, NBIoT, WiFi, and Thread

Text Book

T1: "From machine to machine to the internet of things: Introduction to the new age of intelligence",1st edition, Academic press, 2014.

T2: Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012

References

R1: Bernd Scholz- -3-642-19156-5 e-ISBN 978-3- 642-19157-2, Springer

R2: Andrea Goldsmith, "Android in practice," Cambridge University Press, 2005

Weblinks:

W1: https://relevant.software/blog/mobile-iot-apps/

W2: https://medium.com/@its.mattfitzgerald/top-14-iot-mobile-app-development-trends-to-expect-in-2020-7fd7718155dc

W3:https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.as px%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-%2520live%26ebv%3dEB%26ppid%3dpp_xiii

Topics relevant to "SKILL DEVELOPMENT":

Wifi integration and social media analysis for developing **Skill Development** through **Participative Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

<table>
<tr><td>Course Code:

CIT2506</td><td colspan="4">Course Title: AI and Deep Learning for IoT

Type of Course: Program Core -Theory</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9"></td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">Essentials of AI</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">L</td></tr>
<tr><td>Course Description</td><td colspan="9">This course explores the integration of Artificial Intelligence (AI) and Deep Learning (DL) with the Internet of Things (IoT), focusing on AI-driven data processing, decision-making, and automation in smart applications. Students will learn key concepts of machine learning, neural networks, edge AI, federated learning, and TinyML, along with deployment on IoT edge devices like Raspberry Pi and NVIDIA Jetson. The course covers cloud-based AI, real-time inference, energy efficiency, security challenges, and practical applications in smart agriculture, healthcare, and industrial IoT</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts of Wireless Communication for IoT and attain Skill Development through Participative Learning techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="9">On successful completion of the course the students shall be able to:
1 Understand the concepts of AIoT and their significance in modern industries.
2. Apply techniques to connect mobile devices to IoT gateways, bridging the gap between different networks.
3. Analyze sensor technologies in IoT and their academic foundations to showcase practical understanding.
4. Develop and Evaluate AIoT applications to address real-world challenges.</td></tr>
<tr><td>Course Content</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td>Introduction to Artificial Intelligence and Internet of Things (AIoT)</td><td colspan="3">Assignment</td><td colspan="2">Problem Solving</td><td colspan="2">12 Classes</td></tr>
<tr><td colspan="10">Introduction to Artificial Intelligence and Internet of Things (AIoT) Overview of Artificial Intelligence (AI) and its applications across various industries. Introduction to the Internet of Things (IoT) and its significance in the modern interconnected world. Understanding the concept of Artificial Intelligence of Things (AIoT) and its potential to revolutionize technology integration.</td></tr>
<tr><td>Module 2</td><td>Connecting Mobile Devices to IoT Gateways</td><td colspan="3">Assignment</td><td colspan="2">Problem Solving</td><td colspan="2">10 Classes</td></tr>
</table>

Connecting Mobile Devices to IoT Gateways Exploring the role of IoT gateways in bridging the gap between mobile devices and IoT networks. Techniques for establishing seamless connections between mobile devices and IoT gateways. Hands-on exercises demonstrating the setup and configuration of mobileto-IoT connections.				
Module 3	Sensor Technologies and Academic Concepts	Assignment	Problem Solving	**12 Classes**
Sensor Technologies and Academic Concepts Comprehensive overview of sensor technologies commonly employed in IoT applications. In-depth exploration of various types of sensors and their academic underpinnings. Practical demonstrations and experiments showcasing the functionality and applications of sensors in IoT systems.				
Module 4	AIoT Application Development	Assignment	Problem Solving	**11 Classes**
AIoT Application Development Introduction to tools and platforms essential for building AIoT applications. Practical Aspects of AIoT applications, including: Smart Traffic Signal System for Color Blind Individuals Plant Health Analysis Smart Door Access Control System.				
Targeted Application & Tools that can be used:				
Text Book 1. Michael Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", Pearson Education, 2021 2. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann, 2016 3. Michael J. McGrath, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", Apress, 2013				
References R1. Chandra Singh, K V S S S S Sairam, Niranjan N Chiplunkar, Rathishchandra R Gatti Create citation, "Self-Powered Aiot Systems":Apple Academic Press 2024 R2. Kashif Naseer Qureshi, Thomas Newe Artificial Intelligence of Things (AIoT): New Standards, Technologies and Communication Systems, CRC Press 2024 **Web Based Resources and E-books:** W1.https://www.linkedin.com/learning/ai-in-connected-products-aiot W2. https://www.coursera.org/learn/iot W3. https://www.tinkercad.com/things?type=circuits&sort=staff&view_mode=small				
Topics relevant to "SKILL DEVELOPMENT": AI and Deep Learning for IOT for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: CSE2507	Course Title: Cloud Computing Lab	L- T-P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	**Data Communication and Computer Networks (CSE2011)**					
Anti-requisites	Nil					
Course Description	Cloud Computing provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **CLOUD COMPUTING** and is designed to improve the learners' **SKILL DEVELOPMENT** through **PARTICIPATIVE LEARNING TECHNIQUES**.					
Course Content:						

Targeted Application & Tools that can be used :

Applications:

Cloud Platform, Use of cloud technology in different applications like healthcare, agriculture etc.

Tools:

1. Google App Engine
2. AWS, Saturn Cloud etc.

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

- **Students can design and implement dynamic resource allocation for virtual machine using cloud computing environment.**
- **Design and Implementation of a Scalable Cloud-Based Data Storage System**
- **Development of a Multi-Cloud Management Platform**

List of Laboratory Tasks:

Experiments:

1. **Create a simple cloud software application and provide it as a service using any Cloud Service Provider to demonstrate Software as a Service (SaaS).**
2. **Create a Virtual Machine with 1 vCPU, 2GB RAM and 15GB storage disk using a Type 2 Virtualization Software**
3. **Create a Virtual Hard Disk and allocate the storage using VM ware Workstation**
4. **Create a Snapshot and Cloning of a VM and Test it by loading the Previous Version/Cloned VM**
5. **Demonstrate Infrastructure as a Service (IaaS) by Creating a Virtual Machine using a Public Cloud Service Provider (Azure/GCP/AWS), configure with minimum CPU, RAM, and Storage and Launch the VM image.**
6. **Create a Simple Web Application using Java or Python and host it in any Public Cloud Service Provider (Azure/GCP/AWS) to demonstrate Platform as a Service (PaaS)**
7. **Create a Storage service using any Public Cloud Service Provider (Azure/GCP/AWS) and check the public accessibility of the stored file to demonstrate Storage as a Service**

8. **Create a SQL storage service and perform a basic query using any Public Cloud Service Provider (Azure/GCP/AWS) to demonstrate Database as a Service (DaaS)**
9. **Perform the basic configuration setup for Installing Hadoop 2.x like Creating the HDUSER and SSH localhost**
10. **Install Hadoop 2.x and configure the Name Node and Data Node.**
11. **Launch the Hadoop 2.x and perform MapReduce Program for a Word Count problem**

Text Book

3. **Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, 2013 edition.**

4. **John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press, 2010 edition.**

References

Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", PHI publisher 2013 edition.

K. Chandrasekaran, "Essentials of CLOUD COMPUTING", CRC Press, 2015 edition.

David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press, 2018 edition.

Manvi, Sunilkumar, and Gopal K. Shyam. "Cloud Computing: Concepts and Technologies". CRC Press, 2021.

Web Based Resources and E-books:
W1. IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519 W2. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc
W3. CloudSim Resources
https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html
W4. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer- applications

Topics relevant to "Skill Development": AWS, Azure, APIs, Aneka Cloud Platform, Virtualization, Cloud Platforms in Industry, EC2, Installation of VM Workstation, Cloud Infrastructure and Challenges for Skill Development through
Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: **CSE2510**	**Course Title:** Competitive Programming and Problem Solving **Type of Course: Program Core**	L-T-P-C	0	0		
Version No.						
Course Pre-requisites						

Anti-requisites	
Course Description	The **Competitive Programming and Problem Solving** course equips students with efficient problem-solving skills for coding competitions and real-world challenges. Starting with brute-force solutions, students learn to optimize time and space complexity using advanced techniques like dynamic programming, greedy algorithms, and backtracking. Hands-on practice on platforms like CodeChef and Codeforces helps tackle problems involving number theory, data structures, and algorithmic paradigms. By understanding CP constraints and fostering a strategic mindset, students gain the confidence to excel in competitions, technical interviews, and practical applications.
Course Out Comes	On successful completion of the course the students shall be able to: CO1 : Understanding the issues of online platforms and Competitive Programming (CP) and developing brute force coding for commonly asked CP problems. CO2 : Analyzing the space and time complexity of brute force solutions and designing efficient solutions. CO3 : Evaluating the applicability of suitable algorithmic approaches to solve relevant CP problems. CO4: Creating efficient solutions of CP problems using the learnt algorithmic approaches.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Competitive Programming and Problem Solving** and attain **Skill Development** through **Experiential Learning** techniques.

Module 1: Introduction to Competitive Programming

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

Module 2: Number Theory for Problem-Solving

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

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

plying 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.

Module 5: Problem Solving using Advanced Topics

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.

