Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Computer Engineering

Third Year Scheme & Syllabus

(As per AICTE guidelines, with effect from the Academic Year 2024-25)

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated, and taken forward in a systematic manner. Therefore, autonomy for Vidyalankar Institute of Technology is not merely a transition from pre-cooked syllabi to self-designed curriculum. Autonomy curriculum of the Institute offers required academic flexibility with emphasis on industry requirements and market trends, employability and problem-solving approach which leads to improving competency level of learners with diverse strengths. In line with this, the curriculum framework designed is **Choice Based Credit and Grading System (CBCGS)**. Number of credits for each category of courses learnt by learners, internships and projects is finalized considering the scope of study and the ability that a learner should gain through the programme. The overall credits and approach of curriculum proposed is in line with AICTE model curriculum.

The curriculum comprises courses from various categories like basic sciences, humanities and social sciences, engineering sciences, general education and branch specific courses including professional electives and open electives. The curriculum has core courses of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. These courses are completed by third year of the engineering programme that enables learners to prepare for higher education during their final year. Professional elective courses, that begin from third year of programme, offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique professional elective courses based on industrial requirements and organizing them into tracks is a salient feature of this curricula ensuring employability. Open Elective courses cover multi-disciplinary, special skill development, project management and similar knowledge that make learner capable to work in industrial environment.
For holistic development of learners, apart from technical courses, Humanities and Social Science courses develop the required soft-skills and attitude amongst learners. Our curriculum also introduces Social Service Internship and Internship with institutes abroad along with courses like Design Thinking, Yoga and Meditation, Indian Traditional Knowledge System under General Education category. These general education courses aim to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses. In addition to this, the curriculum is augmented with Life Enrichment audit courses for knowledge inspiring experience.

Additionally, curriculum provides add-on Honours/Minor degree that involves field/ domain study. Learner can avail this degree by completing requirement of additional 15 credits.

Thus, the academic plan of VIT envisages a shift from summative to formative and competency-based learning system which will enhance learner's ability towards higher education, employability and entrepreneurship.

Chairman, Board of Studies
Department of Computer Engineering
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Third Year B. Tech. Computer Engineering **Semester: V**

Course Structure and Assessment Guidelines

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
HS04	Presentation Skills	Practical	1	50	-	-	050
BS12	Engineering Mathematics-V	Theory	3	20	30	50	100
CE09	Theory of Computer Science	Theory+ Tutorial	3	40	20	40	100
CE10T	Artificial Intelligence	Theory	2	15	20	40	075
CE10P	Artificial Intelligence Lab	Practical	1	25	-	25	050
CE11T	Computer Networks	Theory	2	15	20	40	075
CE11P	Computer Networks Lab	Practical	1	25	-	25	050
CE12T	Software Engineering	Theory	2	15	20	40	075
CE12P	Web Design Lab	Practical	1	25	-	25	050
CEXXT	Professional Elective-1	Theory	2	15	20	40	075
CEXXP	Professional Elective-1 Lab	Practical	1	25	-	25	050
CE45	Mini-Project	Practical	2	25	-	50	075

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Professional Elective-1 Courses (CEXX)

Course Code	Course Name	Specialization Track Name
CE22T	Data Warehousing and Data Mining	Artificial Intelligence and Machine Learning (AIML)
CE22P	Data Warehousing and Data Mining Lab	
CE22T	Data Warehousing and Data Mining	Data Analytics (DA)
CE22P	Data Warehousing and Data Mining Lab	
CE23T	Modern Sensors for Internet of Things	Internet of Things (IoT)
CE23P	Modern Sensors for Internet of Things lab	
CE24T	Cryptography and Network Security	Cyber Security (CSec)
CE24P	Cryptography and Network Security Lab	

List of Advance Learning Courses for Semester V

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
CE13T	Machine Learning	Theory	2	15	20	40	075
CE13P	Machine Learning Lab	Practical	1	25	-	25	050
CE44	Machine Vision using Python	Practical	2	50	-	25	075
CE15	System Programming and Compiler Design	Theory	3	20	30	50	100

Third Year B. Tech. Computer Engineering **Semester: VI**

Course Structure and Assessment Guidelines

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
CE13T	Machine Learning	Theory	2	15	20	40	075
CE13P	Machine Learning Lab	Practical	1	25	-	25	050
CE44	Machine Vision using Python	Practical	2	50	-	25	075
CE14	Distributed and Cloud Computing Lab	Practical	2	50	-	25	075
CE15	System Programming and Compiler Design	Theory	3	20	30	50	100
CE16	Distributed Systems	Theory	3	20	30	50	100
CEXXT	Professional Elective-2	Theory	2	15	20	40	075
CEXXP	Professional Elective-2 Lab	Practical	1	25	-	25	050
CEXXT	Professional Elective-3	Theory	2	15	20	40	075
CEXXP	Professional Elective-3 Lab	Practical	1	25	-	25	050

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Professional Elective-2 Courses (CEXX)

Course Code	Course Name	Specialization Track Name
CE21T	Soft Computing	Artificial Intelligence and Machine Learning (AIML)
CE21P	Soft Computing Lab	
CE26T	Advance Databases	Data Analytics (DA)
CE26P	Advance Databases Lab	
CE31T	Embedded Systems	Internet of Things (IoT)
CE31P	Embedded Systems Lab	
CE28T	System Security and Ethical Hacking	Cyber Security (CSec)
CE28P	System Security and Ethical Hacking Lab	

Professional Elective-3 Courses (CEXX)

Course Code	Course Name	Specialization Track Name
CE30T	Probabilistic and Graphical Model	Artificial Intelligence and Machine Learning (AIML)
CE30P	PGM Lab	
CE30T	Probabilistic and Graphical Model	Data Analytics (DS)
CE30P	PGM Lab	
CE42T	Principles of Internet of Things	Internet of Things (IoT)
CE42P	Principles of Internet of Things Lab	

Third Year B. Tech. Computer Engineering - Summer Break

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
CE46	Industry Internship	Practical	5	As decided by the Internal and External guides			

Detailed syllabus of Third Year Semester-V

Course Name: Presentation Skills

Course Code: HS04

Category: Humanities and Social Sciences (HSS)

Preamble:

The course, Presentation Skills, is intended to equip students with the necessary skill-set to help them bridge the gap from the campus to the corporate world. It will help them to be industry ready in sync with the requirements of the program they are pursuing.

Pre-requisites:

Nil

Course Objectives:

- To familiarize students about constructing a personal brand effectively.
- To create engaging and deliver effective business presentation skills by utilizing digital tools.
- To apply communication and strategic planning in business plan pitches and presentations.
- To develop an appreciation for cultural diversity and enhance intercultural communication skills.
- To understand the nuances of storyboarding and storytelling
- To present oneself professionally in interviews, group discussions and various corporate situations.

Course Outcomes:

Learner will be able to:
CO1: Understand the significance of brand-building and apply strategies to construct an effective personal brand.
CO2: Demonstrate proficiency in delivering impactful presentations by utilizing digital tools and applying structured communication principles.
CO3: Proficient in crafting comprehensive business plans by employing persuasive marketing and financial strategies and implementation plans.
CO4: Craft engaging visual stories through storyboarding and storytelling, create compelling video presentations.
CO5: Demonstrate readiness for placements by gaining practice in aptitude tests, HR interviews and GDs, and crafting professional resumes.
CO6: Understand intercultural communication, global citizenship, and respect cultural diversity.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	50	-	-	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Personal Branding	Introduction to Personal Branding –Purpose, Significance, Benefits and Techniques to build a personal brand. Corporate/Organisational Branding. Online identity of Brand on social media. Maintenance and Improvement of your Brand Factors affecting your Brand	6
2	Corporate Presentations	Business Presentation Tips Digital Presentations PAIBOC Model and Minto Pyramid Principles	4
3	Business Plan Presentations	Introduction to Business Plans Company Overview & Industry Analysis Persuasive Communication in Marketing Strategy Operations Strategy in Financial Management Implementation Plan	6
4	Storyboarding and Storytelling	Visual Story Telling Video Presentations Story Structure with images Film and Animation	4
5	Placement Readiness	Mock HR Interviews Mock GDs Aptitude Tests Placement ready resume	6
6	Global Communication	An introduction to inter-cultural communication Introduction to languages and cultures Global media in mass communication Tips to become a global citizen Respecting cultural diversity	4
Total			**30**

Guidelines to conduct practical sessions:

1. Personal Branding
2. Personal Branding
3. Personal Branding
4. Corporate Presentations

5. Corporate Presentations
6. Business Plan Presentations
7. Business Plan Presentations
8. Business Plan Presentations
9. Storyboarding and Storytelling
10. Storyboarding and Storytelling
11. Placement Readiness
12. Placement Readiness
13. Placement Readiness
14. Global Communication
15. Global Communication

List of Assignments:

1. Personal Branding (Individual)
2. Corporate Presentations (Group)
3. Business Plan Presentations (Group)
4. Storyboarding and Storytelling (Group)
5. Global Communication (Individual)

Recommended Online Courses:

1. Introduction to Personal Branding - https://www.coursera.org/learn/personal-branding
2. Strategic Self-Marketing and Personal Branding - https://www.coursera.org/learn/self-marketing
3. Learn to Storyboard for Film or Animation - https://www.udemy.com/course/storyboard-for-film-or-animation/
4. Powerful Tools for Teaching and Learning: Digital Storytelling - https://www.coursera.org/learn/digital-storytelling
5. Presentation Skills: Speechwriting, Slides and Delivery Specialization - https://www.coursera.org/specializations/presentation-skills
6. Business English for Cross-Cultural Communication - https://www.coursera.org/learn/cross-cultural-communication-business

Reference Books:

1. Personal Development for Life and Work, Wallace and Masters, Thomson Learning
2. Organizational Behaviour, Robbins Stephens, Pearson Education
3. Me 2.0: 4 Steps to Building Your Future, Dan Schawbel, Diversion Books
4. Branding Pays: The Five-Step System to Reinvent Your Personal Brand, Karen Kang, Branding Pays Media
5. The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience, Carmine Gallo, McGraw Hill Education
6. Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds, Carmine Gallo, St. Martin's Press
7. The Storytelling Animal: How Stories Make Us Human, Jonathan Gottschall, Mariner Books
8. Made to Stick: Why Some Ideas Survive and Others Die, Chip Heath and Dan Heath, Random House
9. The Culture Map: Decoding How People Think, Lead, and Get Things Done Across Cultures, Erin Meyer, Public Affairs
10. Kiss, Bow, or Shake Hands: The Bestselling Guide to Doing Business in More Than 60 Countries, Terri Morrison and Wayne A. Conaway, Adams Media
11. Brand Thinking and Other Noble Pursuits, Debbie Millman, Allworth
12. Building a Brand Story: Clarify Your Message So Customers Will Listen, Donald Miller, HarperCollins

Course Name: Engineering Mathematics-V

Course Code: BS12

Category: Basic Science (BS)

Preamble:

The objective of the course is to impart knowledge of Probability, probability distribution Estimation theory, testing of hypothesis, Analysis of variance and Non parametric Test.

Pre-requisites:

Engineering Mathematics-I (BS01) and Engineering Mathematics-II (BS03)

Course Objectives:

- Provide foundational knowledge in descriptive statistics and probability.
- Introduce the concept and importance of sampling distributions.
- Teach estimation techniques, including point and interval estimation.
- Develop students' understanding of hypothesis testing principles and methods.
- Explore Analysis of Variance (ANOVA) for comparing means across multiple groups.
- Cover non-parametric tests for analyzing data that do not meet parametric assumptions.

