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 20 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
CEXX	Professional Elective-1	As per course	3	As per course			
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)

Specialization Track Name	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Artificial Intelligence and Machine Learning (AIML) & Data Analytics (DA)	CE22T	Data Warehousing and Data Mining	Theory	2	15	20	40	075
	CE22P	Data Warehousing and Data Mining Lab	Practical	1	25	-	25	050
Internet of Things (IoT)	CE23T	Modern Sensors for	Theory	2	15	20	40	075

		Internet of Things						
	CE23P	Modern Sensors for Internet of Things lab	Practical	1	25	-	25	050
Cyber Security (CSec)	CE24T	Cryptography and Network Security	Theory	2	15	20	40	075
	CE24P	Cryptography and Network Security Lab	Practical	1	25	-	25	050

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
CE14	Cloud Computing Lab	Practical	1	25	-	25	050
CE15	System Programming and Compiler Design	Theory	3	20	30	50	100
CE16T	Distributed Systems	Theory	2	15	20	40	075
CE16P	Distributed Systems Lab	Practical	1	25	-	25	050
CE44	Machine Vision using Python	Practical	2	50	-	25	075
CEXX	Professional Elective-2	As per course	3	As per course			
CEXX	Professional Elective-3	As per course	3	As per course			

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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)

Specialization Track Name	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Artificial Intelligence and Machine Learning (AIML)	CE21T	Soft Computing	Theory	2	15	20	40	075
	CE21P	Soft Computing Lab	Practical	1	25	-	25	050
Data Analytics (DA)	CE26T	Advanced Databases	Theory	2	15	20	40	075
	CE26P	Advanced Databases Lab	Practical	1	25	-	25	050

Internet of Things (IoT)	CE31T	Embedded Systems Design and Tiny OS	Theory	2	15	20	40	075
	CE31P	Embedded Systems Design and Tiny OS Lab	Practical	1	25	-	25	050
Cyber Security (CSec)	CE28T	System Security & Ethical Hacking	Theory	2	15	20	40	075
	CE28P	System Security & Ethical Hacking Lab	Practical	1	25	-	25	050

Professional Elective-3 Courses (CEXX)

Specialization Track Name	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Artificial Intelligence and Machine Learning (AIML) & Data Analytics (DA)	CE30	Probabilistic and Graphical Model	Theory+ Tutorial	3	40	20	40	100
Internet of Things (IoT)	CE42T	Principles of Internet of Things	Theory	2	15	20	40	075
	CE42P	Principles of Internet of Things Lab	Practical	1	25	-	25	050
Cyber Security (CSec)	CE41T	Digital Forensics	Theory	2	15	20	40	075
	CE41P	Digital Forensics Lab	Practical	1	25	-	25	050

Third Year B. Tech. Computer Engineering – Recommended in 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	75	-	75	150

Courses of Semester 7 offered as Advanced Learning:

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
OEXX	Any two from the offered Open Elective courses	Theory	3	20	30	50	100
OEXX		Theory	3	20	30	50	100
CE47	Project-1 (Synopsis)	Theory	3	50	-	50	100

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 process- Version Control , Change Control	6
Total			**30**

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

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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

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	Basic Concepts: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent	5

	associations	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.	
		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

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 Analysis characteristics- Sensitivity, accuracy, precision, range, and resolution. Response time and stability, Applications in various fields and criteria to select sensor	5
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 Lab

Course Code: CE23P

Category: Professional Elective

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:

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 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

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**	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	4

	Access Control	network access control	
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

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: Cloud Computing Lab

Course Code: CE14

Category: Core

Preamble:

This course will make students understand cloud computing essentials, from virtualization to deploying web apps on commercial clouds. Learn about security issues and choosing the right cloud service, while mastering containerization concepts for modern tech solutions. It will let students apply the concepts learned to use cloud infrastructure efficiently.

Pre-requisites:

CE11P: Computer Networks Lab

Course Objectives:

- Understand and analyze the basics of cloud computing, service models, deployment models and architecture.
- Define and understand the concept of virtualization and related technologies.
- Understand different cloud computing services and their relevance.
- Describe the various services provided by Amazon Web Services platform.
- Describe the aspects of security and privacy in cloud computing.

Course Outcomes:

Learner will be able to:

LO1: Implement virtualization techniques.

LO2: Analyze various computing service models and implement them to solve the given problems.

LO3: Design and develop real world web applications and deploy them on commercial cloud(s).

LO4: Explain major security issues in the cloud and mechanisms to address them.