List of Laboratory Tasks:

1. You are given the finishing times of 'N' runners in a marathon. Write a program to find the runner who finished in the third position. **Focus:** Basic data structures (arrays), sorting algorithms (e.g., insertion sort, selection sort), and basic input/output.
2. In the same marathon, you are given the finishing times of 'N' runners and their bib numbers. Write a program to efficiently find the top 10 runners and their corresponding bib numbers. **Focus:** Efficient sorting algorithms (e.g., merge sort, quick sort), data structures like priority queues, and optimizing for large datasets.
3. A library maintains a list of books with their unique IDs. Write a program to check if a given book ID is present in the library. Focus: Searching algorithms (linear search), basic data structures (arrays or lists).
4. The library wants to implement a system to quickly find books by their titles. Suggest an efficient data structure (e.g., a hash table or a trie) and explain how to implement it to achieve fast book lookups. Focus: Understanding the trade-offs between different data structures, choosing the most appropriate data structure for a specific problem, and implementing efficient search operations.
5. An online store sells products with different prices. Write a program to calculate the total cost of a given list of products. **Focus:** Basic arithmetic operations, working with arrays or lists to store product prices.
6. The online store offers discounts based on the total purchase amount. Design an algorithm to efficiently calculate the final cost of an order, considering different discount rules (e.g., percentage discounts, fixed amount discounts, tiered discounts). Focus: Algorithmic design, conditional statements, handling complex scenarios with multiple rules, and potentially using dynamic programming techniques for optimization.
7. You are given two integers, 'a' and 'm'. Calculate 'a' raised to the power 'm' modulo a large prime number 'p'. **Focus:** Basic modular arithmetic operations (modular exponentiation), understanding the modulo operator.
8. In a secure communication system, you need to efficiently compute the modular exponentiation for very large values of 'm'. Implement and analyze the efficiency of the binary exponentiation algorithm for this task. **Focus:** Efficient algorithms for modular exponentiation (binary exponentiation), time complexity analysis, and understanding the importance of efficient algorithms in cryptography.

9. You have a deck of 'N' cards. Calculate the total number of possible hands of size 'K' that can be drawn from the deck. **Focus:** Basic combinatorics (combinations), factorial calculations.
10. In a card game, you need to calculate the probability of drawing certain combinations of cards (e.g., a pair, a three-of-a-kind) from a shuffled deck. Design an efficient algorithm to calculate these probabilities. **Focus:** Advanced combinatorics (permutations and combinations with repetitions), probability calculations, and optimizing calculations to avoid overflows.
11. You are given a network of devices represented as a graph. Determine if there is a path between two given devices in the network. **Focus:** Graph traversal algorithms (depth-first search or breadth-first search).
12. In a secure network, you need to detect and isolate compromised devices. Design an algorithm that efficiently identifies devices that exhibit anomalous behavior (e.g., unusual traffic patterns) using XOR-based techniques for data comparison and pattern matching. **Focus:** Applying XOR operations for data comparison and pattern recognition, understanding the properties of XOR (e.g., commutative, associative), and designing algorithms for network anomaly detection.
13. You are given an array representing the speeds of cars on a highway. Find the minimum time required for all cars to pass a certain point. **Focus:** Basic array traversal, finding the minimum element in an array.
14. In a more realistic scenario, cars have different lengths. Implement a two-pointer approach to simulate the movement of cars and determine the minimum time for all cars to pass a given point. **Focus:** Two-pointer technique, simulating real-world scenarios with arrays, optimizing time complexity.
15. Given a string, find the number of occurrences of a specific substring within the string. **Focus:** Basic string manipulation, string matching (brute-force approach).
16. Implement the KMP (Knuth-Morris-Pratt) string matching algorithm to efficiently find all occurrences of a given pattern within a large text document. **Focus:** Advanced string matching algorithms, understanding the concept of the "next" array in KMP, optimizing for large input sizes.
17. An online auction platform receives bids for different items. Implement a data structure (e.g., a priority queue) to efficiently track the highest bid for each item. **Focus:** Priority queues, insertion and extraction operations on priority queues, basic implementation of a priority queue using an array or a suitable library.
18. The auction platform needs to handle a large number of bids concurrently. Design and implement a system that efficiently processes bids, updates the highest bid for each item, and handles potential race conditions. **Focus:** Concurrent data structures and algorithms, thread safety, handling race conditions, optimizing for high-throughput scenarios.
19. A social network can be represented as a graph where users are nodes, and connections between users are edges. Write an algorithm to find if two given users are connected in the network. **Focus:** Graph traversal algorithms (depth-first search or breadth-first search), basic graph representation (adjacency list or adjacency matrix).
20. In a large social network, efficiently finding the shortest path between two users is crucial. Implement Dijkstra's algorithm to find the shortest paths between users in the network, considering edge weights (e.g., representing the strength of connections). **Focus:** Shortest path algorithms (Dijkstra's algorithm), graph algorithms with weighted edges, optimizing for large graphs.

21. A file system can be modeled as a tree structure. Implement a function to traverse the file system and print the names of all files and directories. **Focus:** Tree traversal algorithms (depth-first search or breadth-first search), basic tree representation (using nodes and pointers).
22. Design and implement a file system that supports efficient operations like creating directories, deleting files, and finding files based on their names or paths. Consider using a combination of tree structures and hash tables for efficient indexing and searching. **Focus:** Designing and implementing file system structures, using multiple data structures together, optimizing for common file system operations.
23. An online shopping cart can be represented as a tree, where each node represents an item or a category of items. Write an algorithm to calculate the total price of all items in the shopping cart. **Focus:** Tree traversal, calculating sums within a tree structure.
24. Implement a system that allows customers to apply discounts and coupons to their shopping carts. Consider using a combination of trees and other data structures (e.g., hash tables) to efficiently apply discounts and calculate the final price. **Focus:** Applying discounts and promotions to tree-like structures, efficient implementation of discount rules, optimizing for complex pricing scenarios.
25. In a social network, users can form groups. Given a list of friendships, determine if all users in a specific group are connected (directly or indirectly) through friendships. **Focus:** Disjoint set union (DSU) data structure, basic connectivity checks.
26. Design an efficient algorithm to find the minimum number of new friendships needed to connect all users in the social network into a single, connected component. **Focus:** Applying DSU for finding connected components, greedy algorithms, optimization for minimizing connections.
27. A treasure hunt involves a series of clues leading to the final treasure. Given a list of possible paths and their associated costs, find the cheapest path to reach the treasure. **Focus:** Greedy algorithms (e.g., Dijkstra's algorithm for shortest paths), basic graph representation.
28. In a more complex treasure hunt, there are time constraints associated with each path. Design an algorithm to find the fastest path to the treasure while considering both path costs and time constraints.

Focus: Combining greedy approaches with other techniques (e.g., priority queues), handling multiple constraints, optimizing for time-critical scenarios.

29. In a simplified chess game with only rooks, determine the minimum number of moves required for a rook to reach a specific target square on an empty board. **Focus:** Breadth-first search (BFS) on a graph (the chessboard), basic graph traversal.
30. In a more realistic chess game with multiple pieces and obstacles, implement a minimax algorithm with alpha-beta pruning to determine the best move for a player. **Focus:** Game tree search, minimax algorithm, optimization techniques like alpha-beta pruning, handling complex game states.

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), Ronald L. Rivest , fourth edition April 2022**

Web Resources

1. https://nptel.ac.in/courses/106106231
2.

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

Course Code:	Course Title:	L-T- P-C	1-0-4-3
CIT3411	**Big Data Analytics for IoT**		

Version No.	1.0		
Course Pre-requisites			
Anti-requisites	**NIL**		
Course Description	The course covers basic concepts for IOT Analytics, collection of data for IOT, Integration of IOT with Cloud, Big Data Environments. Students can learn about applying geospatial analytics and applying machine learning to the IOT data. The course also covers the organization of the IOT data, cost benefits of using IOT and review of IOT in various sectors.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics for IoT and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.		
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Demonstrate IOT Data Analytics and machine learning application in IOT (Apply) CO2: Apply appropriate Hadoop Ecosystem tools to perform data analytics for a given problem (Apply) CO3: Examine concepts of cloud based IOT, Big data and IOT (Apply) CO4: Illustrate techniques and strategies for data collection and Geospatial Analytics to IOT Data (Apply)		
Course Content:			
Module 1	IOT Analytics	Assignment	**5 sessions**
Introduction – IOT Data, Challenges of IOT analytics Applications – IOT analytics Lifecycle and Techniques. IOT Cloud and Big Data Integration – Cloud based IOT platform – Data Analytics for IOT, IOT devices in different domains. IOT Analytics for the Cloud.			
Module 2	Hadoop Ecosystem Tools		**5 sessions**
Introduction – Big Data and Big Data Analytics – Hadoop Ecosystem – Hadoop Distributed File System (HDFS) – MapReduce – YARN Architecture – PIG Architecture – Apache HIVE – Mahout – Apache Spark – Apache HBase –Apache Zookeeper.			
Module 3	Overview of AWS and Thingworx	Assignment	**5 sessions**
AWS overview - AWS key services for IOT analytics. Thingworx overview. Creating an AWS Cloud Analytics environment.			
Module 4	Geospatial Analytics to IOT Data	Case Study	Data Collection and Analysis
Strategies and Techniques in Data collection: Designing data processing for analytics – Applying big data to storage for Geospatial.			
List of Practical Tasks: **Experiment 1:[Module 1]** Level 1: Installation of Raspbian OS,working basic commands on raspberry pi Level 2: Demonstrate to obtain the temperature using DHT22 sensors . **Experiment 2: [Module 1]** Level 1: Design and Simulate the RADAR SYSTEM Using Arduino and display on the serial			

monitor using ultrasonic sensor/PIR WITH &WITH OUT BUZZER/Servo motor

Level 2: using a raspberry pi to Demonstrate to find the distance using ultrasonic sensor hc-sr04

Experiment 3: [Module 1]

Level 1 : using a raspberry pi Set the connections of healthcare sensors

Level 2: using a raspberry pi to Demonstrate to find the ECG, Temperature, etc using Healthcare sensors

Experiment 4: [Module 2]

Level 1: Hadoop Single node cluster installation on ubuntu

Level 2: Hadoop Multiple node cluster installation, windows installation

Experiment 5: [Module 2]

Level 1: Basic hadoop commands and Word count analysis for given dataset

Level 2: Analysis on particular matching word on huge dataset

Experiment 6: [Module 2]

Level 1: Basic hadoop commands and Stock analysis on given dataset

Level 2: Analysis with max, min, average functions on particular field with missing values

Experiment 7: [Module 2]

Level 1: Basic hadoop commands and Temperature analysis on given dataset

Level 2: Analysis with max, min, average functions on particular field with missing values

Experiment 8: [Module 3]

Level 1: Working on hive commands

Level 2: Apply bucketing technique to bring out the difference between partitioning and bucketing

Experiment 9: [Module 3]

Level 1: Working on Hbase commands .