Course Outcome:

Learner will be able to: -

CO1: interpret and work with discrete and continuous probability distributions including binomial, Poisson, normal, exponential, uniform, gamma, and beta distributions..
CO2: Analyze the difference between two sample means and proportions.
CO3: Construct confidence intervals for population means, the difference between two population means, population proportions, and the difference between two population proportions.
CO4: Formulate and conduct hypothesis tests for population means, the difference between two population means, population proportions, and the difference between two population proportions.
CO5: Conduct one-way and two-way ANOVA to analyze variance among groups.
CO6: Apply concepts of Non-parametric test to engineering problems.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No	Module name	Content	No of Hours
1	Descriptive statistics and probability	Basic probability and Baye's theorem, Discrete probability distributions Continuous probability distributions Binomial, Poisson- and normal distributions, Exponential distribution, uniform distribution, gamma & beta distribution	8
2	Sampling Distributions	Sampling Distributions – small sample and large sample, sample mean, difference between two sample means, sample proportions, difference between two sample proportions.	8
3	Estimation	t- Distribution, Confidence intervals for - population mean, difference between two population means, population proportion, difference between two population proportions,	7
4	Hypothesis Testing	Hypothesis testing for – Population mean, difference between two population means, population proportions, difference between two population proportions, Type – I and II error	7
5	Analysis of Variance	Completely randomized design, Randomized complete block design, Regression and Correlation, Simple linear regression, correlation model, correlation coefficient, multiple regression, multiple correlation, one way and two way anova	8
6	Non-parametric Test	Chi square distribution - Properties Test of goodness of fit, independence and homogeneity	7
Total			**45**

Reference Books:

1. Fundamentals of mathematical statistics by S. C. Gupta and V. K. Kapoor, second edition, Sultan Chand Publisher
2. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
3. Probability and statistics for engineers by J. Ravichandran, Wiley /india
4. Probability and Statistics by Schaum's series
5. Probability and Random Process by T. Veerajan

Course Name: Theory of Computer Science

Course Code: CE09

Category: Core

Preamble:

This course introduces students to formal language and automata theory. It covers different types of grammars and automata of different powers that are required to recognize languages defined by the grammars.

Pre-requisites:

BS05 (Engineering Mathematics 3)

Course Objectives:

- Acquire conceptual understanding of fundamentals of grammars and languages.
- Build concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata.
- Develop understanding of different types of Turing machines and applications.

Course Outcomes:

Learner will be able to:
CO1: Express rules in mathematical form (grammar).
CO2: Classify the problem into appropriate type of grammar.
CO3: Apply equivalence theory to recognize power of different automata.
CO4: Design Automata to meet the required specifications.
CO5: Create a tool that designs automata for a given grammar.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Tutorial	Theory	Tutorial
2	1	2	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory + Tutorial	40	20	40	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course.

However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Language and Automata	Concepts: Symbol, Alphabet, Language and Grammar. Types of Grammar and Automata.	2
2	Finite Automata	Deterministic: 5-tuple representation of DFA. Designing DFA for Regular Language. Minimization of DFA. Non-Deterministic: 5-tuple representation of NFA with epsilon moves and NFA without epsilon moves. Equivalence of language recognized by NFA and DFA	6
3	Regular Language and grammar	Regular Expression and Regular Grammar. Equivalence of FA and Regular Expression. Properties of Regular Sets/ Languages. Classifying language as Regular and Non-regular.	6
4	Context Free and Sensitive Languages.	Concepts: CFG, CFL, Derivations and Ambiguity. CFL as a superset of Regular. Normal Forms (CNF and GNF). Properties of CFL.	6
5	Push-down Automata	7-tuple Deterministic PDA. Deterministic and Non-Deterministic PDA. Equivalence of NPDA and CFL.	4
6	Turing Machine	Basic 7-tuple Turing Machine (TM). Variants of TM. TM as acceptor of Recursively Enumerable (RE) Languages. Halting Problem. Recursive and RE Languages. Undecidability	6
Total			**30**

Suggestion for list of Tutorials:

1. At-least one tutorial on each module. Recommended to add additional tutorials for module 3, 5 and 7.
2. Questions should be short and conceptual only. Each tutorial should be designed worth 2 Marks. Required to be solvable in 5 to 10 mins.
3. Tutorial to have major questions mapping to level 1 of Blooms Taxonomy (Understanding) and few questions mapping to level 2 of Blooms Taxonomy (Applying)

Reference Books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman. Introduction to Automata Theory, Languages and Computation. Pearson Education. 2008.
2. Michael Sipser. Introduction to the Theory of Computation. Thomson Course Technology. 2012.
3. Peter Linz. An Introduction to Formal Languages and Automata. Jones and Bartlett Student Edition. 2016.

Course Name: Artificial Intelligence

Course Code: CE10T

Category: Core

Preamble:

AI has become pervasive across diverse domains. Numerous industries, websites and applications leverage AI to enhance their functionality, facilitating tasks such as speech recognition, media generation, and content creation. As technology continues to advance, individuals proficient in AI will increasingly be sought after in the job market.

Pre-requisites:

Data Structure (CE01T) and Engineering Mathematics-III (BS05)

Course Objectives:

- Understand Artificial Intelligence, Agents and Environments
- Know and use various problem-solving methods
- Acquire and use knowledge representation methods in AI
- Know and identify AI applications
- Design and apply Artificial Intelligence in community

Course Outcomes:

Learner will be able to:
CO1: To understand the basics of Artificial Intelligence and design of Artificial intelligence Agent
CO2: To apply the most suitable search strategy to design problem solving agents
CO3: To represent a natural language description of statements in logic and apply the inference rules to design Knowledge Base
CO4: To apply a probabilistic model for reasoning under uncertainty.
CO5: To comprehend various learning techniques
CO6: To design and apply Artificial Intelligence in community

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the

revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Artificial Intelligence	Artificial Intelligence Introduction Artificial Intelligence Problems Agents and Environments The structure of Agents Types of Agents PEAS	4
2	Problem Solving	Problem solving Agent Problem formulation Search Strategies Uninformed Search: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID) Heuristics Informed Search: Greedy best first Search, A* Search, Memory bounded heuristic Search Local Search: Hill climbing search Simulated annealing, Genetic algorithms Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning	6
3	Knowledge Representation	Knowledge based Agents Propositional logic First Order Predicate Logic (FOPL) Inference in FOPL (Resolution by refutation) Forward chaining, backward Chaining. Uncertain Knowledge and Reasoning: Uncertainty, Representing knowledge in an uncertain domain, The semantics of Belief Network, Simple Inference in Belief Network	6
4	Reasoning Under Uncertainty	Handling Uncertain Knowledge Random Variables, Prior and Posterior Probability Inference using Full Joint Distribution Bayes' Rule and its use Bayesian Belief Networks Reasoning in Belief Networks	4
5	Learning	Types of learning: Concepts of Supervised, Unsupervised and Reinforcement Learning Learning Decision trees Explanation based learning Statistical Learning methods	4

6	Artificial Intelligence Applications	Natural Language Processing Text Classification: Spam detection, sentiment analysis. Speech Recognition: Converting spoken language into text Speech Recognition Computer Vision Image Classification: Recognizing objects in images (e.g., cats, dogs, cars). Object Detection: Identifying and localizing objects within images.	5
Total			**30**

Textbooks:

1. Artificial Intelligence: A Modern Approach (AIMA) is a university textbook on artificial intelligence, written by Stuart J. Russell and Peter Norvig.
2. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence : a logical approach", Oxford University Press.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.

Course Name: Artificial Intelligence Lab

Course Code: CE10P

Category: Core

Preamble:

Intelligent machines have replaced human capabilities in many areas. Artificial intelligence is the intelligence exhibited by machines or software. It emphasizes on creating intelligent machines that work and react like humans. AI labs will help to understand these concepts with practical experiments.

Pre-requisites:

Structured Programming Lab (ES04P) / Object Oriented Programming Lab (ES05P) / Software Lab (CE08)

Course Objectives:

- Understand Problem-solving, state-space exploration, implementing search algorithms
- Gain the knowledge of uninformed and informed search strategies
- Understanding game trees, minimax algorithm, implementing turn-based strategies
- Mathematical reasoning, algorithmic thinking, translating mathematical solutions to code
- Critical thinking, comparing different mathematical models, implementation of complex algorithms
- Applying AI to real-world problems, competition problem-solving, game-based search strategies

Course Outcomes:

Learner will be able to:

CO1: Learn how to represent problems in a form suitable for AI techniques, emphasizing state-space representation and constraints.

CO2: Understand and design effective heuristics to guide search algorithms

CO3: Acquire proficiency in various search algorithms, both uninformed (BFS, DFS) and informed (A*, Best First Search, Hill Climbing)

CO4: Translate mathematical models and theories into practical algorithmic solutions.

CO5: Apply AI techniques to game playing, specifically using minimax and its optimizations.

CO6: Apply AI methods to solve practical problems, such as those found in competitive programming challenges

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practical:

Sr No.	Title of Practical
1	Implement a puzzle for Water Jug Problem
2	Implement an AI for Water Jug Problem
3	Implement Program 2 for Tic-Tac-Toe by Rich and Knight
4	Implement Program 2' for Tic-Tac-Toe by Rich and Knight
5	Implement general mathematical solution to the Water Jug Problem
6	Implement mathematical solution to the Water Jug Problem suggested by You-Kwong Man, Member IAENG
7	Implement a puzzle for 8 Puzzle problem
8	Implement a for 8 Puzzle problem using Hill Climbing Search
9	Implement a for 8 Puzzle problem using Best First Search
10	Implement solution to the Missionaries and Cannibals problem
11	Implement a solution for the maze (Explained in lecture) problem using A* Search
12	Implement solution for Hacker rank challenge for BOT saving Princes

Textbooks:

1. Artificial Intelligence: A Modern Approach (AIMA) is a university textbook on artificial intelligence, written by Stuart J. Russell and Peter Norvig.
2. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence : a logical approach", Oxford University Press.
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.

Course Name: Computer Network

Course Code: CE11T

Category: Core

Preamble:

This course aims to give students an overview of the concepts and fundamentals of computer networks. It covers protocol layering, enabling students to analyze network performance. Additionally, the course provides insights into the functions of the OSI and TCP/IP models and various routing protocols.

Pre-requisites:

Fundamentals of Computer Hardware and Networking (ES06T) and Analysis of Algorithm (CE04T)

Course Objectives:

- To introduce concepts and fundamentals of data communication and computer networks.
- To explore the inter-working of various layers of OSI.
- To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite.
- To assess the strengths and weaknesses of various routing algorithms.
- To understand various transport layer and application layer protocols.

Course Outcomes:

Learner will be able to:
CO1: Demonstrate the concepts of data communication and compare ISO - OSI model with TCP/IP model.
CO2: Explore different design issues at data link layer.
CO3: Design the network using IP addressing and subnetting / super netting schemes.
CO4: Analyse various routing algorithms and protocols at network layer.
CO5: Analyse transport layer protocols and congestion control algorithms.
CO6: Explore protocols at application layer.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Computer Networks	Introduction to computer network, network application, (Interconnection networking devices), Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services. Revisiting OSI Model & TCP/IP Model.	4
2	Data Link Layer	Data Link Layer 2.1 DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction(Hamming Code, CRC, Checksum) , Elementary Data Link protocols , Stop and Wait, Sliding Window(Go Back N, Selective Repeat), HDLC 2.2 Medium Access Control sublayer Channel Allocation problem, Multiple access Protocol(Aloha, Carrier Sense Multiple Access (CSMA/CD), Local Area Networks - Ethernet (802.3)	8
3	IP Addressing & Network Layer	IPv4 Addressing (classfull and classless), Subnetting, Supernetting design problems, IPv4 Protocol, Network Address Translation (NAT). IPv6 Addressing, Transition from IPV4 to IPV6	8
4	Routing Protocols	Shortest Path (Dijkastra's), Link state routing, Distance Vector Routing	4
5	Transport Layer	Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers. TCP Flow control (sliding Window), TCP Congestion Control: Slow Start.	4
6	Application Layer	Protocols: DNS, HTTP, SMTP, Telnet, FTP, DHCP	2
Total			**30**

Textbooks:

1. Behrouz A. Forouzan, Forouzan Mosharrat , Computer Networks A Top down Approach, Mc Graw Hill education.
2. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education.

Reference Books:

1. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
2. B. A. Forouzan, "TCP/IP Protocol Suite", Tata McGraw Hill edition, Third Edition.

Course Name: Computer Networks Lab

Course Code: CE11P

Category: Core

Preamble:

This course is to provide students with an overview of the concepts and fundamentals of computer networks.

Pre-requisites:

Fundamentals of Computer Hardware and Networking Lab **(**ES06P) and Analysis of Algorithms Lab (CE04P)

Course Objectives:

- To practically explore OSI layers and understand the usage of simulation tools.
- To analyze, specify and design the topological and routing strategies for an IP based networking infrastructure.
- To identify the various issues of a packet transfer from source to destination, and how they are resolved by the various existing protocols.

Course Outcomes:

Learner will be able to:
CO1: Execute and evaluate network administration commands and demonstrate their use in different network scenario
CO2: Demonstrate the installation and configuration of network simulator.
CO3: Demonstrate and measure different network scenarios and their performance behavior. CO4: Implement the socket programming for client server architecture.
CO5: Analyze the traffic flow of different protocols
CO6: Design a network for an organization using a network design tool

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practicals

Learners are expected to perform practicals based on the following suggested topics.