LO5: Explore various commercially available cloud services and recommend the appropriate one for the given application

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 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 Experiments:

Sr No.	Content
1	Introduction and overview of cloud computing. **Objective:** To understand the origin of cloud computing, cloud cube model, NIST model, characteristics of cloud, different deployment models, service models, advantages and disadvantages.
2	To study and implement Hosted Virtualization using VirtualBox& KVM. **Objective:** To know the concept of Virtualization along with their types, structures and mechanisms. This experiment should have demonstrationof creating and running Virtual machines inside hosted hypervisors like VirtualBox and KVM with their comparison based on various virtualization parameters.
3	To study and Implement Infrastructure as a Service using AWS/Microsoft Azure. **Objective:** To demonstrate the steps to create and run virtual machines inside Public cloud platform. This experiment should emphasize on creating and running Linux/Windows Virtual machine inside AmazonEC2 or Microsoft Azure Compute and accessing them using RDP or VNC tools.
4	To study and Implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service. **Objective:** To demonstrate the steps to deploy Web applications or Web services written in different languages on AWS Elastic Beanstalk/ Microsoft Azure App Service.
5	To study and Implement Storage as a Service using Own Cloud/AWS S3, Glaciers/ Azure Storage. **Objective:** To understand the concept of Cloud storage and todemonstrate the different types of storages like object storage, block level storages etc. supported by Cloud Platforms like Own Cloud/ AWSS3, Glaciers/ Azure Storage.
6	To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/ MongoDB Lab/ Firebase. **Objective:** To know the concept of Database as a Service running on cloud and to demonstrate the CRUD operations on different SQL and NOSQL databases running on cloud like AWS RDS, AZURE SQL/ Mongo Lab/ Firebase.
7	To study and implement Identity and Access Management (IAM) practices on AWS/Azure cloud. **Objective:** To understand the working of Identity and Access Management IAM in cloud computing and to demonstrate the case study based on Identity and Access Management (IAM) on AWS/Azure cloud platform.
8	To study and implement cognitive AI, computer vision, Machine Learning based service in AWS / Azure

	Objective: To know the application-based services provided by AWS and Azure in the domain of AI, NLP and ML.
10	**Mini-project:** Design a Web Application hosted on public cloudplatform [It should cover the concept of IaaS, PaaS, DBaaS, Storage as a Service, Security as a Service etc.]

Text Books:

- Amazon Web Services forDummies, Bernard Golden, John Wiley &Sons, Inc, 2013.
- Fundamentals of Azure, Microsoft Azure Essentials, Michael Collier, Robin Shahan, Microsoft Press, 2015.

Reference Books:

- Enterprise Cloud Computing, Gautam Shroff, Cambridge, 2010.
- Cloud Security, Ronald Krutz and RussellDean Vines, Wiley – India, 2010.

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: CE16T

Category: Core

Preamble:

This course aims to provide students with an overview of the concepts and fundamentals of distributed systems. It covers the architecture and communication mechanisms in distributed environments, enabling students to understand how distributed components collaborate. Additionally, the course explores key aspects such as concurrency, fault tolerance, and scalability, offering insights into system transparency and the challenges of distributed coordination.

Pre-requisites:

Operating systems, Computer Network

Course Objectives:

- To understand the goals, characteristics, and models of distributed systems.
- To analyze communication mechanisms and protocols in distributed environments.
- To study synchronization techniques and their role in ensuring consistency in distributed systems.
- To explore resource management and process migration strategies in distributed systems.
- To examine consistency models, replication, and fault tolerance mechanisms.
- To understand the design and implementation of distributed file systems with real-world examples

Course Outcomes:

Students will be able to:

CO1: Understand the goals, models, and middleware concepts in distributed systems.
CO2: Analyze communication mechanisms such as IPC, RPC, and RMI in distributed environments.
CO3: Apply synchronization techniques like clock synchronization, mutual exclusion, and election algorithms.
CO4: Evaluate resource allocation, load balancing, and process migration techniques.
CO5: Assess consistency models, replication strategies, and fault tolerance mechanisms.
CO6: Analyze distributed file systems with case studies like GFS and HDFS.

Course Scheme:

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

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 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, Distributed System Models, Hardware concepts, Software Concept. Middleware: Introduction to DCE	4
2	**Communication**	Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Parameter-passing Semantics, RPC Failures & Process resilience, Remote Method Invocation (RMI), Message Oriented Communication, Stream Oriented Communication, Group Communication & Issues	5
3	**Synchronization**	Clock Synchronization (Physical & Logical), Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm. Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala's Algorithm, Maekawa's Algorithm Token Based Algorithms: Raymond Tree Algorithm, Suzuki-Kasami's Broardcast Algorithms, Deadlock Management (Avoidance, Detection, Prevention)	9
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.	6
5	**Consistency, Replication and Fault Tolerance**	Introduction to consistency, Data-Centric and Client-Centric Consistency Models.	3
6	**Distributed File Systems**	Characteristics and Goals: Transparency (access, location, replication, fault tolerance, concurrency). DFS vs. Local File Systems. File Access Methods: Remote File Access, File Replication, and Caching. Case Studies: Google File System (GFS), Hadoop Distributed File System (HDFS).	3
Total			**30**

Textbooks:

1. Distributed Systems: Principles and Paradigms by Andrew S. Tanenbaum and Maarten Van Steen.
2. Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair.
3. Distributed Computing: Principles, Algorithms, and Systems by Ajay D. Kshemkalyani and Mukesh Singhal.
4. Distributed Operating Systems by P.K. Sinha.