Level 2: Apply Hbase commands on Insurance database/employee dataset.

Experiment 10: [Module 3]

Level 1: Installation of spark and word count analysis

Level 2: Using RDD and FlatMap count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark

Experiment 11: [Module 4]

Level 1: Temperature Data stored in cloud through IoT devices

Level 2: Retrieve the data set for cloud and Apply data analytics techniques

Experiment 12: [Module 4]

Level 1: Healthcare Data stored through IoT sensors in Cloud

Level 2: Retrieve the data set for cloud and Apply data analytics techniques

Targeted Application & Tools that can be used:

Hadoop ecosystem tools, Thingworx , AWS Cloud

Project work/Assignment:

Student will be asked to carry out a mini project integrating IoT & data Analytics.

Text Book

T1. Big Data Analytics, Seema Acharya, Subhashini Chellappan, Wiley., 2nd Edition, 2019.
T2. Analytics for the Internet of things,Andrew Minteer. Packt publishing, 1st Edition,2017.
T3. Big Data and the Internet of Things, Robert Stackowiak, Art Licht, Venu Mantha and Louis Nagode, Apress, 2nd Edition, 2020

References

R1. IOT and Analytics in Agriculture.,Prasant Kumar Pattnaik, Raghvendra Kumar, Souvik Pal, S. N. Panda. Springer, First Edition, 2020.
R2. Building blocks for IOT Analytics. Internet-of-Things Analytics. John Soldatos (Editor). River Publisher Series in Signal Image and Speech Processing.2020

(iii) web resources
W1. NPTEL: https://onlinecourses.nptel.ac.in/noc20_cs92/preview W2. Coursera: https://www.coursera.org/learn/big-data-introduction W3. EDX: https://www.edx.org/course/big-data-fundamentals W4. E-book Link : https://www.wiley.com /en-us/Internet+of+Things+and+ Data+ Analytics + Handbook -p-9781119173625 https://presiuniv.knimbus.com/user#/home
Topics relevant to "SKILL DEVELOPMENT": Organize IOT data – Linked analytics datasets – Managing data lakes for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CIT3400	Course Title: Architecting Smart IoT Devices Type of Course: Theory	L- P- T-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course equips the students with the skills and knowledge to design and create cutting-edge embedded systems. By leveraging a range of pre-existing hardware and software components, the students will gain insights into the diverse array of available options, including processor families, Sensors, boards, and networks. Topics include Design Principles, Prototyping the Embedded Devices for IoT, Embedded Programming for IoT, Embedded RTOS, Tools for IoT, Recent Trends and applications					
Course Outcomes	On successful completion of this course the students shall be able to: Describe how IoT is different from traditional systems. (Remember). Examine the architecture and operation of IoT(Apply). Develop an IoT prototype for real time scenario. (Apply). Employ various tools and programming paradigms for IoT applications. (Apply)					
Course Content:						
Module 1	Design Principles of IoT	Assignment			10 Classes	
Topics: IoT Conceptual Framework, IoT Architectural View, Technology behind IoT, Design principles of connected devices, Communication Technologies, data acquiring organizing and analytics in IoT, system architecture of loT.						
Module 2	Prototyping the Embedded Devices for IoT	Assignment			10 Classes	
Topics: Embedded system basics, System hardware and prototyping, sensors and actuators for IoT, Radio module and wireless sensor network, gateways internet and web, software components.						
Module 3	Embedded	Assignment			10	

	Programming for IoT			Classes
Topics: Programming connected devices, C and python for IoT, Case study: Temperature controller, Smart irrigation system. Embedded RTOS: Program structure and real time, multitasking and scheduling, RTOS services, signals, semaphores, Nucleus SE, application timers, interrupts in nucleus ES, Nucleus SE initialization.				
Module-4	Tools for IoT	Assignment		10 Classes
Topics: Introduction, chef puppet, NETCONF - YANG case studies. loT physical Devices: Basic building blocks of an IoT device and endpoints, family of ploT devices, pcDuino, Beagle bone black, cubie board, domain specific IoTs.				
Project work/Assignment:				
Assignment 1 on (Module 1 and Module 2) Assignment 2 on (Module 3 and Module 4)				

REFERENCE MATERIALS:

TEXTBOOKS

1. Raj Kamal, Internet of Things, Architecture and Design Principles, 2nd Edition, McGraw Hill Education, May 2022.
2. Arsheep Baga and Vijay Madisetti, Internet of Things: A Hands-On Approach, 1st Edition, Universities press, 2015.

REFERENCES

1. Brojo Kishore Mishra,Amit Vishwasrao Salunkhe, "Internet of Things: Technological Advances and New Applications" 1st Edition, Apple Academic Press, 2023.
2. Colin Walls, Embedded RTOS Design Insights and Implementation. 1st edition. Elsevier. December 2020
3. Fei HU, Security and Privacy in Internet of Things (loTs): Models, Algorithms, and Implementations, 1st Edition, CRC Press, 2016.

JOURNALS/MAGAZINES

IV. IEEE Internet of Things Journal
https://ieee-iotj.org/

V. ACM Transactions on Internet of Things
https://dl.acm.org/journal/tiot

VI. Springer Internet of Things
https://www.sciencedirect.com/journal/internet-of-things

VII. IGI Global – International Journal of Hyperconnectivity and the Internet of Things (IJHIoT)
https://www.igi-global.com/journal/international-journal-hyperconnectivity-internet-things/157228

SWAYAM/NPTEL/MOOCs:

VIII. Coursera – IoT Architecture

IX. NPTEL - Internet of Things (IoT)

Course Code: **CIT3401**	**Course Title:** Intelligent Sensor and System	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	DCCN					
Anti-requisites	NIL					
Course Description	The Intelligent Sensor and System course explores the design, development, and application of smart sensors and intelligent systems in IoT and automation. It covers sensor principles, signal processing, data acquisition, and wireless communication technologies such as BLE, Zigbee, and LoRa. The course also delves into AI-powered sensor analytics, sensor fusion techniques, edge computing, and real-time decision-making for smart applications in healthcare, industrial automation, and smart cities. By the end, learners will gain expertise in building intelligent sensing systems with enhanced accuracy, efficiency, and autonomy.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Intelligent Sensor and System and attain Skill Development through Participative Learning techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Analyze the sensors available in IoT based on application requirements and the Sensing methods. 2. Create a Real-time application by choosing appropriate sensors for temperature monitoring. 3. Interfacing different types of Sensors with MCU. 4. Infer Wireless Sensing, RF Sensing and RF MEMS.					
Course Content						
Module 1	Basics of Sensors and Application Specific Sensors	Assignment	Problem Solving	**12 Classes**		
Basics of Sensors: Introduction- Sensor Vs Transducer, Nature of Sensors, Sensor Output Characteristics, Sensing Technologies, Digital Output Sensors. **Application Specific Sensors:** Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors- optical presence sensor, Light Detectors: Photo diodes – phototransistor – photoresistor CCD and CMOS image sensors, Temperature Sensors:						