Sr No	Suggested Topic(s)
1	Study, understand and perform various networking commands: Ping, Tracert, trace route, ipconfig, ifconfig, nslookup, netstat
2	Designing Network Layout
3	Program for Error Detection
4	Program for Error Correction
5	Program on IP Addressing
6	Case study on Subnetting and Supernetting
7	Socket Programming
8	Chat Application
9	Installation and configuration of Wireshark tool Study the packet transmission using Wireshark and understand/visualize the IP protocol
10	Cisco Packet Tracer

Textbooks:

1. Behrouz A. Forouzan, Forouzan Mosharrat , Computer Networks A Top down Approach, Mc Graw Hill education.
2. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education.

Reference Books:

1. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
2. B. A. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill edition, Third Edition.

Course Name: Software Engineering

Course Code: CE12T

Category: Core

Preamble:

To apply role of SDLC in Software Project Development with the concepts and features of Web Technology. Explore the agile methodologies that drive modern development, emphasizing collaboration and adaptability. The art and science of crafting dynamic, user-friendly websites and applications journey from foundational concepts to advanced techniques, gaining proficiency in HTML, CSS, JavaScript, and more. Through hands-on projects, you'll hone your skills, cultivating a portfolio showcasing your evolving expertise.

Pre-requisites:

NIL

Course Objectives:

- To provide knowledge of Software Engineering Discipline
- To Apply knowledge of Software Engineering Discipline for Web based applications
- To understand Requirement gathering process and design engineering
- To apply analysis and develop software solutions
- To demonstrate and evaluate real time projects with respect to web based software projects
- To apply and analyze testing and quality assurance in web based software solutions

Course Outcomes:

Learner will be able to:
CO1: Define various software application domains and remember different process model used in software development.
CO2: Explain needs for software specifications also they can classify different types of software requirements and their gathering techniques.
CO3: Justify role of SDLC in Software Project Development and they can evaluate importance of Software Engineering in PLC.
CO4: Apply testing to assure quality in software solution and Identify risks, manage the change to assure quality in software projects.
CO5: Understand the core concepts and features of Web Technology
CO6: Design static web pages using HTML5 and CSS3

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Web Programming and Concepts	Introduction to HTML, HTML Document Structure Text Elements, Images and Attributes, Hyperlinks, Semantic HTML, complex image maps, tables and nested tables, Inserting web page, Setting & modifying field properties, Validating HTML CSS: Internal and External CSS, CSS Grid Overview, Sizing Grid Columns and Rows, Building a Simple CSS Grid Layout Javascript & Document Object Model: Introduction to JavaScript, Variables and Objects, Decision Making Statement, Loops, Arrays, Functions & Prototypes, Core JavaScript Objects, DOM Introduction, Event Model, Function	8
2	The Software Process	Generic view of Process, Prescriptive Models: Waterfall Model, Incremental-RAD Model, Evolutionary Process Model-Prototyping, Spiral Agile Methodology, Scrum and Extreme Programming	4
3	Requirements Engineering and Analysis	Requirement, Types of Requirements, Requirement Gathering , Requirement Engineering Task, SRS (Software Requirement Specification)	4
4	Software Estimation and Scheduling	Management Spectrum, 4Ps (people, product and process) ,Process and Project metrics, Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO Model, Project scheduling: WBS, Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule	5
5	Design Engineering	Software Design Concepts, Interaction Design , Design Golden Rules and Heuristics.	3
6	Software Testing and Risk Management	Testing: Software Quality, Testing: Strategic Approach, Strategic Issues- Testing: Strategies for Conventional Software. Risk Management: Risk Identification, Risk Assessment, Risk Projection, RMMM, Software Configuration management, SCM	6

		process- Version Control , Change Control	
Total			**30**

Textbooks:

1. Software Engineering: A Practitioner's Approach Roger PressmanMcGraw-Hill Publications
2. Software Engineering Ian Sommerville, Pearson Education (9th edition)
3. Software Engineering FundamentalsAli Behfrooz and Fredeick J.Hudson Oxford University Press
4. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed., DT Editorial Services

-

Reference Books:

1. Software Engineering – Concepts and Practices Ugrasen Suman Cengage Learning
2. An integrated approach to Software Engineering Pankaj Jalote, Springer/ Narosa
3. Web Development with Node and Express, Ethan Brown, O'Reilly

Course Name: Web Design Lab

Course Code: CE12P

Category: Core

Preamble:

Integrate the principles of Software Development Life Cycle (SDLC) into the realm of Software Project Development, specifically aligning them with the dynamic landscape of Web Technology. Investigate contemporary agile methodologies that propel modern development practices, with a focus on fostering collaboration and adaptability. Embark on the captivating journey of mastering the craft of designing dynamic and user-friendly websites and applications, progressing from fundamental concepts to advanced techniques. Develop proficiency in essential technologies such as HTML, CSS, JavaScript, and beyond through practical, hands-on projects.

Pre-requisites:

NIL

Course Objectives:

- To Apply knowledge of Software Engineering Discipline for Web based applications
- To understand Requirement gathering process and design engineering
- To apply analysis and develop software solutions
- To demonstrate and evaluate real time projects with respect to web based software projects
- To apply and analyze testing and quality assurance in web based software solutions

Course Outcomes:

Learner will be able to:
CO1: Characterize diverse domains of software applications and recall various process models employed in software development.
CO2: Elaborate on the necessity of software specifications, categorize different types of software requirements, and articulate techniques for gathering them.
CO3: Validate the significance of the Software Development Life Cycle (SDLC) in Software Project Development.
CO4: Implement testing methodologies to ensure quality in software solutions. Identify and manage risks and changes to guarantee quality in software projects.
CO5: Comprehend the fundamental concepts and features of Web Technology.
CO6: Formulate static web pages using HTML5 and CSS3.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practicals:

Sr No.	Title of Practicals
1	Project Selection and Conceptualization
2	Design the static web pages required for Project : Registration , Login, Home page , Feature1, 2 (based on project)
3	Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contains alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters length). 3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be Empty).
4	Design a web page using CSS (Cascading Style Sheets) which includes the following: Use different font, styles: In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles.
5	Prepare SRS for Project topic
6	Prepare DFD-Data flow diagram for Project topic
7	Prepare Use case diagram for Project topic
8	Prepare Sequence Activity diagram for Project topic
9	Prepare Component and Deployment diagram for Project topic
10	Prepare WBS and Gantt Chart for Project topic
11	Prepare Test Case plan for Project topic
12	Prepare RMMM Document for Project topic

Textbooks:

1. Software Engineering: A Practitioner's Approach Roger Pressman McGraw-Hill Publications
2. Software Engineering Ian Sommerville, Pearson Education (9th edition)
3. Software Engineering FundamentalsAli Behfrooz and Fredeick J.Hudson Oxford University Press

4. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed., DT Editorial Services

Reference Books:

1. Software Engineering – Concepts and Practices Ugrasen Suman Cengage Learning
2. An integrated approach to Software Engineering Pankaj Jalote, Springer/ Narosa
3. Web Development with Node and Express, Ethan Brown, O'Reilly

Course Name: Data Warehousing & Mining

Course Code: CE22T

Category: Professional Elective (AIML and DA track)

Preamble:
In today's data-driven world, organizations rely heavily on data warehousing and data mining techniques to extract meaningful insights from large volumes of data. This course aims to provide learners with a comprehensive understanding of the foundational principles of data warehousing and basic concepts of data mining. Through theoretical exploration, participants will gain insights into the design, implementation, and administration of data warehouses, as well as the fundamental techniques and applications of data mining.

Pre-requisites:
Database Management Systems (CE05T)

Course Objectives :

- Understand the fundamental concepts and historical development of data warehousing.
- Gain insights into the design principles and architecture of data warehouses.
- Explore the processes involved in ETL (Extract, Transform, Load) in data warehousing.
- Understand the fundamental concepts and architecture of data lakes as centralized repositories for storing and processing diverse data types.
- Familiarize oneself with basic concepts and techniques of data mining, including preprocessing, model building, and evaluation.
- Explore the various methods and applications of data mining in real-world scenarios.

Course Outcomes:
On successful completion, of course, learner/student will be able to:

CO1: Demonstrate a comprehensive understanding of the fundamental concepts of data warehousing and its architecture.

CO2: Design a data warehouse schema using dimensional modeling techniques and explain the ETL process involved in data warehousing.

CO3: To introduce concepts and fundamentals of data lakes

CO4: Understand data mining principles and perform data preprocessing and Visualization.

CO5: Understand the concept of data mining and identify appropriate data mining algorithms to solve real-world problems.

CO6: Implement basic data mining algorithms such as classification, clustering, and association mining

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at the institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Data Warehouse and ETL Process	Introduction to Data Warehouse and Data Mart , Data warehouse architecture, Data warehouse vs Data Marts Dimensional modeling, Design of information package, star schema, snowflake schema, fact constellation schema, factless fact tables, aggregate fact tables. OLAP operations ETL process: Basic steps of the ETL process, different extraction methods, transformations, and different loading techniques.	8
2	Introduction to Data Lakes	Definition, key attributes of data lake, challenges, functionalities, architecture, Curating data lakes, Data Lake vs. data warehouse	3
3	Data Exploration and Data Preprocessing	The KDD process, Data mining system architecture, Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization: box plots, line & bar charts, and scatter plots. Data Preprocessing: Descriptive data, summarization, Cleaning, Integration & transformation, Data reduction.	5
4	Classification	Introduction to data mining techniques, Classification: Decision Tree Induction, Naïve Bayesian Classification. Regression: Simple and multiple	5
5	Clustering	Clustering: Partition based: K-means, Hierarchical Methods (Agglomerative, Divisive).	4
6	Mining frequent patterns and associations	Basic Concepts: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent Itemset. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from requent Itemset, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats.	5

Total	**30**

Textbooks:

1. Margy Ross and Ralph Kimball, "The Data Warehouse Toolkit", 3rd edition, Willey
2. Paulraj Ponniah, "Data Warehouse Fundamentals", Wiley-Interscience Publication
3. Bill Inmon, "Data Lake Architecture", 1st edition, Technics Publication
4. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", 3rd edition, Elsevier

Reference Books:

W. H. Inmon, "Building the Data Warehouse", 3rd edition, Wiley Computer Publishing

Course Name: Data Warehousing & Mining Lab

Course Code: CE22P

Category: Professional Elective (AIML and DA track)

Preamble:
In today's data-driven world, organizations rely heavily on data warehousing and data mining techniques to extract meaningful insights from large volumes of data. This course aims to provide learners with a comprehensive understanding of the foundational principles of data warehousing and basic concepts of data mining. Through hands-on exploration, learners will gain insights into the design, and implementation of data warehouses, as well as the fundamental techniques and applications of data mining.

Pre-requisites:
Database Management Systems Lab (CE05P)

Course Objectives:
- Understand and design the concepts of star, snowflake, and galaxy schemas for efficient data organization in data warehouses.
- Understand and execute complex queries, and apply OLAP operations effectively.
- Understand various preprocessing and visualization techniques.
- Apply regression techniques and classification algorithms to analyze data, predict outcomes, and gain valuable insights.
- Implement clustering algorithms to effectively group data based on similarities, facilitating improved data organization and analysis.
- Apply association rule mining techniques to identify and analyze patterns and relationships between variables in large datasets.

Course Outcomes:
Learners will be able to:
CO1: Develop and design star, snowflake, and galaxy schemas for data warehouses.
CO2: Execute complex queries and perform Online Analytical Processing (OLAP) operations to analyze data.
CO3: Apply various data preprocessing and visualization techniques to effectively communicate data insights and patterns.
CO4: Implement regression techniques and classification algorithms to analyze data, predict outcomes, and gain valuable insights into practical scenarios.
CO5: Implement clustering algorithms to group data based on similarities.
CO6: Implement association rule mining techniques to identify and analyze patterns and relationships

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at the institute level and published to the learners before the commencement of the semester.

Suggested list of experiments:

Sr. No.	List of experiments	Concept
1	Design Information Package, Star Schema & Snowflake Schema	Data Warehouse schema design
2	DW queries & OLAP operations	OLAP
3	Apply different visualization techniques	Data Visualization
4	To implement linear regression (Simple & Multiple) -Python	Regression analysis
5	To implement the ID3 decision tree algorithm – Weka and RapidMiner	Classification
6	To implement Naïve Bayes classifier(python)	Classification
8	To implement the K-means clustering algorithm – Weka and RapidMiner	Clustering
9	To implement Agglomerative clustering algorithm -python	Clustering
10	To implement the Apriori algorithm – Weka and RapidMiner	Association Analysis

Course Name: Modern Sensors for Internet of Things

Course Code: CE23T

Category: Professional elective (IoT Track)

Preamble:

This course introduces students to the fundamental principles and applications of sensors in various engineering fields. It covers different types of sensors, their working mechanisms, and their integration into systems, including IoT, embedded systems, and other fields.