Reference Books:

1. Distributed Algorithms by Nancy A. Lynch
2. Concurrent and Distributed Computing in Java by Vijay K. Garg
3. Reliable Distributed Systems: Technologies, Web Services, and Applications by Kenneth P. Birman
4. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things by Kai Hwang, Jack Dongarra, and Geoffrey Fox

Course Name: Distributed Systems Lab

Course Code: CE16P

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:

Operating systems, Computer Network

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
-	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 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	Case Study of Distributed File Systems.

Textbooks:

1. Distributed Systems: Principles and Paradigms by Andrew S. Tanenbaum and Maarten Van Steen.
2. Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair.
3. Distributed Computing: Principles, Algorithms, and Systems by Ajay D. Kshemkalyani and Mukesh Singhal.
4. Distributed Operating Systems by P.K. Sinha.

Reference Books:

1. Distributed Algorithms by Nancy A. Lynch
2. Concurrent and Distributed Computing in Java by Vijay K. Garg
3. Reliable Distributed Systems: Technologies, Web Services, and Applications by Kenneth P. Birman
4. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things by Kai Hwang, Jack Dongarra, and Geoffrey Fox

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: Soft Computing

Course Code: CE21T

Category: Professional Elective

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: Explain the fundamentals of soft computing, its constituents, and its adaptability.
CO2: Apply fuzzy set theory and design membership functions for imprecise data.
CO3: Develop fuzzy inference systems using Mamdani and Sugeno models for decision-making.
CO4: Solve optimization problems using genetic algorithms and their operators.
CO5: Implement neural network algorithms for supervised and unsupervised learning tasks.
CO6: Design hybrid systems like ANFIS by integrating neural networks and fuzzy logic.

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	Soft computing Constituents, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation.	4
2	Fuzzy Set Theory	Fuzzy Sets, Fuzzy relations, Fuzzification and Defuzzification. Features of the membership Functions, Fuzzy Max-Min and Max-Product Composition	4
3	Fuzzy Rules, Reasoning and Inference System	Fuzzy Rules: Fuzzy If-Then Rules, Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS, Sugeno FIS, Comparison between, Mamdani and Sugeno FIS	4
4	Genetic Algorithm	An Introduction to genetic Algorithms Genetic Algorithms Mathematical Foundations, Schemata Revisited Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA, Generation of Graph Results of Handwriting Recognition, Effect of Genetic Algorithms, Distance Optimization, Style Optimization Solving single-objective optimization problems using GA, Multi-objective Optimization Problem Solving	6
5	Neural Networks	Basics of Neural Networks: Introduction to Neural Networks, Biological Neural Networks, McCulloch Pitt model	8

		Supervised Learning algorithms: Perceptron (Single Layer, Multi-layer), Linear separability, Delta learning rule, Back Propagation algorithm Un-Supervised Learning algorithms: Hebbian Learning, Winner take all, Self Organizing Maps, Learning Vector Quantization.	
6	Hybrid system	Introduction to Hybrid Systems, Adaptive Neuro Fuzzy Inference System (ANFIS).	4
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
4. Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.Margaret.H.Dunham, —Data Mining Introductory and Advanced Topics||, Pearson Education
5. Satish Kumar, “Neural Networks –A classroom approach”, Second Edition,TMH Publication

Course Name: Soft Computing Lab

Course Code: CE21P

Category: Professional Elective

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: Explain the fundamentals of soft computing, its constituents, and its adaptability.
CO2: Apply fuzzy set theory and design membership functions for imprecise data.
CO3: Develop fuzzy inference systems using Mamdani and Sugeno models for decision-making.
CO4: Solve optimization problems using genetic algorithms and their operators.
CO5: Implement neural network algorithms for supervised and unsupervised learning tasks.
CO6: Design hybrid systems like ANFIS by integrating neural networks and fuzzy logic.

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.	Study of Fuzzy set and Theory
2.	Implementing basic fuzzy Operations
3.	Implementation of fuzzy set close to N
4.	Study of the Fuzzy toolbox.
5.	Implementing Train Controller problem
6.	Implementing Washing machine problem
7.	Implementing Water purification problem
10.	Implementing Tipper problem
11.	Study of different learning rules.
12.	Implementing the Perceptron learning rule.
13.	Implementing the Curve Fitting using Genetics algorithm.

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

Preamble:

Mastering advanced database systems requires a well-structured and comprehensive approach. Our roadmap encompasses key areas such as query processing, advanced data management, distributed databases, NoSQL and enhanced data models. These modules integrates theoretical concepts with practical applications, offering hands-on experience. This carefully designed curriculum equips learners with a thorough understanding of modern database systems, preparing them to tackle the complexities of today's data-driven environments.