thermos-resistive sensors – thermoelectric contact sensor.				
Module 2	Sensor with Microcontroller	Assignment	Problem Solving	**11 Classes**
Sensor with Microcontroller: Introduction, Amplification and Signal Conditioning, Integrated Signal Conditioning, Digital Conversion, MCU Control, MCUs for Sensor Interface, Techniques and Systems Considerations, Sensor Integration.				
Module 3	Wireless Sensing	Assignment	Problem Solving	**2 Classes**
Wireless Sensing: Wireless Data and Communications, Wireless Sensing Networks, Industrial Wireless Sensing Networks, RF Sensing, Telemetry, RF MEMS, Complete System Consideration.				
Module 4	art Applications and System Requirements	Assignment	Problem Solving	**) Classes**
Smart Applications and System Requirements: Automotive Applications, Industrial (Robotic) Applications, Consumer Applications, Future Sensor Plus Semiconductor Capabilities, Future System Requirements.				
Targeted Application & Tools that can be used:				
Text Book 1. Frank, Randy, "Understanding smart sensors", Artech House integrated microsystems series, 3rd Edition, 2013. 2. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", 5th Edition, Springer, 2016.				
References R1. Vlasios Tsiatsis, Stamatis Karnouskos, Jan Holler, David Boyle, Catherine Mulligan, "Internet of Things: Technologies and Applications for a New Age of Intelligence", Academic Press, 16- Nov- 2018. R2. Henry Leung, Subhas Chandra Mukhopadhyay, "Intelligent Environmental Sensing", Springer, 22-Jan-2015. **Web Resources:** W1.https://www.sciencedirect.com/topics/engineering/smart-sensors W2. https://www.azosensors.com/article.aspx?ArticleID=1289				
Topics relevant to "SKILL DEVELOPMENT": Intelligent Sensor and System for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: CIT3402	Course Title: IoT Architectures and Protocols Type of Course: Theory	L- P- T-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course equips the students with the skills and knowledge to design and create cutting-edge embedded systems. By leveraging a range of pre-existing hardware and software components, you will gain insights into the diverse array of available options, including processor families, operating systems, boards, and networks. Topics include Design Principles, Prototyping the Embedded Devices for IoT, Embedded Programming for IoT, Embedded RTOS, Tools for IoT, Recent Trends and applications					
Course Outcomes	On successful completion of this course the students shall be able to: Identify the main components of Internet of Things (Remember). Assess different Internet of Things technologies and their applications Program the sensors and controller as part of IoT Apply). Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing. (Apply)					
Course Content:						
Module 1	IoT Fundamentals	Assignment			10 Classes	
Topics: Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security						
Module 2	IoT Reference Architecture	Assignment			10 Classes	
Topics: Control Units – Communication modules – Bluetooth – Zigbee – Wifi – GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc..), MQTT, Wired Communication, Power Sources						
Module 3	Technologies behind IoT	Assignment			10 Classes	
Topics: Four pillars of IOT paradigm, - RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IOT Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems						
Module-4	Programming the microcontroller for IoT	Assignment			10 Classes	

Topics:
Working principles of sensors – IOT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator Applications of IoT: Business models for IoT, Green energy buildings and infrastructure, Smart farming, Smart retailing and Smart fleet management

Project work/Assignment:

Assignment 1 on (Module 1 and Module 2)
Assignment 2 on (Module 3 and Module 4)

REFERENCE MATERIALS:

TEXTBOOKS

1. Anil Kumar, Jafer Hussain, and Anthony Chun, " Connecting the Internet of Things: IoT Connectivity Standards and Solutions", 1st Edition, Apple Press, 2023
2. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1 st edition, Wiley Publications, 2019.

REFERENCES

1. Tsiatsis, Vlasios, Tsiatsis, Vlasios, Stamatis Karnouskos, Jan Holler, David Boyle, and Catherine Mulligan, Internet of Things: technologies and applications for a new age of intelligence, 2nd edition, Academic Press, 2018
2. Vermesan, Ovidiu, and Peter Friess, eds. Internet of things-from research and innovation to market deployment, 1st edition, Aalborg: River publishers, 2014.

JOURNALS/MAGAZINES

X. IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385

XI. IEEE Transactions on Pattern Analysis and Machine Intelligence https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf

XII. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x

SWAYAM/NPTEL/MOOCs:

3. Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview
4. Coursera – Neural Networks and Deep Learning Andrew Ng

I. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

Course Code: **CIT3403**	**Course Title:** **Embedded Systems For IoT** **Type of Course:** **Theory**		**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Innovative Projects Using Arduino					
Anti-requisites	NIL					
Course Description	This course provides an in-depth understanding of embedded systems and the Internet of Things (IoT), focusing on hardware architecture, programming, and real-world applications. Students will learn about microcontrollers, interfacing techniques, and embedded C programming. The course covers IoT concepts, including communication protocols, data acquisition, and cloud integration. Practical lab sessions will enable students to develop and implement IoT-based applications using platforms like Arduino and Raspberry Pi. By the end of the course, students will be able to design, build, and deploy smart embedded systems for applications in home automation, healthcare, agriculture, and industrial IoT.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Embedded System for IoT and attain Employability through Problem Solving Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. To learn the internal architecture and programming of an embedded processor. 2. To introduce interfacing I/O devices to the processor. 3. To introduce the evolution of the Internet of Things (IoT). 4. To build a small low-cost embedded and IoT system using Arduino/RaspberryPi/ openplatform.					
Course Content						
Module 1	8-BIT EMBEDDED PROCESSOR and EMBEDDED C PROGRAMMING	Assignment	Problem Solving	**10 sessions**		
Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling. EMBEDDED C PROGRAMMING: Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies						
Module 2	IOT AND ARDUINO PROGRAMMIN	Assignment	Problem Solving	**10 sessions**		

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino– Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.				
Module 3	IoT Communication And Open Platforms	Assignment	Problem Solving	**06 sessions**
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee– GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming –Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins –Connecting to the Cloud.				
Module 4	APPLICATIONS DEVELOPMENT	Assignment	Problem Solving	**04 sessions**
Complete Design of Embedded Systems – Development of IoT Applications – Home Automation –Smart Agriculture – Smart Cities – Smart Healthcare				
Targeted Application & Tools that can be used:				
Text Book 1. **Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay** – *The 8051 Microcontroller and Embedded Systems Using Assembly and C* (2nd Edition, Pearson) 2. **Raj Kamal** – *Internet of Things: Architecture and Design Principles* (McGraw Hill) 3. **Jonathan Valvano** – *Embedded Systems: Introduction to ARM Cortex-M Microcontrollers* (CreateSpace) 4. **Michael Margolis** – *Arduino Cookbook* (O'Reilly Media) 5. **Simon Monk** – *Programming the Raspberry Pi: Getting Started with Python* (McGraw Hill)				
References R1. David E. Simon – An Embedded Software Primer (Pearson) R2. Frank Vahid and Tony Givargis – Embedded System Design: A Unified Hardware/Software Introduction (Wiley) R3. Adrian McEwen & Hakim Cassimally – Designing the Internet of Things (Wiley) R4. Pethuru Raj & Anupama Raman – The Internet of Things: Enabling Technologies, Platforms, and Use Cases (CRC Press) R5. Daniel Minoli – Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications (Wiley) **Web Based Resources and E-books:** W1. https://archive.nptel.ac.in/courses/108/102/108102169/ W2. https://archive.nptel.ac.in/courses/106/105/106105193/ W3. https://www.coursera.org/learn/iot W4. https://www.edx.org/course/collaborative-data-science-for-healthcare W4. https://ocw.mit.edu/courses/6-087-practical-programming-in-c-january-iap-2010/				

Topics relevant to "SKILL DEVELOPMENT":
Embedded System for **Employability through Problem Solving Methodologies.** This is attained through the assessment component mentioned in the course handout.

Course Code: **CIT3404**	**Course Title: IoT System Design and Development** **Type of Course: Theory**		**L-T-P-C**	3	0	0 3
Version No.						
Course Pre-requisites	Innovative Projects using Aurdino					
Anti-requisites	NIL					
Course Description	The IoT System Design and Development course provides a comprehensive understanding of IoT architecture, hardware components, communication protocols, data management, and real-world applications. Students will gain hands-on experience with embedded platforms like Arduino, Raspberry Pi, and Jetson Nano, integrating sensors, actuators, and microcontrollers for IoT solutions. The course covers Wi-Fi, Bluetooth, LPWAN, and CoAP protocols, along with IoT data storage, analytics, and visualization. Learners will explore IoT applications in smart homes, healthcare, agriculture, industrial automation, and smart cities, while addressing design challenges, security concerns, and emerging technologies such as AIoT, Blockchain, and 5G integration. Through participative learning and problem-solving activities, students will develop practical skills to design and implement IoT-driven smart applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of IoT system Design and Development and attain Employability through Problem Solving Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand the basic concepts, principles and challenges in IoT. 2. Describe the functioning of hardware devices and sensors used for IoT. 3. Analyze network communication aspects and protocols used in IoT. 4. Apply IoT for developing real life applications using Arduino programming.					
Course Content						
Module 1	Introduction to Internet of Things (IoT) and Hardware for IoT	Assignment	Problem Solving	**11 Classes**		

Introduction to Internet of Things (IoT): Vision, Definition, IoT architecture: Layers and protocols, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Sensing, Actuation. IoT communication models: Device-to-device, device-tocloud, device-to-gateway, Challenges and opportunities in IoT **Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, microcontrollers, and single-board computers, Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, Raspberry pi, Jetson nano Beagle Bone, and Intel Galileo boards				
Module 2	IoT Protocols and Arduino Programming	Assignment	Problem Solving	**11 Classes**
IoT Protocols and Arduino Programming: Wi-Fi, Bluetooth, CoAP, LPWAN protocol. Sensor Networks: Sensor deployment & Node discovery, Introduction to Arduino Programming: Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in Arduino, programming the Arduino for IoT, Integration of Sensors and Actuators with Arduino				
Module 3	IoT Data Management and Analytics	Assignment	Problem Solving	**12 Classes**
IoT Data Management and Analytics: Data generation and collection in IoT systems, IoT data storage, Cloud-based and local storage, Data preprocessing and analysis, Basics of analytics for IoT data, IoT dashboards, Visualization and interpretation of data, Role of machine learning and AI in IoT				
Module 4	Challenges in IoT Design challenges	Assignment	Problem Solving	**11 Classes**
Challenges in IoT Design challenges: IoT applications: Smart homes, smart cities, healthcare, agriculture, Smart Metering, City Automation, Automotive Applications, home automation, smart cards, and industry, IoT and automation: Role in industrial IoT (IIoT), Emerging technologies: AIoT, Blockchain for IoT, and 5G integration IoT, Development Challenges, Security Challenges.				
Targeted Application & Tools that can be used:				
Text Book 1. Olivier Hersent, David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", willey.				
References R1. Jeeva Jose, Internet of Things, Khanna Publishing House. R2. Michael Miller "The Internet of Things" by Pearson. R3. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016. R4. Arshdeep Bahga, Vijay Madisetti "Internet of Things (A hands on approach)" 1ST edition, VPI publications,2014. R5. Adrian McEwen, Hakin Cassimally "Designing the Internet of Things" Wiley India. **Web Based Resources and E-books:** W1. https://avigna.ai/what-are-protocols-in-iot-a-guide-to-communication-standards-				

for-smart-devices/ W2. https://www.arduino.cc/en/Guide W3. https://www.startertutorials.com/blog/wireless-protocols-for-iot.html W4. https://www.edx.org/course/collaborative-data-science-for-healthcare
Topics relevant to "SKILL DEVELOPMENT": IoT System Design and Development for **Employability through Problem Solving Methodologies** . This is attained through the assessment component mentioned in the course handout.