Pre-requisites: Nil

Course Objectives:

- Understand the basic principles and classifications of sensors.
- Learn about various types of sensors and their applications.
- Design and implement sensor systems in practical scenarios.
- Integrate sensors with IoT and embedded systems.
- Explore the use of sensors in biomedical applications

Course Outcomes:

Student will be able to:
CO1: Understand fundamentals of Sensors and their characteristics.
CO2: Use different type sensors in Embedded and IoT applications.
CO3: Apply knowledge of conditioning in the design of data acquisition system.
CO4: Create a small sensor network using knowledge of communication protocols.
CO5: Understand concept of communication protocols.
CO6: Designing small application using one or more sensor.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head	ISA	MSA	ESA	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Sensors Fundamentals and Characteristics	Sensor Classification, Physical Principles of Sensors- Resistive, capacitive, inductive sensors, Optical, magnetic, and thermal sensors, Sensor Characteristics, Performance and Types, Error	5

		Analysis characteristics- Sensitivity, accuracy, precision, range, and resolution. Response time and stability, Applications in various fields and criteria to select sensor	
2	Types of sensors	Optical Sensors- Photodetectors and phototransistors, Fiber optic sensors, Imaging sensors. Mechanical Sensors- Strain gauges and pressure sensors, Accelerometers and gyroscopes, Ultrasonic sensors. Chemical and Biological Sensors- Electrochemical sensors, gas sensors, humidity and temperature sensors, Biosensors	6
3	Data acquisition and Signal Conditioning	Analog and Digital data acquisition system, Data logger, Amplification, filtering, and Analog-to-Digital conversion, Noise reduction techniques, Calibration methods	5
4	Wireless Sensor Networks	Basics of wireless communication, Network topologies and protocols, Bluetooth, ZigBee, Ultra Wide Band (UWB), Near Field Communication (NF) and RFID, WiFi and IEEE 802.11architecture, applications in IoT.	6
5	IoT Systems Integration and communication protocols	Introduction to IoT, Integrating sensors with microcontrollers (e.g., Arduino, Raspberry Pi), Communication protocols (I2C, SPI, UART),	4
6	Sensor applications	On board automobile sensing system, Home automation and Environment monitoring system, Biomedical sensing system, Radio sensing for industrial applications,	4
Total			**30**

Textbooks:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland
3. D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003
4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
5. Sensors and Transducers" by Ian R. Sinclair - Comprehensive introduction to various sensors and their applications.

Reference Books:

1. Edited by Qusay F Hasan, Atta ur rehman Khan, Sajid A madani, "Internet of Things Challenges, Advances, and Application", CRC Press
2. Triethy HL - Transducers in Electronic and Mechanical Designs, Mercel Dekker, 2003
3. Gerd Keiser,"Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi. 212
4. John G Webster, Halit Eren, "Measurement, Instrumentation and sensor Handbook", 2014, 2nd edition, CRC Press, Taylor and Fransis Group, New York.
5. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013, ISBN: 978-1-118-43062-0
6. Nathan Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", Second Edition, IET Control, Robotics and Sensors Series 127, 2020

Course Name: Modern Sensors for Internet of Things

Course Code: CE23P

Category: Professional elective- Lab (IoT Track)

Preamble:

This course introduces students to different types of sensors, their working mechanisms, and their integration into systems. Selection and interfacing of a sensor in the IoT and embedded systems design.

Pre-requisites: Nil

Course Objectives:

- To understand various sensors type and their characteristics.
- To understand different type of sensors and their application.
- To understand communication protocol and their use in sensor network.
- To understand various types communication protocols required in IoT applications and their characteristics.
- To learn to develop small IoT or Embedded system using sensor.

Course Outcomes:

Student will be able to:

CO1: Identify and test the characteristics of various sensors.
CO2: Select most appropriate sensor and design required signal condition for the same.
CO3: Implement communication and wireless communication protocol in IoT application.
CO4: Design and implement small IoT or Embedded system.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment Scheme:

Head	ISA	MSA	ESA	Total
Practical	25	-	25	050

Suggested List of Practical:

- Identification of sensor and their important characteristics.
- Testing and Calibration of sensor.
- Identification of Sensitivity, range, resolution, Response time parameters of sensors
- Develop a system to record one of the physical parameter using appropriate sensor

- Develop a system to communicate one or more physical parameters using wireless communication.
- Develop a system to communicate one or more physical parameters using communication protocol.
- Design and develop a small IoT or system using one or more sensor and a communication procol.

Textbooks:

6. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
7. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland
8. D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003
9. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
10. Sensors and Transducers" by Ian R. Sinclair - Comprehensive introduction to various sensors and their applications.

Reference Books:

7. Edited by Qusay F Hasan, Atta ur rehman Khan, Sajid A madani, "Internet of Things Challenges, Advances, and Application", CRC Press
8. Triethy HL - Transducers in Electronic and Mechanical Designs, Mercel Dekker, 2003
9. Gerd Keiser,"Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi. 212
10. John G Webster, Halit Eren, "Measurement, Instrumentation and sensor Handbook", 2014, 2nd edition, CRC Press, Taylor and Fransis Group, New York.
11. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013, ISBN: 978-1-118-43062-0

Nathan Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", Second Edition, IET Control, Robotics and Sensors Series 127, 2020

Course Name: Cryptography & Network Security

Course Code: CE24T

Category: Professional Elective (CSec track)

Preamble:

Most today's computing devices support network connectivity, from your laptops and desktops to web servers, to Internet-of-Things devices. This connectivity is essential for enhancing the capabilities of computer technology. However, it has also fostered an environment rampant with network security and privacy concerns. This course aims to provide a thorough grounding in network security suitable for those interested in working in or conducting research in the area, as well as students more generally interested in either security or networking. We will examine core network protocols and their security, as well as broader issues relating to Internet security for which networking plays a role. Through this course, you should learn the fundamentals of how computer networks should operate, and what can and does go wrong.

Pre-requisites:
Operating system- CE07T

Course Objectives:

- Basic concepts computer networks and security
- Various cryptography algorithms including secret key management and different authentication techniques.
- Different types of malicious software's and its effect on security
- Various secure communication standards including IPSEC, SSL/TLS and email.
- Network management security and network access control techniques in computer security.
- Different attacks on network and infer the use of firewalls and security protocol.

Course Outcomes:

Learner will be able to:
CO1: Explain the fundamentals concepts of computer security and network security.
CO2: Identify the basic cryptographic techniques using classical and block encryption methods.
CO3: Study and describe the system security malicious software.
CO4: Describe the Network layer security, Transport layer security and application layer security.
CO5: Explain the need of network management security and illustrate the need for NAC.
CO6: Identify the function of an IDS and firewall for system security.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Introduction to Network Security & cryptography**	Computer security and Network Security(Definition), CIA, Services, Mechanisms and attacks, The OSI security architecture, Network security model. Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, transposition techniques: keyed and keyless transposition ciphers). Introduction to steganography	4
2	**Cryptography: Key management, distribution and user authentication**	Cryptography: Key management, distribution and user authentication Block cipher modes of operation, Data Encryption Standard, Advanced Encryption Standard (AES). RC5 algorithm. Public key cryptography: RSA algorithm. Hashing Techniques: SHA256, SHA-512, HMAC and CMAC, Digital Signature Schemes – RSA, DSS. Remote user Authentication Protocols, Kerberos, Digital Certificate: X.509, PKI	8
3	**Malicious Software**	Malicious Software: SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Keyloggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie	4
4	**IP Security**	IP Security, Transport level security and Email Security: IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (AH and ESP), Transport level security: VPN. Need Web Security considerations, Secure Sockets Layer (SSL)Architecture, Transport Layer Security (TLS), HTTPS, Secure Shell (SSH) Protocol Stack. Email Security: Secure Email S/MIME Screen reader support enabled.	8
5	**Network Management Security and Network Access Control**	Network Management Security and Network Access Control: Network Management Security:SNMPv3, NAC: Principle elements of NAC, Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control	4

6	**System Security**	System Security: IDS, Firewall Design Principles, Characteristics of Firewalls, Types of Firewalls	2
Total			**30**

Textbooks:

1. Cryptography and Network Security: Principles and Practice by William Stallings, 6th edition Pearson publication
2. Cryptography and Network security by Behrouz A. Forouzan, Tata Mc Graw Hill
3. Information Security Principles and Practice, Mark Stamp, Wiley publication

Reference Books:

1. Security in Computing by Charles P. Pfleeger, Pearson publication
2. Computer Security Art and Science by Matt Bishop, Addison- Wesley publication

Course Name: Cryptography & Network Security Lab

Course Code: CE24P

Category: Professional Elective (CSec track)

Preamble:

The purpose of this security lab is to provide hands-on experience and practical knowledge in understanding various aspects of cybersecurity and information security practices. Through this lab, students will explore different security mechanisms, tools, techniques, and methodologies to safeguard digital assets, mitigate risks, and respond effectively to security incidents. Security lab provides a valuable opportunity for participants to gain practical skills, insights, and hands-on experience in the field of cybersecurity. By actively engaging in lab activities and embracing security best practices, students will be better equipped to address the evolving challenges and complexities of today's cybersecurity landscape.

Pre-requisites:

Operating system- CE07P

Course Objectives:

- To apply the knowledge of symmetric cryptography to implement classical ciphers
- To analyze and implement public key encryption algorithms, hashing and digital signature algorithms
- To explore the different network reconnaissance tools to gather information about networks
- To explore the tools like sniffers, port scanners and other related tools for analyzing
- To Scan the network for vulnerabilities and simulate attacks
- To set up intrusion detection systems using open source technologies and to explore email security

Course Outcomes:

Learner will be able to:
LO1: Illustrate symmetric cryptography by implementing classical ciphers.
LO2: Demonstrate Key management, distribution and user authentication.
LO3: Explore the different network reconnaissance tools to gather information about networks.
LO4: Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
LO5: Use open-source tools to scan the network for vulnerabilities and simulate attacks
LO6: Demonstrate the network security system using open-source tools.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practicals:

Sr No.	Title of Practicals
1	Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher)
2	1)Block cipher modes of operation using a) Data Encryption Standard b)Advanced Encryption Standard (AES). 2)Public key cryptography: RSA algorithm. 3)Hashing Techniques: HMAC using SHA 4)Digital Signature Schemes – RSA, DSS
3	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
4	1) Download and install nmap. 2) Use it with different options to scan open ports, perform OS fingerprinting, ping scan, tcp port scan, udp port scan, etc.
5	a) Keylogger attack using a keylogger tool. b) Simulate DOS attack using Hping or other tools c) Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities
6	1) Set up IPSec under Linux. 2) Set up Snort and study the logs. 3) Explore the GPG tool to implement email security
7	Design a network and demonstrate. 1) Path the network follows before implementing VPN 2) Path the network follows after implementing VPN
8	Demonstrate Phishing attack over LAN and WAN network using Kali Linux
9	Demonstrate SQL Injection attack using Kali Linux
10	Demonstrate Fake Email attack using Kali Linux

Textbooks:

1. Build your own Security Lab, Michael Gregg, Wiley India.
2. CCNA Security, Study Guide, TIm Boyles, Sybex.
3. Hands-On Information Security Lab Manual, 4th edition, Andrew Green, Michael Whitman, Herbert Mattord.
4. The Network Security Test Lab: A Step-by-Step Guide Kindle Edition, Michael Gregg.

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India.
2. Network Defense and Countermeasures, William (Chuck) Easttom.

3. Principles of Information Security + Hands-on Information Security Lab Manual, 4th Ed. , Michael Whitman , Herbert J. Mattord.

Detailed syllabus of Third Year Semester-VI

Course Name: Machine Learning

Course Code: CE13T

Category: Core

Preamble:

Machine Learning (ML) is a fundamental area of study in modern computer science and engineering, enabling systems to automatically learn and improve from experience without being explicitly programmed. This course provides undergraduate engineering students with a comprehensive understanding of the theoretical aspects of machine learning algorithms, models, and techniques. Through a combination of theoretical lectures, practical exercises, and hands-on projects, students will gain the necessary knowledge and skills to understand, implement, and evaluate various machine learning algorithms.