Pre-requisites:

Database Management System

Course Objectives:

- To provide insights into distributed database designing
- To impart knowledge related to query processing and query optimization phases of a database management system.
- To introduce the concepts of access control models (DAC, MAC, and RBAC) and their implementation in database management systems.
- To specify the various approaches used for using XML and JSON technologies.
- To apply the concepts behind the various types of NoSQL databases and utilize it for Mongodb
- To learn about the trends in advance databases

Course Outcomes:

Learner will be able to:
CO1: Design distributed database using the various techniques for query processing
CO2: Measure query cost and perform distributed transaction management
CO3: Analyze and implement access control mechanisms such as Discretionary Access Control (DAC), Mandatory Access Control (MAC), and Role-Based Access Control (RBAC) to ensure data security in database systems
CO4: Organize the data using XML and JSON database for better interoperability
CO5: Compare different types of NoSQL databases
CO6: Describe various trends in advance databases through temporal, graph based and spatial based databases

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	Distributed Databases	Introduction, Distributed DBMS Architecture, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design.	4
2	Query Processing and Optimization	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.	6
3	Advanced Database Access protocols	Discretionary Access Control Based on Granting and Revoking Privileges. Mandatory Access Control and Role Based Access Control, Remote Database access protocol.	4
4	Data interoperability – XML and JSON	XML Databases: Document Type Definition, XML Schema, Querying and Transformation: XPath and XQuery. Basic JSON syntax, (Java Script Object Notation),JSON data types, Stringifying and parsing the JSON for sending & receiving, JSON Object retrieval using key-value pair and JQuery, XML Vs JSON	6
5	NoSQL Distribution Model	NoSQL database concepts: NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system. Types of NoSQL databases: Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties.	5

6	Trends in advance databases	Temporal database: Concepts, time representation, time dimension, incorporating time in relational databases. Graph Database: Introduction, Features, Transactions, consistency, Availability, Querying, Case Study Neo4J. Spatial database: Introduction, data types, models, operators and queries	5
Total			**30**

Textbooks:

1. Korth, Siberchatz, Sudarshan, "Database System Concepts", 6thEdition, McGraw Hill.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 5thEdition, Pearson Education
3. Pramod Sadalge, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison Wesely/ Pearson
4. Jeff Friesen , Java XML and JSON,Second Edition, 2019, aprés Inc.

Reference Books:

1. Peter Rob and Carlos Coronel,Database Systems Design, Implementation and Management, Thomson Learning, 5th Edition.
2. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3. Adam Fowler, NoSQL for dummies, John Wiley & Sons, Inc.

Course Name: Advanced Databases Lab

Course Code: CE26P

Category: Professional Elective

Preamble:

The Advanced Database Lab focuses on practical applications of advanced database concepts. Students will work on EER modeling, SQL-based database design, distributed database fragmentation, query cost estimation, and security features in PostgreSQL. The lab also covers XML databases, MongoDB setup, queries, triggers, and database connectivity with front-end applications. This hands-on approach equips students with the skills to manage and implement advanced database systems effectively.

Pre-requisites:

Database Management System Lab

Course Objectives:

- To understand advanced database concepts through practical applications.
- To design and implement Enhanced Entity-Relationship (EER) models.
- To explore distributed database techniques like fragmentation.
- To analyze and estimate query costs for efficient database operations.
- To gain hands-on experience with NoSQL databases like MongoDB.
- To explore database security, triggers, and connectivity with front-end systems

Lab Outcomes:

Learner will be able to:
LO1: Students will create and implement EER models for real-world scenarios.
LO2: They will perform distributed database fragmentation and query optimization.
LO3: Students will demonstrate secure database access using PostgreSQL.
LO4: They will implement and query XML and MongoDB databases.
LO5: Learners will create active database triggers and understand their functionalities.
LO6: They will connect databases to front-end applications and perform operations seamlessly.

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	Design EER Model for a real-life scenario and implement it using SQL
2	Implementation of fragmentation in distributed database environment.
3	Implement the Program to estimate cost of the query for various join operation
4	Explore the security and access control features of PostgreSQL (or equivalent system)
5	Implement XML Database
6	Install and Configure client and server for MongoDB
7	Design and implement any 5 queries using MongoDB
8	Implementation of triggers for understanding features of active database
9	Implement Database connectivity with any front end and perform database operations

Textbooks:

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

Reference Books:

1. T. Ozsu and P. Valduriez, Distributed Database Systems. Prentice Hall, Oct. 2011. [ISBN: 013616736X]
2. "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

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:

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:

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

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
Lab	25	--	25	50

Suggested List of Practical:

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

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

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: CE30

Category: Professional Elective

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	Tutorial	Theory + Tutorial	Practical
2	1	3	--