Course Code: **CIT3405**	**Course Title:** Edge and Fog Computing for IoT	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Fog Computing for IoT					
Anti-requisites	L					
Course Description	This course explores the concepts, architecture, and technologies behind Edge and Fog Computing as essential components of modern Internet of Things (IoT) ecosystems. Students will learn how these paradigms address the limitations of cloud computing by bringing computation closer to data sources, thus enabling low latency, bandwidth efficiency, and real-time decision-making. Topics include distributed processing, resource management, latency optimization, security, and real-world applications across domains such as smart cities, healthcare, industrial IoT (IIoT), and autonomous systems.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Edge and Fog Computing for IoT and attain Skill Development through Participative Learning techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Explore technologies behind the communication and management of fogs and edge resources. 2. Learn the techniques for storage and computation in fogs, edges, 5G and clouds. 3. Implement Internet of Everything (IoE) applications through fog computing architecture and use optimization techniques for the same. 4. Analyze the performance and issues of the applications developed using fog and edge architecture.					
Course						

<table>
<tr><td>Content</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Internet of Things (IoT) and New Computing Paradigms and Challenges in Federating Edge Resources</td><td>Assignment</td><td>Problem Solving</td><td>12 Classes</td></tr>
<tr><td colspan="5">Internet of Things (IoT) and New Computing Paradigms: Introduction - Relevant Technologies - Fog and Edge Computing Completing the Cloud - Hierarchy of Fog and Edge Computing - Business Models – Edge Computing Platforms - Opportunities and Challenges
Challenges in Federating Edge Resources: Introduction - Methodology - Integrated C2F2T Literature by Modeling Technique - Integrated C2F2T Literature by Use - Case Scenarios - Integrated C2F2T Literature by Metrics – Threads - Standards</td></tr>
<tr><td>Module 2</td><td>Orchestration of Network Slices in Fog, Edge, and Clouds and Optimization Problems in Fog and Edge Computing</td><td>Assignment</td><td>Problem Solving</td><td>12 Classes</td></tr>
<tr><td colspan="5">Orchestration of Network Slices in Fog, Edge, and Clouds: Introduction – Background - Network Slicing - Network Slicing in Software-Defined CloudsNetwork Slicing Management in Edge and Fog - Internet of Vehicles (IoV): Architecture, Protocols and Seven-layer security model architecture for Internet of Vehicles - IoV: Network Models, Challenges and future aspects
Optimization Problems in Fog and Edge Computing: Preliminaries - The Case for Optimization in Fog Computing-Formal Modeling Framework for Fog Computing – Metrics - Further Quality Attributes - Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle - Toward a Taxonomy of Optimization Problems in Fog Computing</td></tr>
<tr><td>Module 3</td><td>Middleware for Fog and Edge Computing and Technologies in Fog Computing</td><td>Assignment</td><td>Problem Solving</td><td>8 Classes</td></tr>
<tr><td colspan="5">Middleware for Fog and Edge Computing: Need for Fog and Edge Computing Middleware - Design Goals-State-of-the-Art Middleware Infrastructures - System Model - Case Study.
Technologies in Fog Computing: Fog Data Management - Smart Building - Predictive Analysis with FogTorch - Machine Learning in Fog Computing - Data Analytics in the Fog - Data Analytics in the Fog Architecture.</td></tr>
</table>

Module 4	Applications of Fog and Edge Computing	Assignment	Problem Solving	**8 Classes**
Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real - Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications - Testing Perspectives of Fog - Based IoT Applications - Legal Aspects of Operating IoT Applications in the Fog				
Targeted Application & Tools that can be used:				
Text Book 1. Buyya, Rajkumar, and Satish Narayana Srirama, Fog and Edge computing: Principles and Paradigms, 2019, 1st edition, John Wiley & Sons, USA.				
References R1. Bahga, Arshdeep, and Vijay Madisetti, Cloud computing: A hands-on approach, 2014, 2 ndedition, CreateSpace Independent Publishing Platform, USA. R2. OvidiuVermesan, Peter Friess, "Internet of Things –From Research and Innovation to Market Deployment", 2014, 1st edition, River Publishers, India. **Web Based Resources and E-books:** W1. https://www.cisco.com/c/en/us/solutions/internet-of-things/fog-computing.html W2. https://www.fogcomputingconsortium.org/architecture/ W3. https://www.technologyreview.com/2015/03/17/247693/fog-computing/ W4. https://www.etsi.org/technologies/multi-access-edge-computing				
Topics relevant to "SKILL DEVELOPMENT": Edge and Fog computing for IOT for **Skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: **CIT3406**	**Course Title: Cloud Computing for IOT** **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Cloud Computing					
Anti-requisites	NIL					

Course Description	This course offers a comprehensive introduction to the Internet of Things (IoT) and Cloud Computing, focusing on key concepts, technologies, and hands-on experience. The course starts with understanding the fundamentals of IoT, including its components like Arduino architecture, sensors, and actuators. Students will explore IoT communication protocols, networking using the ESP8266 Wi-Fi module, and cloud integration for data storage and processing. The course will provide an overview of cloud platforms such as AWS, Microsoft Azure, and Google Cloud Platform. Additionally, students will delve deeper into cloud services, with a focus on AWS architecture, compute, and storage services. By the end of the course, students will have a solid understanding of designing IoT systems and integrating them with cloud platforms for data management and analytics.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Cloud Computing for IoT and attain Employability through Problem Solving Methodologies			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand the fundamental concepts of IoT and how sensors and actuators work with Arduino. 2. Understand cloud computing and how to manage, store, and process data on cloud platforms. 3.Work with major cloud platforms such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform. 4. Understand the core architecture of AWS and its services such as Lambda, EC2, and S3 for building and scaling cloud-based IoT applications.			
Course Content				
Module 1	troduction of IoT	Assignment	roblem Solving	**12 Classes**
Introduction of IoT Introduction to IoT. Understanding IoT fundamentals, Arduino Simulation Environment. Arduino Uno Architecture, and Sensor & Actuators with Arduino and Overview of Sensors working.				
Module 2	dation in IoT Systems	Assignment	Problem Solving	**11 Classes**
Updation in IoT Systems Basic Networking with ESP8266 WiFi module. Basics of Wireless Networking, IoT Protocols, and Cloud Platforms for IOT with some real live minor projects.				
Module 3	Cloud Computing	Assignment	Problem Solving	**Classes**

Cloud Computing: Introduction, Management, storage and processing of data on networks of the internet server, and On-demand IT resources over the internet etc. Introduction to platforms such as Amazon Web Services, Microsoft Azure and Google Cloud Platform.				
Module 4	dvancement in Cloud Computing	Assignment	Problem Solving	**10 Classes**
Advancement in Cloud Computing: Brief on AWS Architecture and different models of Cloud Computing. Compute Services: AWS Lambda, Elastic Beanstalk, AWS EC2, Auto Scaling, and Load Balancing. Storage Services: Amazon EBS, Amazon S3, Amazon EFS, Amazon Glacier, Amazon Global Accelerator, Amazon FSx, and Storage Gateway				
Targeted Application & Tools that can be used:				
Text Book 1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547 2. 2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759 3. 3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895				
References R1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan R2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014 R3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014**Web Based Resources and E-books:** W1.https://www.coursera.org/learn/iot-wireless-cloud-computing W2. https://www.edx.org/learn/amazon-web-services-aws/amazon-web-services-aws-iot-developing-and-deploying-an-internet-of-things				
Topics relevant to "SKILL DEVELOPMENT": Cloud Computing for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: **CIT3407**	**Course Title: IOT Data Analytics and Machine Learning** **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Essentials of AI					
Anti-requisites	NIL					