Pre-requisites:

NIL

Course Objectives:

- To understand fundamental concepts of Machine Learning
- To learn and implement supervised learning techniques such as regression, classification
- To be able to interpret outcome of classification process and evaluate them
- To learn and implement unsupervised learning techniques such as clustering
- To understand working of artificial neural network and to implement ANN learning algorithms
- To get basic understanding of deep networks

Course Outcomes:

Learner will be able to:
CO1: To demonstrate a thorough understanding of the principles and importance of machine learning
CO2: To apply various techniques for supervised learning
CO3: To develop critical thinking skills to evaluate the performance of various classifiers
CO4: To implement various techniques for unsupervised learning
CO5: To design ANN architecture for problem solving
CO6: To understand basic concepts of deep networks

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Machine Learning	Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Data formats, Applications, Feature Selection and Filtering, Dimensionality Reduction Techniques, Principal Component Analysis, Linear Discriminant Analysis, Singular Valued Decomposition.	6
2	Supervised Learning-I	Regression: Linear regression models, Nonlinear regression (only introduction), SVM classifier Support Vector Machine classification algorithm, hyper plane, optimal separating hyperplanes, kernel functions, kernel selection, applications. Introduction to random forest, growing of random forest, random feature selection	6
3	Supervised Learning-II	Evaluation of classifiers: Accuracy, Precision, Recall, F1 score, TPR, TNR, Confusion matrix, ROC, Overfitting, Underfitting, Variance, Bias, Concepts of regularization and generalization, Ensemble Learning: Basic concept, Stacking, Bagging, Boosting, Random Forest, AdaBoost, GBM, XG Boost	6
4	Unsupervised Learning	Types of Clustering algorithms, Graph Based Clustering: Clustering with minimal spanning tree. Model based Clustering: Expectation Maximization Algorithm. Density Based Clustering: DBSCAN, Evaluating clustering tendency, Evaluation of clusters	6
5	Introduction to Neural Networks	Biological neuron, models of a neuron, Introduction to Neural networks, network architectures (feedforward, feedback etc.), Perceptron, training a Perceptron, Multilayer Perceptron, Limitations of MLP.	4
6	Introduction to optimization	Introduction to optimization in ML, Role of Loss Functions and Optimization. Case Study.	2
		Total	**30**

Textbooks:

1. "Introduction to Machine Learning" by Ethem Alpaydın, 4th Edition, MIT press.
2. Machine Learning in Action" by Peter Harrington, Manning Publication.
3. "Deep Learning" Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press Ltd
4. "Machine Learning", Tom M. Mitchell, McGraw Hill.

Reference books:

1. "Machine Learning for beginners" by Harsh Bhasin, BPB Publication

Course Name: Machine Learning Lab

Course Code: CE13P

Category: Core

Preamble:

Machine Learning (ML) is a fundamental area of study in modern computer science and engineering, enabling systems to automatically learn and improve from experience without being explicitly programmed. This course provides undergraduate engineering students with a comprehensive understanding of the theoretical aspects of machine learning algorithms, models, and techniques. Through a combination of theoretical lectures, practical exercises, and hands-on projects, students will gain the necessary knowledge and skills to understand, implement, and evaluate various machine learning algorithms.

Pre-requisites:

Software Lab (ES10)

Course Objectives:

- Develop students' ability to implement supervised learning models
- Enhance students' proficiency in implementing and applying unsupervised learning methods
- Foster students' awareness of deep networks
- Provide students with opportunities to analyze performance of classifiers

Course Outcomes:

Learner will be able:
CO1: To demonstrate the ability to implement regression and classification models
CO2: To implement ensemble learning models
CO3: To explore properties of unsupervised learning models
CO4: To identify characteristics of various activation functions used in ANN
CO5: To apply ANN learning algorithms to train the NN model for given problem
CO6: To exhibit proficiency in identifying and implementing appropriate ML model to solve real world problems

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology

based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practicals:

Sr No.	Title of Practical's
1	To implement linear regression models
2	To implement classification models
3	To implement ensemble learning techniques
4	To implement clustering techniques
5	To demonstrate various activation functions
6	To implement basic logic gate functions using MP neuron
7	To implement different NN learning algorithms
8	To implement hand written digit recognition using MLP
9	To implement mini project on selected problem statement

Course Name: Machine Vision Using Python

Course Code: CE44

Category: Program Core Course (PCC)

Preamble:

Python is a popular programming language for image processing due to its simplicity, ease of use, and availability of powerful libraries such as OpenCV and Pillow. This course is an overview of how to get started with machine vision using Python: Installing Python and necessary libraries, Install OpenCV, Install Pillow, Loading and displaying an image, Import the necessary libraries, import Image, Load an image, Image manipulation, Convert an image to grayscale, Resizing an image, Image filtering and processing, Applying a Gaussian blur, Applying a threshold, Detecting edges, Saving an image. There are many other operations and techniques that can be applied to images using Python, and the libraries mentioned above offer a wide range of functionalities to explore.

Pre-requisites:

Software Lab – ES10

Course Objectives:

- Understand Python Libraries for Image Processing
- Explore advanced image manipulation techniques, including but not limited to image stitching, blending, and advanced filtering.
- Learn about various geometric transformations such as translation, scaling, rotation, affine, and perspective transformations
- Learn the fundamentals of object detection and recognition, including the key concepts and algorithms used.
- Explore techniques such as cross-correlation and normalized cross-correlation for template matching.
- Learn the basic concepts of lossless and lossy compression techniques and their applications.

Course Outcomes:

Learner will be able to:

CO1: Gain a comprehensive understanding of key Python libraries used for image processing, including OpenCV, PIL, and scikit-image.

CO2: Implement advanced image manipulation techniques such as image stitching, blending, and filtering to create seamless and visually appealing images.

CO3: Grasp the fundamental concepts of object detection and recognition, and implement key algorithms to identify and classify objects within images.

CO4: Utilize techniques such as cross-correlation and normalized cross-correlation for template matching to locate specific patterns and objects in images.

CO5: Understand the basic principles of lossless and lossy compression techniques and apply these methods to effectively compress and decompress image data.

CO6: Develop Python programs to extract hidden data from images, reversing the steganography process to retrieve the embedded information accurately.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	4	-	2

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	50	-	25	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Content
1	Introduction to Python libraries for image processing, Basic image manipulation and enhancement techniques.
2	Advanced image manipulation and enhancement techniques, Geometric transformations, understanding image color spaces, Applying color manipulation techniques.
3	Understanding image histograms, applying image smoothing and sharpening techniques, understanding and applying basic and advanced image filtering techniques.
4	Image restoration techniques, Edge detection techniques, Feature extraction techniques.
5	Image segmentation, Thresholding techniques, Watershed segmentation.
6	Object detection and recognition, template matching, deep learning for image classification and recognition.
7	Image classification model with TensorFlow, Advanced deep learning models for medical image processing.
8	Preprocessing, Segmentation and Registration of medical images.
9	Understanding 3D image processing, image visualization and manipulation, filtering and segmentation.
10	Image compression technique, JPEG and Wavelet-based compression technique.
11	Introduction to image steganography, hiding data and Extracting hidden data from images using Python.
12	Review of course materials, Final project presentation and wrap-up

Textbooks:

1. Python Crash Course – A Hands-On, Project-Based Introduction To Programming (2nd Edition).
2. Python Programming – An Introduction To Computer Science (3rd Edition)

Reference books:

1. Hands-on Image Processing with Python, Sandipan Dey.

Course Name: System Programming and Compiler Design

Course Code: CE15

Category: Core

Preamble:

This course studies programming language translation and compiler design concepts; language recognition symbol table management, semantic analysis, code optimization and code generation.

Pre-requisites:

Theory of Computer Science (CE09)

Course Objectives:

- To understand the basic principles of compiler design, its various constituent parts, algorithms and data structures required to be used in the compiler.
- To understand the need to follow the syntax in writing an application program and to learn how the analysis phase of compiler is designed to understand the programmer 's requirements without ambiguity
- To synthesize the analysis phase outcomes to produce the object code that is efficient in terms of space and execution time

Course Outcomes:

Learner will be able to:
CO1: Summarize the different stages in the process of compilation.
CO2: Understand working of different compiler construction tools.
CO3: Design top-down and bottom-up parsers.
CO4: Understand the different representations of intermediate code.
CO5: Apply different code optimization method.
CO6: Develop algorithms to generate code for a target machine.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course.

However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to System Software and Compiler	Concept of System Software, Goals of system software, system program and system programming, Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers. Introduction to compilers, Phases of compilers	4
2	Lexical Analysis	**Lexical Analysis**- Role of Finite State Automata in Lexical Analysis, Design of Lexical analyzer, data structures used.	4
3	Syntax and Semantic Analysis	**Syntax Analysis**- Role of Context Free Grammar in Syntax analysis, Types of Parsers: Top down parser- LL(1), Bottom up parser- SR Parser, Operator precedence parser, SLR. **Semantic Analysis**, Syntax directed definitions	15
4	Intermediate Code Generation	**Intermediate Code Generation**: Types of Intermediate codes: Syntax tree, Postfix notation, three address codes: Triples and Quadruples, indirect triple. **Additional:** Macro Processer Design	9
5	Code Optimization	**Code Optimization**: Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent.	4
6	Code Generation	**Code Generation:** Issues in the design of code generator, code generation algorithm. Basic block and flow graph **Addition:** Assembler Design.	9
		Total	**45**

Textbooks:

1. A. V. Aho, R. Shethi, Monica Lam, J.D. Ulman: Compilers Principles, Techniques and Tools, Pearson Education, Second Edition.
2. J. J. Donovan: Systems Programming Tata McGraw Hill, Edition 1991
3. D, M .Dhamdhere ,Compiler construction 2e, Macmillan publication, second edition .

Reference books:

1. John R. Levine, Tony Mason & Doug Brown, Lex & YACC, O 'Reilly publication, second edition.
2. Leland L. Beck, System software: An introduction to system programming, Pearson publication, third edition

Course Name: Distributed Systems

Course Code: CE16

Category: Core

Preamble:

This course aims to give students an overview of the concepts and fundamentals of computer networks. It covers protocol layering, enabling students to analyze network performance. Additionally, the course provides insights into the functions of the OSI and TCP/IP models and various routing protocols.

Pre-requisites:

Fundamentals of Computer Hardware and Networking and Analysis of Algorithm

Course Objectives:

- To introduce concepts and fundamentals of data communication and computer networks.
- To explore the inter-working of various layers of OSI.
- To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite.
- To assess the strengths and weaknesses of various routing algorithms.
- To understand various transport layer and application layer protocols.

Course Outcomes:

Students will be able to:

1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies.
2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3. Analyze the various techniques used for clock synchronization and mutual exclusion
4. Demonstrate the concepts of Resource and Process management and synchronization algorithms
5. Demonstrate the concepts of Consistency and Replication Management
6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Introduction to Distributed Systems**	Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept. Middleware: Models of Middleware, Services offered by middleware, Client Server model.	6
2	**Communication**	Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI) Message Oriented Communication, Stream Oriented Communication, Group Communication	6
3	**Synchronization**	Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala's Algorithm, Maekawa's Algorithm Token Based Algorithms: Suzuki-Kasami's Broardcast Algorithms, Deadlock Management	15
4	**Resource and Process Management**	Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach Introduction to process management, process migration, Threads,	9
5	**Consistency, Replication and Fault Tolerance**	Introduction to replication and consistency, Data-Centric and Client- Centric Consistency Models, Replica Management Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery	5
6	**Distributed File Systems and Name Services**	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS), Andrew File System (AFS)	4
Total			**45**

Textbooks:

1 Andrew S. Tanenbaum and Maarten Van Steen Distributed Systems: Principles and Paradigms
2 George Coulouris, Jean Dollimore, Tim Kindberg Distributed Systems: Concepts and Design

Reference Books:

3. P.K. Sinha Distributed Operating Systems : Concepts and design

Course Name: Distributed and Cloud Computing Lab

Course Code: CE14

Category: Core

Preamble:

This lab is designed to provide students with hands-on experience in the principles and practices of distributed computing. In this lab, you will explore various aspects of distributed systems, including architecture, communication, synchronization, and fault tolerance.

Pre-requisites:

Fundamentals of Computer Network, Operating System

Course Objectives:

1. To understand basic underlying concepts of forming distributed systems.
2. To learn the concept of clock Synchronization
3. To learn Election Algorithm.
4. To explore mutual exclusion algorithms and deadlock handling in the distributed system
5. To study resource allocation and management.
6. To understand the Distributed File System

Course Outcomes:

Learner will be able to:

CO1: Develop test and debug using Message-Oriented Communication or RPC/RMI based client-server programs.

CO2: Implement techniques for clock synchronization.

CO3: Implement techniques for Election Algorithms.

CO4: Demonstrate mutual exclusion algorithms and deadlock handling.

CO5: Implement techniques of resource and process management.