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	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 Probability & Graph Theory**	Introduction to Probability Theory: Probability Theory, Basic Concepts in Probability, Probability Axioms and Properties, Conditional Probability and Independence, Introduction to Graphs: Graph Definitions and Types, Graph Representation: Adjacency Matrix and List, Subgraphs, Paths and Trails, Cycles and Loop. Additional:- Discrete Random Variables, Continuous Random Variables: Binomial, Poisson, Uniform, Normal, Mean/ Expectation, Variance, SD and Covariance.	7
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. Additional:- Local Probabilistic Models: Tabular CPDs, Deterministic CPDs, Context Specific CPDs, Generalized Linear Models.	8
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. Additional:-Exact inference variable elimination:	8

		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.	8
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, Overfitting, 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. Additional:- Structured Decision Problems: Decision Tree.	8
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.	6
		Total	**45**

Textbooks:

1. Daphne Koller and Nir Friedman, "Probabilistic Graphical Models: Principles and Techniques", Cambridge, MA: The MIT Press, 2009 (ISBN 978-0-262-0139- 2).
2. David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 1st edition, 2011.
3. 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: Principles of Internet of Things

Course Code: CE42T

Category: Professional Elective

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 4.5 Introduction to embedded system design principles	5
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	5

		Security considerations in IoT applications	
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 Elective

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

Course Name: Digital Forensics

Course Code: CE41T

Category: Professional Elective

Preamble:

This course introduces students to the principles, techniques, and methodologies of digital forensics. It covers the investigation and analysis of digital evidence, including file systems, network traffic, and digital devices. Emphasis is placed on legal and ethical considerations, as well as practical hands-on experience with forensic tools and techniques.

Pre-requisites:

Cryptography and Network Security

Course Objectives:

- To explore the fundamentals of digital forensics, digital evidence and incident response
- To learn the tools and techniques required for computer forensics.
- To understand the network attacks and tools and techniques required to perform network forensics.
- To learn how to investigate attacks on mobile platforms.
- To generate a forensics, report after investigation.

Course Outcomes:

Learner will be able to:
CO1: Recognize the need of digital forensics and define the concept of digital evidence and incident response
CO2: Apply the knowledge of computer forensics using different tools and techniques.
CO3: Detect the network attacks and analyse the evidence.
CO4: Apply the knowledge of computer forensics using different tools and techniques.
CO5: List the method to generate legal evidence and supporting investigation reports
CO6: Understand the legal framework in Digital forensics

Course Scheme:

Contact Hours		**Credit 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 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 Digital Forensics	Introduction to Digital Forensics, Need and Objectives of Digital Forensics, Types of Digital Forensics, Process of Digital Forensics, Benefits of Digital Forensics, Chain of Custody, Anti Forensics. Digital Evidence and its Types, Rules of Digital Evidence. Incident Response, Methodology of Incident Response, Roles of CSIRT in handling incident.	4
2	Computer Forensics	Introduction to Computer Forensics, Evidence collection (Disk, Memory, Registry, Logs etc), Evidence Acquisition, Analysis and Examination (Window, Linux, Email, Web, Malware) , Challenges in Computer Forensics, Tools used in Computer Forensics.	6
3	Network Forensics	Introduction, Evidence Collection and Acquisition (Wired and Wireless), Analysis of network evidence (IDS, Router,), Challenges in network forensics, Tools used in network forensics	6
4	Mobile Forensics	Introduction, Evidence Collection and Acquisition, Analysis of Evidence, Challenges in mobile forensics, Tools used in mobile forensics	4
5	Report Generation	Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report.	4
6	Introduction to Legal Frameworks	Overview of legal principles in digital forensics Sources of law relevant to digital evidence (statutory, case law, regulations), Jurisdictional considerations in digital investigations, Admissibility of digital evidence in court Rules of evidence (e.g., hearsay, authentication, best evidence rule) Chain of custody requirements and documentation, GDPR (General Data Protection Regulation) and its implications for digital forensics, HIPAA (Health Insurance Portability and Accountability Act) considerations, Other relevant privacy laws and their impact on digital investigations, Challenges with encryption and decryption Anti-forensic techniques and legal implications	6
Total			**30**

Textbooks:

1. John Sammons, "The Basics of Digital Forensics: The Premier for Getting Started in Digital Forensics", 2nd Edition, Syngress, 2015.
2. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic: The fascinating world of Digital Evidences" Wiley India Pvt Ltd 2017.
3. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.

Reference Books:

1. Sangita Chaudhuri, Madhumita Chatterjee, "Digital Forensics", Staredu, 2019.
2. Bill Nelson,Amelia Phillips,Christopher Steuart, "Guide to Computer Forensics and Investigations" Cengage Learning, 2014.
3. Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008.