<table>
<tr><td>Course Description</td><td colspan="5">This course provides an in-depth understanding of data analytics and machine learning techniques for IoT applications. Students will explore how IoT devices generate data, methods for data collection, processing, and real-time analytics. The course covers statistical analysis, feature engineering, and predictive modeling using machine learning techniques tailored for IoT environments. Additionally, students will learn about edge and cloud-based analytics, AI-driven decision-making, and anomaly detection for IoT security and efficiency.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objective of the course is to familiarize the learners with the concepts of IOT Data Analytics and Machine Learning and attain Skill Development through Participative Learning techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="5">On successful completion of the course the students shall be able to:
1. Understand the fundamentals of IoT Analytics and Challenges
2. Understand and analyze IoT Devices and Networking Protocols
3. Understand exploring and visualizing data
4.Apply IoT Analytics for the Cloud</td></tr>
<tr><td>Course Content</td><td colspan="5"></td></tr>
<tr><td>Module 1</td><td>Defining IoT Analytics and Challenges and IoT Devices and Networking Protocols</td><td>Assignment</td><td>Problem Solving</td><td>12 Classes</td></tr>
<tr><td colspan="6">Defining IoT Analytics and Challenges: Introduction to IoT, applications, IoT architectures, introduction to analytics, IoT analytics challenges
IoT Devices and Networking Protocols: IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, Analyzing data to infer protocol and device characteristics.</td></tr>
<tr><td>Module 2</td><td>Exploring IoT Data</td><td>Assignment</td><td>Problem Solving</td><td>12 Classes</td></tr>
<tr><td colspan="6">Exploring IoT Data: Exploring and visualizing data, Techniques to understand data quality, Basic time series analysis, Statistical analysis.</td></tr>
<tr><td>Module 3</td><td>Data Science for IoT Analytics</td><td>Assignment</td><td>Problem Solving</td><td>8 Classes</td></tr>
<tr><td colspan="6">Data Science for IoT Analytics: Introduction to Machine Learning, Feature engineering with IoT data, Validation methods, Understanding the bias–variance tradeoff, Use cases for deep learning with IoT data.</td></tr>
</table>

Module 4	ML in Industrial IoT	Assignment	Problem Solving	**8 Classes**
ML in Industrial IoT Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.				
Targeted Application & Tools that can be used:				
Text Book 1. Minteer, Andrew, Analytics for the Internet of Things (IoT), Packt Publishing Ltd. July 2017, ISBN 9781787120730.				
References 1. Kai Hwang, Min Chen, Big-Data Analytics for Cloud, IoT and Cognitive Computing, Wiley. 2. Hwaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley. 3. John Soldatos, Building Blocks for IoT Analytics Internet-of-Things Analytics, River Publishers Gerardus Blokdyk. 4. IoT Analytics A Complete Guide, 5starcooks **Web Based Resources and E-books:** W1: Coursera – IoT Data Analytics & Machine Learning W2: Udacity – AI for IoT W3: edX – Data Analytics for IoT				
Topics relevant to "SKILL DEVELOPMENT": Industrial and Medical IOT for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: **CIT3408**	**Course Title: Digital Twin and Simulation in IoT** **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Cryptography and Network Security					
Anti-requisites	L					
Course Description	This course covers the foundations and advanced concepts of Internet of Things (IoT), communication protocols, and the design of Digital Twins. It emphasizes the integration of IoT with emerging technologies such as edge computing, cloud computing, and machine learning for data-driven insights in manufacturing, healthcare, smart cities, and more. The course will also explore the role of IoT in industrial automation, control systems, and process industry, providing real-world case studies and applications.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of Wearable Technology and IOT and attain Skill Development through Participative Learning techniques			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Enumerate different communication technologies used in Industry 4.0. 2. Perform edge, and cloud computing and visualize the data 3. Introduce the concept of Digital Twins in manufacturing the industry 4. Design Digital Twins for discrete and process industries			
Course Content				
Module 1	ntroduction	Assignment	Problem Solving	**12 Classes**
Introduction: The various industrial revolutions, digitalization, and the networked economy, drivers, enablers, comparison of industry 4.0 factory and today's factory, challenges. Communication Technologies of IIoT Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID, Industry standards communication technology (LoRA, WAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network.				
Module 2	Visualization and Data Types of IIoT Communication	Assignment	Problem Solving	**12 Classes**
Visualization and Data Types of IIoT Communication. Front-end EDGE devices, Emerging descriptive data standards for IIoT, Cloud database, Could computing, Fog/Edge computing. Pushing data to the cloud. Grabbing the content from a web page, Sending data on the web, Troubleshooting. Application of IIOT Case study: Health monitoring, smart city, Smart irrigation, Robot surveillance.				
Module 3	Design of Digital Twins	Assignment	Problem Solving	**12 Classes**
Design of Digital Twins: Technological needs. Physics-based approach: Model identification, Model creation. Data- driven approach: Model development using ML/DL models. Digital twins for Prototype, Product, and Performance.				
Module 4	Digital Twins validation	Assignment	Problem Solving	**10 Classes**
Digital Twins validation. Control system requirements in a Discrete Industry, Digital Twins of a Product, Digital Thread in a Discrete Industry, Data Collection & Analysis for Product & production improvements, Automation Simulation, and Digital Enterprise. Process Industry: Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twins of a plant, Digital Thread in Process Industry.				
Targeted Application & Tools that can be used:				

Text Book

1. Bruno Sergi, Elena G.Popkova, Aleksei V. Bogoviz and Tatiana N. Litvinova, "Understanding Industry 4.0: AI, The internet of things, and the future of work", Emerald publishing limited, 2019.
2. Alp Ustundag and Emre Cevikcan, "Industry 0: Managing the Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017.

References

R1. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
R2. Shyam Varan Nath, Pieter van Schalkwyk, Dan Isaacs, "Building Industrial Digital Twins Design, Develop, and Deploy Digital Twin Solutions for Real-world Industries Using Azure Digital Twins", Packt Publishing, 2021.
Web Based Resources and E-books:
W1.https://docs.oracle.com/en/cloud/paas/iot-cloud/iotgs/iot-digital-twin-framework.html
W2. https://www.cumulocity.com/resource-library/what-are-iot-digital-twins/
W3. https://www.ptc.com/en/blogs/corporate/iot-digital-twin

Topics relevant to "SKILL DEVELOPMENT":
IIoT, Digital Twin and IEEE802.15.4 for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CIT3409	**Course Title:** Autonomous System & Robotics with IOT **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Cloud Computing					
Anti-requisites	NIL					
Course Description	Robotics and IoT are converging to create intelligent, autonomous systems that enhance efficiency across industries such as agriculture, healthcare, manufacturing, and transportation. By integrating IoT sensors, cloud computing, AI, and machine learning, robots can perceive, analyze, and act in real time, enabling applications like smart warehouses, autonomous vehicles, precision farming, and remote healthcare. IoT-driven robotics allows for real-time monitoring, predictive maintenance, and adaptive decision-making, making systems more efficient and responsive.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Autonomous System and Robotics with IoT and attain Skill Development through Participative Learning techniques					

<table>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:
1. Understand IoT ecosystem in robotic paradigm
2. Analyze IoT infrastructure and develop IoRT applications
3. Apply IoT in robotics over different platforms
4. Implement Cloud robotics in automations</td></tr>
<tr><td>Course Content</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to IoT and Vision systems and Robotic Sensors</td><td>Assignment</td><td>Problem Solving</td><td>12 Classes</td></tr>
<tr><td colspan="5">Introduction to IoT and Vision systems: History and evolution of IoT, AI, ML, Machine Vision, optoelectronic sensors, 3D & 2D machine vision technologies, robot navigation, control schemes, motion controllers, intelligent algorithms and vision systems.

Robotic Sensors: Optical sensors and actuators; Mechanical sensors and actuators; Acoustic sensors and actuators; Performance characteristics of sensors and actuators</td></tr>
<tr><td>Module 2</td><td>Internet of Robotic Things</td><td>Assignment</td><td>Problem Solving</td><td>10 Classes</td></tr>
<tr><td colspan="5">Internet of Robotic Things: Communication architecture for IoRT; Decentralized and automated IoT infrastructure using Blockchain; IoRT Platforms Architecture, IoRT applications</td></tr>
<tr><td>Module 3</td><td>Autonomous Vehicle Systems and Industrial Internet of Things</td><td>Assignment</td><td>Problem Solving</td><td>Classes</td></tr>
<tr><td colspan="5">Introduction to Autonomous Driving; Perception in Autonomous Driving; Robot Operating System (ROS) Overview - Client Systems for Autonomous Driving - Decision planning and control in autonomous vehicle systems - Cloud Platform for Autonomous Driving.

Industrial Internet of Things: IIoT Architecture; IIoT Applications and Challenges; IIoT Standards and Frameworks; IIoT security concerns.</td></tr>
<tr><td>Module 4</td><td>IoMT and Robotics in Healthcare and Cloud Robotics and Industrial Automation</td><td>Assignment</td><td>Problem Solving</td><td>11 Classes</td></tr>
</table>

IoMT and Robotics in Healthcare: IoMT Driven connected healthcare, Efficient design for IoMT based healthcare design, Robotics in healthcare. **Cloud Robotics and Industrial Automation:** Components of Cloud Robotics; Limitations and challenges of Cloud Robotics; Applications: Autonomous mobile robots, Cloud medical robots, Industrial robots
Targeted Application & Tools that can be used:
Text Book 1. Vermesan, Ovidiu, and Joël Bacquet, eds.,Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution, 1st edition, River Publishers, 2017. 2. A.K.Gupta, S.K.Arora, and J.Riescher, Industrial Automation and Robotics, 1st edition, Mercury Learning and Information LLC,2017
References R1. A.K Dubey, A.Kumar, and S.R Kumar., AI and IoT-based Intelligent Automation in Robotics, 1st edition. Wiley, 2020 R2. A.E.Hassanien, N.Dey, and S.Borra, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications, 1st edition ,Taylor & Francis Group,2019 R3. S.Liu, L.Li and J.Tang, Creating Autonomous Vehicle Systems, Synthesis Lectures on Computer Science, 1st edition ,Morgan & Claypool,2018 R4. Nathan Ida, Sensors, Actuators, and Their Interfaces: A multidisciplinary introduction, 2nd edition The Institution of Engineering and Technology, 2017 **Web Resources:** W1. https://www.iotforall.com/ W2. https://www.iotforall.com/future-iot-robotics W3.https://www.iotforall.com/is-the-internet-of-robotic-things-the-future-of-manufacturing
Topics relevant to "SKILL DEVELOPMENT": Autonomous System and robotics for **Skill development** through **Participative Learning techniques**. This is attained through the assessment component mentioned in the course handout.