CO6: Describe the concepts of distributed File Systems with some case studies.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
-	4	-	2

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practicals

Learners are expected to perform practicals based on the following suggested topics.

Sr No	Suggested Topic(s)
1	Study of NOS, DOS And Middleware
2	Design a Distributed application using socket. Application consist of a server which takes an integer value from the client, calculates factorial and returns the result to the Client program.
3	Design a Distributed Application using RMI for remote computation
4	Implementing BERKELEY Clock Synchronization algorithm.
5	Implementing Bully Election algorithm.
6	Implementation of CHM for distributed deadlock detection.
7	Implementation of Ricart Agrawala algorithm for distributed Mutual Exclusion
8	Implementation of Raymond Tree for Token based Mutual Exclusion
9	Implementing load distribution algorithm
10	Design a distributed application which consist of a server and client using threads.
11	Case studies for understanding consistency model
12	Implementation of a prototype for a stateless file server and its cache mechanisms

Textbooks:

1 Andrew S. Tanenbaum and Maarten Van Steen Distributed Systems: Principles and Paradigms

2 George Coulouris, Jean Dollimore, Tim Kindberg Distributed Systems: Concepts and Design

Reference Books:

1. P.K. Sinha Distributed Operating Systems: Concepts and design

Course Name: Soft computing

Course Code: CE21T

Category: Professional Elective (AIML Track)

Preamble:

Soft computing is an emerging approach to computing based on some biological inspired methodologies such as genetics, evolution, ant's behaviors, particles swarming, human nervous systems, etc. Now, soft computing is the only solution when we don't have any mathematical modeling of problem solving (i.e., algorithm), need a solution to a complex problem in real time, easy to adapt with changed scenario and can be implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, handwritten character reconditions, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.

Pre-requisites:

- Engineering Mathematics (All Semesters)

Course Objectives:

After completing this course, you will be able to learn:

- Fuzzy logic and its applications.
- Artificial neural networks and its applications.
- Solving single-objective optimization problems using GAs.
- Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).
- Applications of Soft computing to solve problems in varieties of application domains.

Course Outcomes:

Learner will be able to learn:
CO1: Concept of Soft computing to solve problems in varieties of application domains.
CO2: Artificial neural networks and its applications.
CO3: Fuzzy logic and its applications
CO4: Solving single-objective optimization problems using GAs
CO5: Solving multi-objective optimization problems using Evolutionary algorithms.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Soft Computing	Concept of computing systems. "Soft" computing versus "Hard" computing Characteristics of Soft computing Some applications of soft computing techniques	2
2	Neural Networks	Fundamental Concepts and Models of Artificial Neural Systems: Neural Processing, Learning and Adaptation, Neural Network Learning Rules, and Comparison. Pattern Classification. Perceptron Convergence Theorem. Multi-layer Feedforward Network: Delta Learning Rule for multi perceptron Layer, Generalized Delta Learning Rule, Feedforward Recall, Learning Factors, Character Recognition Application	6
3	Fuzzy Set Theory	Fuzzy Extension Principle, Fuzzy Relations, Projection and Cylindrical Extension of FuzzyRelations, Fuzzy Max-Min and Max-Product Composition. Fuzzy Knowledge Based Systems with Applications, Defuzzification Methods, Fuzzy Composition Rules, Architecture of Mamdani Type Fuzzy Control Systems.	6
4	Hybrid Systems	**ANFIS**: Adaptive Neuro-Fuzzy Inference Systems: Introduction, ANFIS Architecture, and Hybrid Learning Algorithm.	4

5	Genetic Algorithms	Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques Basic GA framework and different GA architectures. GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs..	6
6	Multi-objective Optimization Problem Solving	Concept of multi-objective optimization problems (MOOPs) and issues of solving them. Multi-Objective Evolutionary Algorithm (MOEA). Non-Pareto approaches to solve MOOPs Pareto-based approaches to solve MOOPs Some applications with MOEAs.	6
Total			**30**

Text Books:

1. Principles of Soft Computing, S.N. Sivanandam, S.N. Deepa, Willey, 2nd
2. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press
3. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India
4. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey

Reference Books:

1. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
2. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education
3. Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional

Course Name: Soft Computing Lab

Course Code: CE21P

Category: Professional Elective (AIML Track)

Preamble:

Soft computing provides a reliable solution when we don't have any mathematical modeling of problem solving (i.e., algorithm), need a solution to a complex problem in real time, easy to adapt with changed scenario and can be implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, handwritten character reconditions, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc

Pre-requisites:

- Engineering Mathematics (All Semesters)

Course Objectives:

After completing this course, you will be able to learn:

- Fuzzy logic and its applications.
- Artificial neural networks and its applications.
- Solving single-objective optimization problems using GAs.
- Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).
- Applications of Soft computing to solve problems in varieties of application domains.

Course Outcomes:

Learners will be able to learn:

CO1: Concept of Soft computing to solve problems in a variety of application domains.
CO2: Artificial neural networks and its applications.
CO3: Fuzzy logic and its applications
CO4: Solving single-objective optimization problems using GAs
CO5: Solving multi-objective optimization problems using Evolutionary algorithms.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	--	25	50

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Suggested List of Practical's:

Sr No.	Suggested Topic(s)
1.	Fuzzy membership function
2.	Fuzzy Extension principle
3.	Fuzzy controller
4.	Perceptron Learning rule
5.	Delta Learning Rule
6.	Associative Memory
7.	Genetic Algorithm
10.	Competitive Learning

Text Books:

1. Principles of Soft Computing, S.N. Sivanandam, S.N. Deepa, Willey, 2nd
2. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press
3. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India
4. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey

Reference Books:

1. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
2. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education
3. Fuzzy Logic: A Practical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional

Course Name: Advanced databases

Course Code: CE26T

Category: Professional Elective Course (DA Track)

Preamble:

Mastering on mastering advanced database systems demands a structured approach. Our comprehensive roadmap covers query processing, advanced data management, distributed databases, enhanced data models, and information retrieval. Each module delves into its domain, blending theory with hands-on tasks. This systematic curriculum ensures learners gain a holistic understanding of modern database systems, ready to navigate complex data landscapes.

Pre-requisites:
DBMS

Objective:

1. To impart knowledge related to query processing and query optimization phases of a database management system.
2. To sensitize the learners about the importance of access control and data security
3. To introduce advanced database models like distributed databases.
4. To learn advanced techniques for data management and to overview emerging data models like Temporal, Mobile, and Spatial database.
5. To learn different IR models and queries in IR Systems

Course Outcomes:
Learner will be able to:
CO1: Measure query costs and design alternate efficient paths for query execution.

CO2: Apply sophisticated access protocols to control access to the database.

CO3: Design distributed databases for improving resource utilization, availability and performance

CO4: To apply the traits of temporal and spatial data models as per the need

CO5: Perform efficient and effective retrieval of information to facilitate the decision-making

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Query Processing and Optimization**	Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions. Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression Estimating Statistics of Expression Results Choice of Evaluation Plans. Self-learning Topics: Solve problems on query Optimization.	6
2	**Data access control mechanisms**	Discretionary Access Control Based on Granting and Revoking Privileges. Mandatory Access Control and Role Based Access Control, Remote Database access protocol. Self-learning Topics: Learn Data Security concepts like Authentication, Authorization and encryption	6
3	**Distributed Databases**	Introduction: Distributed Data Processing, Distributed Database System: Architecture, Types, Design Issues. Data Fragmentation, Allocation in distributed databases. Self-learning Topics: Query Optimization in Distributed Databases	6
4	**Enhanced Data Models**	Active Database Concepts and Triggers, Temporal Database, Spatial Database, Introduction to Deductive Databases Self-learning Topics: Case Study like: "Temporal Dynamics in Information Retrieval: Modelling Temporal Relevance and Query Intent Shifts Over Time"	6

5	**Introduction to Information Retrieval**	Retrieval Models, Types of Queries in IR Systems, Text Preprocessing Self-learning Topics: Case Study like "Enhancing Search Relevance Using Deep Learning: A Comparative Analysis of Neural Ranking Models"	6
Total			**30**

Textbooks:

[1]. Korth, Silberschatz and Sudarshan, "Database System Concepts", 6th Edition, McGraw – Hill
[2]. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
[3]. M. Tamer Ozsu, "Principals of Distributed Systems", 3rd Edition, Springer.
[4]. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

[1] Manning Christopher and Raghavan Prabhakar, "Introduction to Information Retrieval", Cambridge University Press
[2] Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 9th Edition

Course Name: Advanced Database Lab

Course Code: CE26P

Category: PEC (DA Track)

Preamble:

The Advanced Database Laboratory immerses students in leading-edge database technologies and advanced concepts, expanding upon foundational knowledge from prerequisite courses. Through hands-on exploration, students delve into topics including NoSQL databases, distributed data management, query processing and optimization, and advanced SQL techniques. Practical exercises and projects facilitate a deeper understanding of database design, optimization, and administration. Additionally, students gain valuable insights into emerging trends and challenges within the dynamic realm of database management.

Pre-requisites:
DBMS

Course Objective:
• Mastering Conceptual DB Design using EER Model and implementing it using SQL DDL
• Explore advanced SQL concepts
• Gain practical experience in working with distributed databases, temporal data bases, spatial data bases and active databases and proposing a solution using appropriate model(s).
• Learn how to integrate PHP scripts with MySQL databases to create dynamic web applications.
• Develop proficiency in designing, implementing, and optimizing complex database systems for real world applications and interface a database with front end tools
• Apply best practices in database administration, security, and scalability to ensure robust and efficient database systems.

Course Outcomes:
Learner will be able to:
CO1: Students will be able to design database schemas using EER model techniques and implement them using SQL.
CO2: Students will demonstrate proficiency in writing advanced SQL queries and understand query optimization principles.
CO3: Students will develop skills in accessing and manipulating databases through JDBC in Java programs.
CO4: Students will understand query evaluation plans, indexing strategies, and their impact on database performance.
CO5: Students will implement distributed database solutions, including partitioning strategies, for scalability and performance.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	25	050

Suggested list of experiments:

Sr. No.	List of experiments
1	Design EER Model for a real-life scenario and implement it using SQL
2	Understand and compare performance by rewriting queries using indexing
3	Implement the Program to estimate cost of the query for various join operation
4	Build Web Applications with access control features
5	Explore the security and access control features of PostgreSQL (or equivalent system)
6	Implementation of fragmentation in distributed database environment.
7	Implementation of triggers for understanding features of active database
8	Design a temporal and spatial data base schema , map it to tables and solve queries involving temporal and spatial attributes

Textbooks

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson/Addision wesley, 2007
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition,Tata McGraw Hill, 2011

Reference Books:

3. T. Özsu and P. Valduriez, Distributed Database Systems. Prentice Hall, Oct. 2011. [ISBN: 013616736X]
4. "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" by Martin Fowler and Pramod J. Sadalage

Course Name: Embedded System Design with Tiny Operating System (OS)

Course Code: CE31T

Category: Professional Elective (IoT Track)

Preamble:

Embedded System is a used for developing a dedicated task or application. Internet of Things (IoT) is an upcoming technology based on the base of embedded systems. Machine learning (ML) is also an upcoming technology and concepts of ML are used in many applications. This course blends the concepts of embedded systems with machine learning for developing smart and dedicated applications for requirements of IoT. It introduces the fundamental concepts of operating system and use of operating system in the development of embedded systems.

Pre-requisites:

- C Programming
- Object Oriented Programming
- Microprocessor and microcontroller

Course Objectives:

- To understand the fundamentals of ARM 7 family.
- To understand concepts of embedded systems.
- To understand communication interface for embedded systems.
- To understand working with Real Time Operating Systems (RTOS).
- To understand fundamental concepts of tiny machine learning.
- To use tiny machine learning for embedded systems.

Course Outcomes:

Student will be able to:

CO1: Understand fundamental concepts of advanced 32 bit micro-controllers.

CO2: Demonstrate the fundamental concepts of embedded system design

CO3: Use communication interface for design of embedded system.

CO4: Understand concept of Real Time Operating Systems (RTOS) for embedded system design.

CO5: Understand fundamental concepts of tiny machine learning.