Course Name: Digital Forensics Lab

Course Code: CE41P

Category: Program Elective

Preamble:

This lab course facilitates rigorous and impartial digital investigations through the application of scientific methods and best practices in forensic analysis. Aim is to provide reliable evidence to support legal proceedings, internal investigations, and proactive security measures.

Pre-requisites:

Computer Networks Lab
Operating system Lab
Computer & Network Security Lab

Course Objectives:

1. Conduct thorough examinations of digital devices, networks, and storage media to uncover relevant evidence while maintaining chain of custody and integrity.
2. Utilize state-of-the-art forensic tools and methodologies to extract, analyze, and interpret digital evidence effectively and efficiently.
3. Foster collaboration with law enforcement agencies, legal teams, and internal stakeholders to ensure the accuracy and relevance of forensic findings.
4. Uphold ethical principles and legal guidelines in all investigative processes, respecting privacy rights and confidentiality.

Course Outcomes:

Learner will be able to:
CO1: Understanding of Digital Forensics Principles
CO2: Proficiency in Forensic Tools and Techniques
CO3: Ability to Conduct Forensic Examinations
CO4: Evidence Handling and Chain of Custody
CO5: Report Writing and Presentation Skills
CO6: Ethical and Legal Considerations

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 Practicals:

Sr No.	Title of Practicals
1	Use tools like Nmap to scan a network for active hosts and services. Enumerate services to gather information about versions and configurations.
2	Identify common vulnerabilities (e.g., using CVE database) in a target system. Use vulnerability scanners like OpenVAS or Nessus to detect vulnerabilities.
3	Exploit common vulnerabilities such as buffer overflows, SQL injection, or XSS attacks. Use frameworks like Metasploit to automate exploitation.
4	Use tools like John the Ripper or Hashcat to crack passwords from hashed files. Experiment with different password cracking techniques (dictionary attacks, brute force, etc.).
5	Perform SQL injection attacks on vulnerable web applications. Cross-Site Scripting (XSS) attacks to inject malicious scripts into web pages. Directory traversal and file inclusion attacks.
6	Crack Wi-Fi passwords using tools like Aircrack-ng or Wifite. Perform rogue access point attacks and man-in-the-middle (MITM) attacks on Wi-Fi networks.
7	Use tools like Autopsy or Sleuth Kit to analyze disk images for evidence of security breaches. Investigate system logs and network traffic to reconstruct security incidents.
8	Configure firewalls and intrusion detection/prevention systems (IDS/IPS).
9	Conduct physical penetration tests to gain unauthorized access to facilities or systems.
10	Mini project

Textbooks:

1. "Computer Forensics: Investigating Network Intrusions and Cybercrime" by EC-Council
2. "Digital Forensics with Open Source Tools" by Cory Altheide and Harlan Carvey
3. "The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory" by Michael Hale Ligh, Andrew Case, Jamie Levy, and AAron Walters
4. "Practical Forensic Imaging: Securing Digital Evidence with Linux Tools" by Bruce Nikkel

Reference Books:

1. "Handbook of Digital Forensics and Investigation" edited by Eoghan Casey
2. "Windows Forensic Analysis Toolkit: Advanced Analysis Techniques for Windows 10" by Harlan Carvey
3. "Network Forensics: Tracking Hackers through Cyberspace" by Sherri Davidoff and Jonathan Ham
4. "Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation" by Lee Reiber

Detailed syllabus of Open Elective Courses of Semester 7 (offered as Advance Learning)

List of Open Elective Courses

Sr. No.	Course Code	Course Name	Hours Per Week			Credits	Preferred Semester
			Theory	Practical	Tutorial		
1	OE21	Cyber Law	3	-	-	3	7
2	OE22	Project Management	3	-	-	3	7
3	OE23	Product Lifecycle Management	3	-	-	3	7
4	OE24	Sustainability Management	3	-	-	3	7
5	OE25	Operation Research	3	-	-	3	7
6	OE26	IPR and Patenting	3	-	-	3	8
7	OE27	Research Methodology	3	-	-	3	8
8	OE28	Renewable Energy Management	3	-	-	3	8
9	OE29	Energy Audit and Management	3	-	-	3	8
10	OE30	Bioinformatics	3	-	-	3	8
11	OE31	Nanotechnology	3	-	-	3	8

Course Name: Cyber Law

Course Code: OE21

Category: Open Elective

Preamble:

This course explores the evolving landscape of cyber law and security, equipping students with legal frameworks and technology insights necessary to navigate the challenges posed by digital crimes. It emphasizes both technical and legal aspects of cybersecurity, with a focus on Information Technology Act, 2000 (ITA 2000) and the amendments in the Information Technology Amendment Act, 2008 (ITAA 2008).