Course Code: **CIT3410**	**Course Title: Secure IoT** **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Cryptography and Network Security					
Anti-requisites	L					
Course Description	This course is ideal for those pursuing careers in IoT development, network security, and privacy management, providing them with the skills necessary to tackle the unique security challenges presented by the rapidly growing IoT ecosystem.					

<table>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of IoT security and Privacy and attain Skill Development through Participative Learning techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:
1. Identify different Internet of Things technologies and their applications. 2. Assess the need for Privacy and security model for the Internet of Things.
3. Explore various Trust Model for IoT and customize real time data for IoT applications.
4. Design security framework and solve IoT security issues</td></tr>
<tr><td>Course Content</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Security in IoT and Network Robustness and Malware Propagation Control in IoT</td><td>Assignment</td><td>Problem Solving</td><td>8 Classes</td></tr>
<tr><td colspan="5">IoT security: Vulnerabilities, Attacks and Countermeasures - Security Engineering for IoT development - IoT security lifecycle
Network Robustness and Malware Propagation Control in IoT: Network Robustness - Fusion Based Defense Scheme - Sequential Defense Scheme - Location Certificate Based Scheme - Sybil node detection scheme - Formal Modeling and Verification -Sybil Attack Detection in Vehicular Networks - Performance evaluation of various Malware Dynamics Models - Analysis of Attack Vectors on Smart Home Systems.</td></tr>
<tr><td>Module 2</td><td>Privacy Preservation in IoT and Privacy Protection in IoT</td><td>Assignment</td><td>Problem Solving</td><td>Classes</td></tr>
<tr><td colspan="5">Privacy Preservation in IoT: Privacy Preservation Data Dissemination: Network Model, Threat Model – Problem formulation and definition - Baseline data dissemination - Spatial Privacy Graph based data dissemination -Experiment Validation - Smart building concept- Privacy Threats in Smart Building - Privacy Preserving Approaches in Smart Building - Smart Meter Privacy Preserving Approaches.
Privacy Protection in IoT: Lightweight and Robust Schemes for Privacy Protection in IoT Applications: One Time Mask Scheme, One Time Permutation Scheme - Mobile Wireless Body Sensor Network - Participatory Sensing.</td></tr>
<tr><td>Module 3</td><td>Trust Models for IoT</td><td>Assignment</td><td>Problem Solving</td><td>Classes</td></tr>
<tr><td colspan="5">Trust Model Concepts - Public Key Infrastructures Architecture Components - Public Key Certificate Formats - Design Considerations for Digital Certificates - Public Key Reference Infrastructure for the IoT - Authentication in IoT - Computational Security for IoT</td></tr>
</table>

Module 4	Security Protocols for IoT Access Networks	Assignment	Problem Solving	**Classes**
Time Based Secure Key Generation -Security Access Algorithm: Unidirectional, Bidirectional Transmission - Cognitive Security - IoT Security Framework - Secure IoT Layers – Secure Communication Links in IoT - Secure Resource Management, Secure IoT Databases.				
Targeted Application & Tools that can be used:				
Text Book 1. Hu, Fei. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, 2016, 1st edition, CRC Press, USA.				
References R1. Russell, Brian and Drew Van Duren. Practical Internet of Things Security, 2016,1st edition, PACKT Publishing Ltd, UK R2. Kim, S., Deka, G. C., & Zhang, P. (2019). Role of blockchain technology in IoT applications. Academic Press. R3. Whitehouse O Security of things: An Implementers' guide to cyber security for internet of things devices and beyond, 2014, 1st edition, NCC Group, UK. **Web Based Resources and E-books:** W1. https://www.iotsecurityfoundation.org/ W2. https://owasp.org/www-project-internet-of-things/ W3. https://www.csail.mit.edu/research/internet-things W4. https://www.nist.gov/programs-projects/cybersecurity-internet-things				
Topics relevant to "SKILL DEVELOPMENT": IOT Security and Privacy for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: **CIT3412**	**Course Title: IoT for healthcare and Wearable Technology** **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	Data Communication and Computer Network					
Anti-requisites	NIL					
Course Description	A course on Iot for healthcare and wearable technology within the context of the Internet of Things (IoT) would explore the fundamentals of both, focusing on how wearable devices collect and transmit data, and the applications of this technology across various sectors					

Course Objective	The objective of the course is to familiarize the learners with the concepts of IoT for healthcare and Wearable Technology and attain Skill Development through Participative Learning techniques			
Course Out Comes	On successful completion of the course the students shall be able to: 1. To provide a basic understanding of evolution of IoT and its functional modules. 2. To develop skillset to implement IoT systems for wearable applications. 3. To identify the real world problem and give IoT solutions. 4. To analyse and select appropriate protocols, wireless techniques for the problem			
Course Content				
Module 1	Role of IoT in wearable devices and IoT supported technologies: Internet/Web and networking basics	Assignment	Problem Solving	**12 Classes**
Role of IoT in wearable devices: Smart connectivity and Big picture of IoT-smart devices, networks, Wireless technologies and need for data analysis. Evolution of wearable technology, Wearable IoT use cases- Smart watches , Android wear, Smart glasses, fitness trackers, health care devices, cameras, smart clothing etc **IoT supported technologies: Internet/Web and networking basics:** OSI model, data transfer referred with OSI model, IP Addressing, point to point data transfer, point to multi point data transfer & network topologies, sub-nets, network topologies referred with web, introduction to web servers and cloud computing				
Module 2	IoT supported technologies: Hardware platforms and Wireless communicatio n standards	Assignment	Problem Solving	**12 Classes**
IoT supported technologies: Hardware platforms: Overview of single board computers (Raspberry pi/Beagle bone black), ARM Cortex Processors, Arduino. Network Fundamentals: Overview and working principle of wired and wireless networking equipment's – router, switches, access points, and hubs. Networking configurations in Linux accessing hardware & device files interactions. **Wireless communication standards:** Bluetooth - IEEE 802.15.1, Wireless LAN- IEEE 802.11(WiFi) , Near Field communication, WiMaxIEEE 802.16, LR-WPAN- IEEE 802.15.4 (Zigbee), 6LoWPAN, mobile network, GPS				
Module 3	IOT architecture:	Assignment	Problem Solving	**10 Classes**

IoT functional requirements, building blocks, IoT architecture layers, cloud and fog based architecture, M2M – Machine to Machine architecture, Web of Things, physical layer, MAC layer, 6LoWPAN security aspects in IoT				
Module 4	IOT Application Development and Wearable IoT	Assignment	Problem Solving	**11 Classes**
Application Protocols: MQTT, REST/HTTP, CoAP, MySQL Back-end Application Designing: Apache for handling HTTP Requests, PHP & MySQL for data processing, MongoDB Object type Database, HTML, CSS &jQuery for UI Designing, JSON lib for data processing, Security & Privacy during development, Application Development for mobile Platforms: Overview of Android / IOS App Development tools **Wearable IoT:** Case studies – Health care, fitness and sports, industrial, defence and security, home automation, gaming, fashion and apparel				
Targeted Application & Tools that can be used:				
Text Book 1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2013				
References 1. The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World 1st Edition 2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, StamatisKarnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014. 3. IEEE Standards Association Working Group for an Architectural Framework for the Internet of Things (IoT) (P2413) - http://grouper.ieee.org/groups/2413/ 4. Internet of Things – Architecture – Final Architectural Reference Model for the IoT v3.0, http://www.iot-a.eu/publi **Web Based Resources and E-books:** W1.https://www.techtarget.com/searchmobilecomputing/definition/wearable-technology W2. https://www.investopedia.com/terms/w/wearable-technology.asp				
Topics relevant to "SKILL DEVELOPMENT": Wireless Communication Standards, Application protocols and wearable devices for **Skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: **CIT3413**	**Course Title:** Industrial IOT **Type of Course:** **Theory**	**L-T-P-C**	3	0	0	3
Version No.						