CO6: Use concept of tiny machine learning for design of embedded systems.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	2	2	1

Assessment Guidelines:

Head	ISA	MSA	ESE	Total (Passing @40% of total)
Theory	15	20	40	75
Lab	25	--	25	50

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	ARM 7 family and Programming	Introduction, features, basic architecture, Cortex family, register organization with different registers like CPSR	6
2	Introduction to embedded systems	Introduction and different examples/applications, classification of embedded systems, design metrics of an embedded systems, embedded system design life cycle, processor technology for embedded systems, concept of modelling in embedded systems	5
3	Communication Protocols for embedded systems	UART, SPI, I2C, CAN with details like pins, working, timing diagram and common applications, introduction to other communication protocols like zig-bee and Wi-Fi.	6
4	Real Time Operating Systems	Basic concept of operating system, process management with scheduling and related issues, process synchronization with algorithms, concept of threading	6
5	Machine Learning Fundamentals	Concept of machine learning, fundamentals of tiny ML, design and challenges, Building and training machine learning model, Convolutional Neural Networks	4
6	Application Development	Building applications and deployment of model	3
Total			**30**

Textbooks:

13. Embedded System Architecture, Programming & Design (Tata McGraw Hill Publication, Third Edition)- Raj Kamal
14. An Embedded Software Primer- David E. Simon
15. Embedded Real Time Systems Programming- Sriram V. Iyer, Pankaj Gupta
16. MicroC/OS-II, Indian Low price Edition 2002- Jean J. Labrose
17. Embedded Real Time Systems: Concepts, design & Programming (Dreamtech Publication)- K. V. K. K. Prasad

Reference Books:

1. Embedded System Design: A Unified Hardware/Software Introduction (Wiley Publication)- frank Vahid, Tony Givargis
2. ARM System-on-Chip Architecture (Pearson 2005)- Steve Furber
3. Tiny Machine Learning - Pete Warden and Daniel Situnayake
4. Rajib Mall: "Real Time Systems theory and practice", Pearson 2008

Assessment:

1. **ISA (In-Semester-Assessment):** In semester assessment will carry total 15 marks. It will consist of weekly graded assignments based on modules (each carrying 10 marks). The assignments are self-study work and need to be completed by individual students separately. Every student will be submitting four completed assignments. Students are encouraged to develop their own problem statements and devise a proper method / solution. Importance will be given to the concept understanding and applying it to solve the industrial problem using coding.

2. **MSA (Mid-Semester-Assessment):** Mid Semester Assessment will consist of three mid semester internal theory test carrying 20 marks based on completion of minimum modules. This test will be common for all the students. ***Repeat examination will not be conducted.***

3. **ESE (End-Semester-Examination):** End Semester Examination will be conducted for total of 40 marks based on the completion of remaining modules post completion of mid semester examination or an entire syllabus. This test will be common for all the students.

Course Name: Embedded System Design with Tiny Operating System (OS) Laboratory

Course Code: CE31P

Category: Professional Elective (IoT Track)

Preamble: Embedded System is a used for developing a dedicated task or application. Internet of Things (IoT) is an upcoming technology based on the base of embedded systems. Machine learning (ML) is also an upcoming technology and concepts of ML are used in many applications. This course enables learner to use concept of tiny machine learning and Real Time Operating System for design of embedded systems.

Pre-requisites:

- C Programming
- Object Oriented Programming
- Microprocessor and microcontroller

Course Objectives:

- To understand the fundamentals of ARM 7 family.
- To understand concepts of embedded systems.
- To understand communication interface for embedded systems.
- To understand working with Real Time Operating Systems (RTOS).
- To understand fundamental concepts of tiny machine learning.
- To use tiny machine learning for embedded systems.

Course Outcomes:

Student will be able to:

CO1: Use concepts of advanced 32 bit micro-controllers.

CO2: Apply the fundamental concepts of embedded system design.

CO3: Use communication interface for design of embedded system.

CO4: Use Real Time Operating Systems (RTOS) for embedded system design.

CO5: Use fundamental concepts of tiny machine learning.

CO6: Apply concept of tiny machine learning for design of embedded systems.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment Scheme:

Head	ISA	MSA	ESA	Total
Practical	25	-	25	25

Suggested List of Practical:

All practical will be project based with focus on following application

1. Smart population count system
2. Smart traffic light system
3. Smart temperature monitoring system
4. E notice board
5. E display
6. Smart elevator system

Textbooks:

1. Embedded System Architecture, Programming & Design (Tata McGraw Hill Publication, Third Edition)- Raj Kamal
2. An Embedded Software Primer- David E. Simon
3. Embedded Real Time Systems Programming- Sriram V. Iyer, Pankaj Gupta
4. MicroC/OS-II, Indian Low price Edition 2002- Jean J. Labrose
5. Embedded Real Time Systems: Concepts, design & Programming (Dreamtech Publication)- K. V. K. K. Prasad

Reference Books:

1. Embedded System Design: A Unified Hardware/Software Introduction (Wiley Publication)- frank Vahid, Tony Givargis
2. ARM System-on-Chip Architecture (Pearson 2005)- Steve Furber
3. Tiny Machine Learning - Pete Warden and Daniel Situnayake
4. Rajib Mall: "Real Time Systems theory and practice", Pearson 2008

Assessment: In-Semester-Assessment (25 Marks)

1. ***All the students are required (mandatory) to be present in person during the laboratory conduction session.*** The ISA will consist of awarding marks for the complete, successful and in time submission of minimum 10 dually graded experiments (project based).
2. ***Project prototype to be developed and demonstrated.***
3. ***Graded marks for 10 experiments will be converted to ISA marks of 25. Only one repeat session is allowed to cover up the missed lab session.***
4. Students will be awarded grade / or marks on each experiment based on his / her own contribution, showcasing the knowledge application skills, demonstrating measurement work, developing code / solution to the given problem and peer interaction. ***Student will lose the marks if he or she remains absent for the Laboratory Practical Session.***

Course Name: System Security & Ethical Hacking

Course Code: CE28T

Category: Professional Elective Course (CSec Track)

Preamble:

This course delves into the fundamentals of system security, exploring the principles, techniques, and tools used to protect computer systems and networks from unauthorized access, breaches, and cyber threats. Additionally, it provides insights into ethical hacking, emphasizing responsible and lawful approaches to identify vulnerabilities and strengthen security measures. This course is designed to equip you with the essential knowledge and skills to understand the intricacies of system security and ethical hacking.

Pre-requisites:
Computer Networks- IT06T
Operating system- IT05T
Computer & Network Security- IT24T

Course Objectives:

1. Understand the principles and concepts of system security.
2. Identify common vulnerabilities and threats to computer systems and networks.
3. Explore ethical hacking methodologies and tools.
4. Learn how to conduct security assessments and penetration testing.
5. Develop strategies to mitigate security risks and protect against cyber attacks.
6. Cultivate ethical and responsible behavior in the context of hacking and cybersecurity.

Course Outcomes:

Learner will be able to:
CO1: Explain the fundamentals concepts of system security.
CO2: Implementing the concepts of cryptography in securing the infrastructure..
CO3: Explain the importance of network and web security.
CO4: Understand in brief the concepts of Mobile and cloud security.
CO5: Explain the concept of Ethical hacking and cybercrimes.
CO6: Understand the legal aspects of Ethical hacking.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to System Security and Access Control and Authentication	Overview of system security principles, Threat landscape and cybersecurity trends, Legal and ethical considerations in cybersecurity, Access control models: DAC, MAC, RBAC, Authentication methods: passwords, biometrics, MFA, Role-based access control (RBAC)	6
2	Cryptography and Data Protection	Basics of cryptography: encryption, decryption, Symmetric and asymmetric encryption algorithms, Data integrity and confidentiality mechanisms	4
3	Network and Web Security	Firewalls and intrusion detection/prevention systems (IDS/IPS), Secure network protocols: SSL/TLS, SSH, Wireless network security: WPA, WPA2, WPA3, Common web vulnerabilities (SQL injection, XSS), Web application firewalls (WAF), Secure coding practices	6

4	Cloud and Mobile Security	Security challenges in cloud computing, Cloud service models (IaaS, PaaS, SaaS), Cloud security controls and best practices, Mobile device management (MDM), Mobile application security, Secure communication protocols.	8
5	Cybercrime and Ethical Hacking	Introduction to Cybercrime, Types of Cybercrime, Classification of Cybercriminals, Role of computer in Cybercrime, Prevention of Cybercrime. Ethical Hacking, Goals of Ethical Hacking, Phases of Ethical Hacking, Difference between Hackers, Crackers and Phreakers, Rules of Ethical Hacking	4
6	Ethical hacking legal aspects	Laws and regulations related to hacking and cybersecurity, Ethical hacking code of conduct, Case studies and ethical dilemmas in hacking	2
Total			**30**

Textbooks:

1. Gupta, "IT Infrastructure & Its Management", First Edition, Tata McGraw-Hill Education.
2. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
3. Computer Security, Dieter Gollmann, Third Edition, Wiley Publications.
4 Data Communications and Networking, Forouzan, Fourth Edition, Mc Graw Hill Publication
5 Wireless Networks, P. Nicopolitidis, M.S. Obaidat, G.I Papadimitriou, A.S Pomportsis, Wiley Publications

Reference Books:

1. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
2. CCNA Security Study Guide, Tim Boyle, Wiley Publications
3. Introduction to Computer Security, Matt Bishop, Pearson.

Course Name: System Security & Ethical Hacking Lab

Course Code: CE28P

Category: Professional Elective Course (CSec Track)

Preamble:

This course delves into the fundamentals of system security, exploring the principles, techniques, and tools used to protect computer systems and networks from unauthorized access, breaches, and cyber threats. Additionally, it provides insights into ethical hacking, emphasizing responsible and lawful approaches to identify vulnerabilities and strengthen security measures. This course is designed to equip you with the essential knowledge and skills to understand the intricacies of system security and ethical hacking.

Pre-requisites:
Computer Networks
Operating system
Computer & Network Security

Course Objectives:

1. Understand the principles and concepts of system security.
2. Identify common vulnerabilities and threats to computer systems and networks.
3. Explore ethical hacking methodologies and tools.
4. Learn how to conduct security assessments and penetration testing.
5. Develop strategies to mitigate security risks and protect against cyber attacks.
6. Cultivate ethical and responsible behavior in the context of hacking and cybersecurity.

Course Outcomes:

Learner will be able to:
CO1: Explain the fundamentals concepts of system security.
CO2: Implementing the concepts of cryptography in securing the infrastructure..
CO3: Explain the importance of network and web security.
CO4: Understand in brief the concepts of Mobile and cloud security.
CO5: Explain the concept of Ethical hacking and cybercrimes.
CO6: Understand the legal aspects of Ethical hacking.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to System Security and Access Control and Authentication	Overview of system security principles, Threat landscape and cybersecurity trends, Legal and ethical considerations in cybersecurity, Access control models: DAC, MAC, RBAC, Authentication methods: passwords, biometrics, MFA, Role-based access control (RBAC)	6
2	Cryptography and Data Protection	Basics of cryptography: encryption, decryption, Symmetric and asymmetric encryption algorithms, Data integrity and confidentiality mechanisms	4
3	Network and Web Security	Firewalls and intrusion detection/prevention systems (IDS/IPS), Secure network protocols: SSL/TLS, SSH, Wireless network security: WPA, WPA2, WPA3, Common web vulnerabilities (SQL injection, XSS), Web application firewalls (WAF), Secure coding practices	6

4	Cloud and Mobile Security	Security challenges in cloud computing, Cloud service models (IaaS, PaaS, SaaS), Cloud security controls and best practices, Mobile device management (MDM), Mobile application security, Secure communication protocols.	8
5	Cybercrime and Ethical Hacking	Introduction to Cybercrime, Types of Cybercrime, Classification of Cybercriminals, Role of computer in Cybercrime, Prevention of Cybercrime. Ethical Hacking, Goals of Ethical Hacking, Phases of Ethical Hacking, Difference between Hackers, Crackers and Phreakers, Rules of Ethical Hacking	4
6	Ethical hacking legal aspects	Laws and regulations related to hacking and cybersecurity, Ethical hacking code of conduct, Case studies and ethical dilemmas in hacking	2
Total			**30**

Textbooks:

1. Gupta, "IT Infrastructure & Its Management", First Edition, Tata McGraw-Hill Education.
2. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
3. Computer Security, Dieter Gollmann, Third Edition, Wiley Publications.
4 Data Communications and Networking, Forouzan, Fourth Edition, Mc Graw Hill Publication
5 Wireless Networks, P. Nicopolitidis, M.S. Obaidat, G.I Papadimitriou, A.S Pomportsis, Wiley Publications

Reference Books:

1. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
2. CCNA Security Study Guide, Tim Boyle, Wiley Publications
3. Introduction to Computer Security, Matt Bishop, Pearson.