Pre-requisites: Nil

Course Objectives:

- To introduce students to the legal framework governing cyber activities, with a focus on ITA 2000 and ITAA 2008.
- To understand the technical foundations of cybersecurity and the role of various security mechanisms in preventing cyber threats.
- To explore different types of cybercrimes and the processes involved in investigating and addressing them.
- To examine the legal aspects of e-commerce, e-governance, and the use of electronic signatures in Indian law.
- To analyze the importance of privacy, data protection, and how international laws influence Indian regulations.
- To provide a global perspective on cyber law and international conventions, addressing challenges like intellectual property and cyber warfare.

Course Outcomes:

Student will be able to:
CO1: Explain the key provisions of ITA 2000 and ITAA 2008 and their impact on various legal domains.
CO2: Gain practical knowledge of cybersecurity tools and techniques such as encryption, firewalls, and digital signatures.
CO3: Identify different types of cybercrimes and apply forensic techniques to investigate digital crimes.
CO4: Assess the legal implications of e-commerce, e-governance, and electronic contracts in India.
CO5: Analyze privacy and data protection laws in India and evaluate them from an international perspective.
CO6: Understand global cyber law frameworks and how international treaties impact the regulation of cyberspace in India.

Course Scheme:

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

Assessment Guidelines:

Head	ISA	MSA	ESA	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	Introduction to Cyber Law and IT Act	Evolution and necessity of ITA 2000 Overview of ITA 2000 and ITAA 2008: Key provisions, authorities, and penalties Amendments to Indian Penal Code, Evidence Act, and other laws Case studies on jurisdiction under cyber law	6
2	Cyber Security Framework	Definition and importance of cybersecurity Overview of threats: hacking, malware, phishing, and cyberterrorism Basic security mechanisms: firewalls, encryption, PKI, and digital signatures Role of CERT-IN and other agencies in India	7
3	Cyber Crimes and Investigation	Types of cybercrimes: data theft, identity theft, cyberstalking, cyberbullying, and online fraud Investigation procedures for cybercrimes Seizure of digital evidence and forensic procedures Digital forensics: tools and anti-forensics measures	8
4	E-Commerce, E-Governance, and Cyber Law	E-commerce regulations under ITA 2000 and ITAA 2008 Validity of electronic signatures and contracts in Indian law E-Governance and issues in e-taxation Cyber Tribunal and appellate processes	8
5	Privacy, Data Protection, and Emerging Trends	Sensitive Personal Data or Information (SPDI) under Indian law International perspectives on data protection and privacy (GDPR, HIPAA) Impact of cloud computing and data localization Case studies on privacy violations and legal recourse	8
6	International Cyber Law and Legal Framework	UNCITRAL model law and international conventions on cybercrime Intellectual property rights in cyberspace: trademarks, patents, and copyright Cyber warfare, digital sovereignty, and human rights Cyber law practices in other jurisdictions (US, EU, China)	8
Total			**45**

Textbooks:

1. "Cyber Law & Cyber Crimes" by Advocate Prashant Mali, Snow White Publications, Mumbai.
2. "Information Technology Law and Practice" by Vakul Sharma, Universal Law Publishing Co. Pvt. Ltd.
3. "The Indian Cyber Law" by Suresh T. Vishwanathan, Bharat Law House, New Delhi.

Reference Books:

1. "Digital Evidence and Computer Crime" by Eoghan Casey, Academic Press.
2. "Cyber Law in India" by Farooq Ahmad, Pioneer Books.
3. "Computer Forensics: Principles and Practices" by Linda Volonino et al., Pearson Prentice-Hall, 2007.

Course Name: Project Management

Course Code: OE22

Category: Open Elective

Preamble:

This course discusses tools that any organization can use to improve its ability to plan, implement, and control its activities as well as the ways in which it utilizes its people and resources.

Pre-requisites: Nil

Course Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course Outcomes:

Student will be able to:
CO1. Apply selection criteria and select an appropriate project from different options.
CO2. Write work breakdown structure for a project and develop a schedule based on it.
CO3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
CO4. Use Earned value technique and determine & predict status of the project.
CO5. Capture lessons learned during project phases and document them for future reference

Course Scheme:

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

Assessment Guidelines:

Head	**ISA**	**MSA**	**ESA**	**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	Project Management Foundation	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	6
2	Initiating Projects	How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter, Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	8
3	Project Planning and Scheduling	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS)	8
4	Planning Projects	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	8
5	Executing Projects, Monitoring and Controlling Projects and Project Contracting	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. Project Contracting: Project procurement management, contracting and outsourcing	8
6	Project Leadership and Ethics Closing the Project	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project	7

		termination, completing a final report; doing a lesson learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study	
Total			**45**

Reference Books:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7 th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Name: Product Life Cycle Management

Course Code: OE 23

Category: Open

Preamble:

This course aims to give students an overview of product Life Cycle Management (PLM) which is a strategic approach to managing the entire lifecycle of a product, from its inception through design, manufacturing, deployment, and disposal. This course gives student insights on various aspects such as PLM Strategies, Product design, Product Data Management, Virtual Product Development Tools, Integration of Environmental Aspects in Product Design, Life Cycle Assessment and Life Cycle Cost Analysis.