Course Pre-requisites	DCCN			
Anti-requisites	NIL			
Course Description	The Industrial Internet of Things (IIoT) course explores the integration of smart sensors, edge computing, and connectivity in industrial settings to enhance automation, efficiency, and data-driven decision-making. It covers IIoT architecture, communication protocols, security challenges, real-world applications in manufacturing, energy, and healthcare, and the role of AI and machine learning in predictive maintenance. The course also delves into industrial cloud platforms, digital twins, and cybersecurity best practices, providing a comprehensive understanding of IIoT's impact on Industry 4.0 and smart factories.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Industrial IoT and attain Skill Development through Participative Learning techniques			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Identify the Key opportunities and benefits in Industrial IoT 2. Apply virtual network to demonstrate the use of Cloud in Industrial IoT 3. Analyze industrial IoT Three tier topology and data management system 4. Summarize Legacy Industrial and Modern Communication Protocols			
Course Content				
Module 1	Introduction	Assignment	Problem Solving	**12 Classes**
Introduction To Industrial Internet and Use-Cases: Industrial Internet- Key IIoT Technologies- Innovation and the IIoT -Key Opportunities and Benefits - The Digital and Human Workforce - Logistics and the Industrial Internet-IOT Innovations in Retail. The Technical and Business Innovators of The Industrial Internet: Cyber Physical Systems (CPS), – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog – Role of Big Data in IIOT - Role of Machine learning and AI in IIOT				
Module 2	IIOT Reference Architecture	Assignment	Problem Solving	**10 Classes**
IIOT Reference Architecture: Industrial Internet Architecture Framework (IIAF) - Industrial Internet Viewpoints -. Architectural Topology: The Three Tier Topology- Key System Characteristics- Data Management- Advanced data analytics				
Module 3	Protocols for Industrial Internet Systems	Assignment	Problem Solving	**12 Classes**

Protocols for Industrial Internet Systems: Legacy Industrial Protocols - Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies- Gateways: industrial gateways - CoAP (Constrained Application Protocol)- NFC.				
Module 4	Middleware Software Patterns and IIOT Platforms	Assignment	Problem Solving	**11 Classes**
Middleware Software Patterns and IIOT Platforms: Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFoxLoRaWAN Augmented reality- Real-World Smart Factories, Application of IIOT: Case study: Health monitoring, IoT smart city, Smart irrigation, Robot surveillance				
Targeted Application & Tools that can be used:				
Text Book 1. Gilchrist, Alasdair, "Industry 4.0 The Industrial Internet of Things", Apress, 2017.				
References R1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat "Industrial Internet of Things: Cyber manufacturing Systems" (Springer), 2017. R2. Zaigham Mahmood, "The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer), 2019. R3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor) R4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-onApproach)", 1st Edition, VPT, 2014. R5. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642- 19156-5 e-ISBN 978-3-642- 19157-2, Springer R6. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 20132 Cuno Pfister, Getting Started with the Internet of Things, O "Reilly Media, 2011, ISBN: 978-1-4493-9357-1 **Web Resources:** W1. https://www.coursera.org/learn/applied-industrial-internet-of-things W2. https://www.isa.org/training/course-description/dt101 W3. https://www.coursera.org/certificates/iiot-boulder				
Topics relevant to "SKILL DEVELOPMENT": Industrial IOT for **Skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: **CIT3414**	**Course Title: IOT Data Analytics and Machine Learning** **Type of Course: Theory**		**L-T-P-C**	3	0	0	3
Version No.							
Course Pre-requisites	DCCN						
Anti-requisites	NIL						
Course Description	This course provides a comprehensive understanding of energy management principles and techniques in IoT systems. It covers various energy sources, storage solutions, and power management strategies, focusing on optimizing energy consumption in IoT devices. Students will explore energy-efficient sensors, low-power communication technologies, and AI-driven energy optimization techniques. The course also delves into designing and implementing energy-efficient IoT solutions, including renewable energy integration and performance optimization. Additionally, it addresses advanced topics such as energy management in smart cities, industrial IoT applications, and sustainability challenges.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Energy Efficient IOT system and attain Skill Development through Participative Learning techniques						
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand various energy sources, consumption patterns, and management techniques in IoT systems. 2. Analyze energy-efficient hardware and software solutions for IoT energy optimization. 3. Design and implement energy-efficient IoT solutions using renewable energy sources. 4. Evaluate real-world applications of IoT energy management in smart cities, industries, and sustainable development.						
Course Content							
Module 1	**Energy Management Basics in IoT**	Assignment	Problem Solving	**12 Classes**			
Energy Management Basics in IoT: Energy sources and storage options, Battery technologies and renewable energy solutions, Energy consumption patterns in IoT devices, Power management strategies, Energy-efficient design principles.							
Module 2	**chnologies for IoT Energy Management**	Assignment	Problem Solving	**2 Classes**			

Technologies for IoT Energy Management: Energy-efficient sensors and actuators, Low-power communication technologies (LoRaWAN, Zigbee, BLE), AI-driven energy optimization, Software-based energy analytics, Networking and connectivity considerations for energy efficiency.

Module 3	**Designing and Implementing IoT Energy Solutions**	Assignment	Problem Solving	**8 Classes**

Designing and Implementing IoT Energy Solutions: Efficient design principles, Component selection and integration, Renewable energy integration in IoT, Prototyping and testing methodologies, Deployment and performance optimization strategies.

Module 4	**Advanced Topics in IoT Energy Management**	Assignment	Problem Solving	**8 Classes**

Advanced Topics in IoT Energy Management: Smart cities and smart grids, Energy management in industrial IoT, Sustainable development and environmental considerations, Emerging trends and challenges, Ethical and regulatory aspects of IoT energy solutions.

Targeted Application & Tools that can be used:

Text Book

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, and David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 2014, First Edition, Academic Press.
2. Shuang-Hua Yang, Wireless Sensor Networks: Principles, Design, and Applications, 2013, First Edition, Springer.

References

R1. Mischa Dohler, Burkhard Rätting, Energy Harvesting for Autonomous Systems, 2010, First Edition, Artech House.
R2. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, 2021, First Edition, Cambridge University Press.
R3. Mohammad S. Obaidat, Mieso K. Denko, Isaac Woungang, Handbook of Green Information and Communication Systems, 2013, First Edition, Elsevier. **Web Based Resources and E-books:**
W1: https://iot-analytics.com/
W2: https://www.coursera.org/certificates/iiot-boulder
W3: https://www.coursera.org/learn/energy-management-for-iot-devices

Topics relevant to "SKILL DEVELOPMENT":
Energy Efficiency for IOT System for **Skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CIT3415	**Course Title: Internet of Things** **Type of Course: Integrated**		**L- T-P- C**	1	0	4	3
Version No.	2.0					
Course Pre-requisites	1. Students should know basic python programming. 2. Students have basic knowledge basic electronic components such as sensors – temperature, motion, pressure, and actuators etc. 3. Students should have basic idea about Cloud and its uses.					
Anti-requisites	NIL					
Course Description	The Internet of Things (IoT) is an emerging paradigm combining heterogeneous devices at an unprecedented scale, thereby enabling individuals and organizations to gain greater value from networked connections among people, processes, data, and things. The Internet of Things (IoT) is a course of objects interacting with people, with information systems, and with other objects. The course will focus on creative thinking, IoT concepts & IoT technologies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Internet of Things and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Identify the application areas of IoT 2. Understand building blocks of Internet of Things and characteristics 3. Describe IoT Protocols 4. Demonstrate use of IoT devices for simple application					
Course Content:						
Module 1	INTRODUCTION TO INTERNET OF THINGS	Assignment	Simulation/Data Analysis	**18 Sessions**		
Introduction, Definition & Characteristics of IOT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical design of IoT- IoT functional blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless sensor networks, Cloud computing, Big data Analytics						
Module 2	IOT COMMUNICATION MODEL AND PROTOCOLS	Assignment	Numerical from E-Resources	**18 Sessions**		
Connectivity Protocols: 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, ISA 100,NFC, RFID. Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol						
Module 3	IOT COMMUNICATION MODEL AND PROTOCOLS	Term paper/Assignment	Simulation/Data Analysis	**19 Sessions**		
Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol. RFID: Introduction, Principle of RFID, Components of an RFID system.						
List of Laboratory Tasks 1 Installation of arduino IDE & Arduino program to implement scrolling LED, to glow even/odd LED 2 Arduino program to demonstrate usage of push button to control the LED 3 Arduino program to demonstrates traffic control system						

4 Arduino program to demonstrates usage of servo motor with potentio meter.
5.Arduino program to Control an LED using Bluetooth.
6.Arduino program to implement RFID reader for security access.
7. Arduino Program to detect obstacle using IR sensor.
8.Arduino Program to detect motion using PIR sensor.
9.Installation of Raspberry pi software
10. Working basic commands on Raspberry pi & to demonstrate remote logging in raspberry pi
11.Raspberry pi program to implement blinking LED
12. Raspberry pi program to implement camera module for video
13. Raspberry pi program to obtain the temperature using DHT sensors
14.Using a Raspberry Pi with distance sensor (ultrasonic sensor HCSR04)
15. Raspberry pi program to implement Garage spot light

Targeted Application & Tools that can be used:

Interfacing of ARDUINO and Raspberry pi for developing smart CITIES

Tools:

Tinker cad
Cooja simulator
Contiki
Thingspeak

Text Book

T1 Arshdeep Bagha, Vijay Madisetti, Internet of Things A hands on approach, First Edition, Universities
Press, 2018
T2 Hakima Chaouchi, The internet of Things Connecting Objects to web Wiley 2017

References

R1 Vinit Kumar Gunjan, MohdDilshad Ansari,Mohammed Usman, ThiDieuLinh Nguyen Internet of Things Technology, Communications and Computing Springer January 2023
R2 Dr. Hassan Internet of Things A to Z: Technologies and Applications IEEE Press 2018

E-Resources

NPTEL course –
a) https://onlinecourses.nptel.ac.in/noc22_cs53/preview
b) https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
c) https://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to "SKILL DEVELOPMENT": Case studies of water supply projects – Design criteria through group discussion. Interpolation of sensors through group presentation for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 7100	**Course Title: Mini Project** **Type of Course:**	**L- T-P- C**	0	0	0	4
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**					
Anti-requisites	**NIL**					

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

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

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

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