Course Name: Probabilistic Graphical Models (PGM)

Course Code: CE30T

Category: Professional Elective Course

Preamble:

Probabilistic graphical models (PGMs) are a powerful framework that combines probability theory and graph theory to represent and reason about uncertainties in complex systems. They use graphs to encode the conditional dependencies between random variables, facilitating efficient computation of joint distributions and marginal probabilities. PGMs include various models such as Bayesian networks, which utilize directed acyclic graphs, and Markov networks, which employ undirected graphs to represent relationships. These models are widely used in fields like machine learning, artificial intelligence, and bioinformatics for tasks such as prediction, diagnostics, and decision-making under uncertainty.

Pre-requisites:

Engineering Mathematics-V & Machine Learning

Course Objectives:

- Understand the principles of probability including random variables, distributions, expectation, and variance, to model and analyze uncertainty in various contexts.
- Understand the fundamental concepts and algorithms of graph theory, enabling the analysis and optimization of networks and relational structures.
- Learn to construct and use Bayesian networks for representing probabilistic dependencies, performing inference, and making data-driven decisions.
- Understand and apply Markov network models to capture and analyze local dependencies in undirected graphs for complex system modeling.
- Gain proficiency in modeling and analyzing sequential and time-series data using Hidden Markov Models.
- Explore practical applications of probabilistic graphical models across machine learning, artificial intelligence, and bioinformatics, developing skills to solve real-world problems.

Course Outcomes:

Learner will be able to:

CO1: Understand the basic concepts of Probability theory and Graph theory.

CO2: Learn and apply Bayesian networks for representing probabilistic dependencies, performing inference, and making data-driven decisions.

CO3: Understand and utilize Markov network models to represent joint distributions and local dependencies, enhancing their analytical skills for complex systems.

CO4: Gain proficiency in modeling and analyzing sequential and time-series data using Hidden Markov Models,

CO5: To make inferences, learning, actions and decisions while applying probabilistic models.

CO6: Represent real world problems using graphical models; design inference algorithms; and learn the structure of the graphical model from data.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	--	2	--

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Introduction to Probability & Graph Theory**	Introduction to Probability Theory: Probability Theory, Basic Concepts in Probability, Probability Axioms and Properties, Conditional Probability and Independence, Discrete Random Variables: Binomial, Poisson, Continuous Random Variables: Uniform, Normal, , Continuous Spaces, Expectation, Variance and Covariance. Introduction to Graphs: Graph Definitions and Types, Graph Representation: Adjacency Matrix and List, Subgraphs, Paths and Trails, Cycles and Loop.	4
2	**Bayesian Network Model and Inference**	Directed Graph Model: Bayesian Network-Structure and Semantics, Exploiting Independence Properties, Naive Bayes Model, Bayesian Network Model, Basic Independencies in Bayesian Networks, Conditional Independence and d-Separation, Bayesian Network Semantics, Graphs and Distributions. Exact inference: Variable Elimination, Conditioning, CPD's and its types, Inference with Structured CPDs.	6
3	**Markov Network Model and Inference**	Undirected Graph Model : Markov Model-Structure and Components of Markov Networks, Parameter Estimation Techniques, Gibb's distribution, Reduced Markov Network, Markov Network Independencies.	6

		Exact inference variable elimination: Graph Theoretical Analysis for Variable Elimination, Conditioning.	
4	**Hidden Markov Model and Inference**	Structure of HMM: States, Observations, Probabilities, Template Based Graph Model: HMM- Temporal Models, Template Variables and Template Factors, Directed Probabilistic Models, Undirected Representation, Structural Uncertainty.	6
5	**Learning and Taking Actions and Decisions**	Learning Graphical Models: Goals of Learning, Density Estimation, Specific Prediction Tasks, Knowledge Discovery. Learning as Optimization: Empirical Risk, over fitting, Generalization, Evaluating Generalization Performance, Selecting a Learning Procedure, Goodness of fit, Learning Tasks. Parameter Estimation: Maximum Likelihood Estimation, MLE for Bayesian Networks. Causality: Conditioning and Intervention, Correlation and Causation, Causal Models, Structural Causal Identifiability, Mechanisms and Response Variables, Learning Causal Models. Utilities and Decisions: Maximizing Expected Utility, Utility Elicitation. Structured Decision Problems: Decision Tree.	6
6	**Applications**	Application of Bayesian Networks: Classification, Forecasting, Decision Making. Application of Markov Models: Cost Effectiveness Analysis, Relational Markov Model and its Applications, Application in Portfolio Optimization. Application of HMM: Speech Recognition, Part of Speech Tagging, Bioinformatics.	2
		Total	**30**

Textbooks:

3. Daphne Koller and Nir Friedman, "Probabilistic Graphical Models: Principles and Techniques", Cambridge, MA: The MIT Press, 2009 (ISBN 978-0-262-0139- 2).
4. David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 1st edition, 2011.
5. Martin Wainwright and Michael Jordan, M., "Graphical Models, Exponential Families, and Variational Inference", 2008.

Reference books:

1. Finn Jensen and Thomas Nielsen, "Bayesian Networks and Decision Graphs (Information Science and Statistics)", 2nd Edition, Springer, 2007.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

Course Name: Probabilistic Graphical Models Lab

Course Code: CE30P

Category: Professional Elective Course

Preamble:
In PGM practical sessions, students will delve into the fundamental concepts and applications of probability theory, graph theory, Bayesian networks, Markov networks, and hidden Markov models. Through hands-on exercises and projects, they will gain proficiency in simulating probabilistic outcomes, implementing graph algorithms for traversal and optimization, constructing Bayesian networks from data, performing inference in Markov networks, and decoding sequences using hidden Markov models. These practical's aim to bridge theoretical understanding with practical skills, equipping students with the tools to analyze real-world data, model complex systems, and make informed decisions in uncertain environments

Pre-requisites:
Skill Based Lab-Python

Course Objectives:
- Implement simulations and analyze real-world data to understand and apply fundamental probabilistic concepts.
- Apply graph algorithms to solve optimization problems and analyze network structures in various applications.
- Construct Bayesian networks & Markov Network models from data and perform probabilistic inference for decision-making under uncertainty.
- Implement sequence analysis algorithms to decode hidden states and apply HMMs in pattern recognition tasks.

Course Outcomes:
Learner will be able:
CO1: To simulate and analyze probabilistic phenomena, applying statistical methods to real-world data.
CO2: To apply graph algorithms to solve problems in connectivity, shortest paths, and network flows, demonstrating analytical skills in network analysis.
CO3: Evaluate Bayesian networks from data, performing probabilistic inference and decision analysis in uncertain environments.
CO4: Use factor graphs and inference algorithms to model and analyze complex probabilistic relationships in data.
CO5: implement algorithms for sequence analysis, decode hidden states using HMMs, and apply them in tasks such as speech recognition and biological sequence analysis.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose a revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Practical's:

Sr No.	Title of Practical's
1	Experiment on Probability Theory
2	Experiment on Graph Theory
3	Experiment on Bayesian Network Modelling
4	Experiment on Markov Chain Modeling
5	Experiment on HMM
6	Experiment on Maximum Likelihood Estimation
7	Experiment on Decision Making using Decision Trees
8	Experiment on Learning with Optimization

Course Name: Principles of Internet of Things

Course Code: CE42T

Category: Professional electives (IoT Track)

Preamble:

The world around us is becoming increasingly interconnected. Internet of Things (IoT), a rapidly evolving field that's transforming the way we live, work, and interact with the world around us. This course will be your deep dive into the foundations of IoT. Students will delve into the language of sensors and actuators, uncover the secrets of communication between devices, and understand the challenges and opportunities that come with a connected world.

By the end, students will gain a solid understanding of the fundamental building blocks of IoT and be well-equipped to navigate this exciting and ever-growing field. Students will also be able to build use cases and Mini projects

Pre-requisites:

- C Programming
- Object Oriented Programming
- Microprocessor and Microcontroller

Course Objectives:

- To Understand the core concepts of the Internet of Things (IoT) and its key components & Levels.
- To Explore different Protocols used in IoT Communication
- To Gain a foundational knowledge of common IoT Interfaces.
- To Develop critical thinking skills to analyze proper selection of Boards
- To build practical skills by programming or building a simple IoT project to solidify your understanding**.**

Course Outcomes:

Student will be able to:
CO1: Understand the concept of IoT and its key components of IoT.
CO2: Understand different IoT Communication Protocols.
CO3: Understand different hardware Communication Protocols.
CO4: Select appropriate development boards for Building IOT Applications.
CO5: Develop programs for IoT application.
CO6: Develop creative applications of IoT technology in chosen fields.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Internet of Things	1.1 Definition and characteristics of IoT 1.2 History and evolution of IoT 1.3 Architectural layers of an IoT system (perception, network, application, data management) 1.4 Levels of IoT	5
2	Communication Protocols	2.1 IoT Edge to Cloud protocols: HTTP, REST APIs, WebSocket, MQTT, COAP, Comparison of Protocols.M2M Communication Protocols, 2.2 Bluetooth BR/EDR and Bluetooth low energy. RFID IoT System , RFID IoT Network Architecture, ZigBee IP/ZigBee SE2.0, Wifi(WLAN), 2.3 Message Communication protocols for connected devices Data exchange formats: JSON & XML	5
3	Sensor Interfaces	3.1 Digital Interfaces: UART, Serial Peripheral Interface (SPI), I2C (Inter-Integrated Circuit), Controller Area Network (CAN), Middleware Technologies, 3.2 Communication Protocols and Models. Practical Components Programming with interface in Arduino, MBed and Raspberry Pi	5
4	Hardware Fundamentals	4.1 Introduction to various sensors (temperature, humidity, pressure, motion, etc.) 4.2 Actuators and their types (solenoids, motors, relays) 4.3 Microcontrollers and development boards (e.g., Arduino, Raspberry Pi) 4.4 Interfacing sensors and actuators with microcontrollers	5

		4.5 Introduction to embedded system design principles	
5	Software Development for IoT	5.1 Introduction to programming languages for IoT (e.g., Python, C++) 5.2 Data acquisition, processing, and visualization techniques 5.3 Introduction to IoT platforms and frameworks Security considerations in IoT applications	5
6	IOT Applications and USE Cases	Case Studies Illustrating IoT Design in Applications like Home Automation, Smart Cities, Environment, Agriculture, Healthcare.	5
Total			**30**

Text Books:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach, Universities Press.
2. Raj Kamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill Education, First edition

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

Course Name: Principles of Internet of Things Lab

Course Code: CE42P

Category: Professional electives (IoT track)

Preamble:

This lab will describe the market around the Internet of Things (IoT), the technology used to build these kinds of devices, how they communicate, how they store data, and the kinds of distributed systems needed to support them

Pre-requisites:

Programming Languages – II & III, Microprocessor & Microcontroller- IV.

Course Objectives:

- To Understand interfacing of Sensors & actuators
- To identify how IoT differs from traditional data collection systems.
- To explore the interconnection and integration of the physical world and able to design & develop IOT Devices.

Course Outcomes:

Student will be able to:
CO1: Adapt different techniques for data acquisition using various IoT sensors for different applications.
CO2: Demonstrate the working of actuators based on the collected data.
CO3: Use different IoT simulators and correlate working of IoT protocols.
CO4: Select appropriate development board for IoT application.
CO5: Implement IoT protocols like MQTT for communication to realize the revolution of internet in mobile devices, cloud and sensor networks.
CO6: Develop use cases for Different IoT Applications.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be

approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Suggested List of Practical's:

1. To study and implement interfacing of different IoT sensors with Raspberry Pi/Arduino/NodeNCU
2. To study and implement interfacing of actuators based on the data collected using IoT sensors. (like led switch ON/OFF, stepper word)Modulation and Demodulation of Binary Frequency Shift Keying.
3. To study and demonstrate use of IoT simulators (like Beviswise) on any real time device (LED/stepper motor)
4. To study MQTT Mosquitto server and write a program on Arduino/Raspberry Pi to publish sensor data to MQTT broker.
5. Interfacing to Wireless Communication Devices like Bluetooth , LoRA
6. Install OS in Raspberry Pi
7. Predictive Maintenance in Industrial Automation Systems
8. Study different hardware Boards used in IoT applications

Mini Projects / Case Study :-

Select any one case study (in a group of 2-3) and perform the experiments 5 to 10. The sample case studies can be as follows:

1. Smart home automation system
2. Healthcare management system
3. Smart traffic management system & so on…

Write a program on Raspberry Pi to push and retrieve the data from cloud like thingspeak, thingsboard, AWS, Azure etc.

Text Books / Reference Books

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly publication, 2016
2. Joakim Verona," Practical DevOps", PACKT publishing, 2016
3. Honbo Zhou," The internet of things in the cloud", CRC press, Taylor and Francis group, 2012
4. Perry Lea," Internet of things for architects", PACKT publishing, 2018