Pre-requisites:

Nil

Course Objectives:

- To familiarize the students with the need, benefits and components of PLM
- To acquaint students with Product Data Management & PLM strategies
- To give insights into new product development program and guidelines for designing and developing a product
- To familiarize the students with Virtual Product Developmen

Course Outcomes:

Students will be able to:

- Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
- Illustrate various approaches and techniques for designing and developing products.
- Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
- Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

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 Product Lifecycle Management and PLM Strategies	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
2	Product Design	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering. and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	10
3	Product Data Management (PDM)	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	06
4	Virtual Product Development Tools	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case Studies	07

5	Integration of Environmental Aspects in Product Design	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of- Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	06
6	Life Cycle Assessment and Life Cycle Cost Analysis	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	06
Total			**45**

Textbooks:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Name: Sustainability Management

Course Code: OE24

Category: Open Elective

Preamble:

To provide learners with a comprehensive understanding of sustainability principles, strategies, and management practices that enable organizations to operate responsibly while achieving long-term success.

Pre-requisites:

NIL

Course Objectives:

- To provide a comprehensive understanding of sustainability concepts and their importance in global and organizational contexts.
- To equip participants with the tools and frameworks to develop and implement effective sustainability strategies.
- To foster the ability to analyze environmental, social, and economic impacts and propose practical solutions.
- To empower learners to lead and manage sustainable practices through innovation, technology, and ethical decision-making.

Course Outcomes:

Learner will be able to:

CO1: Understand the Core Principles of Sustainability: Comprehend the key environmental, social, and economic dimensions of sustainability

CO2: Analyze Environmental Impacts: Evaluate organizational and societal environmental footprints and recommend sustainable practices.

CO3: Develop Strategies for Social and Economic Sustainability: Formulate strategies that address social equity, community engagement, and economic resilience.

CO4: Implement Sustainability Practices: Design and implement sustainability strategies within an organizational context, including reporting and stakeholder management.

CO5: Leverage Technology and Innovation: Utilize emerging technologies to enhance sustainability outcomes.

CO6: Lead and Manage Change: Apply leadership and change management principles to foster a sustainability-focused culture.

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 Sustainability	Overview of Sustainability: Definition, history, and importance. Sustainable Development Goals (SDGs): UN's 2030 Agenda and its impact on global development. Three Pillars of Sustainability: Environmental, social, and economic dimensions. Current Challenges: Climate change, resource depletion, inequality, and global initiatives.	5
2	Environmental Sustainability	Understanding Environmental Impact: Carbon footprint, waste management, and biodiversity. Energy Management: Renewable energy sources, energy efficiency, and innovations in energy systems. Circular Economy: Concepts, examples, and transitioning to closed-loop systems. Sustainable Resource Management: Water, minerals, and sustainable agriculture.	8
3	Social Sustainability	Social Equity and Inclusion: Addressing diversity, equity, and inclusion in organizations. Community Engagement: Building partnerships and contributing to societal development. Labor Practices: Ethical employment practices, health, and safety. Corporate Social Responsibility (CSR): Importance, frameworks, and success stories.	7
4	Economic Sustainability	Sustainable Business Practices: Triple bottom line approach. Green Finance: ESG investing, green bonds, and carbon pricing. Sustainable Innovation: Developing products and services that align with sustainability goals. Regulatory Frameworks: Policies and standards for sustainable business operations.	5

5	Sustainability Strategy & Implementation	Developing a Sustainability Strategy: Key steps and tools. Stakeholder Engagement: Identifying and collaborating with key stakeholders. Sustainability Reporting: Standards (GRI, SASB), metrics, and case studies. Measuring Impact: Life cycle assessment (LCA), carbon accounting, and sustainability indicators.	8
6	Technology and Innovation for Sustainability	Digital Transformation: Role of AI, IoT, and big data in achieving sustainability. Green Technologies: Innovations in clean energy, transportation, and waste management. Smart Cities: Integration of sustainable technologies in urban planning. Role of Blockchain: Transparency and traceability in sustainability practices.	6
7	Leadership and Change Management in Sustainability	Sustainability Leadership: Characteristics and examples of successful leaders. Driving Organizational Change: Overcoming resistance and fostering a sustainability culture. Ethical Decision Making: Frameworks for responsible leadership. Global Case Studies: Examining successful implementations of sustainability initiatives.	6
Total			**45**

Textbooks:

1. "Sustainability Principles and Practice" by Margaret Robertson.
2. "The Triple Bottom Line" by Andrew Savitz.
3. "The Business Guide to Sustainability" by Darcy Hitchcock and Marsha Willard.

Reference Books:

1. "Cradle to Cradle: Remaking the Way We Make Things" by William McDonough and Michael Braungart.
2. "Sustainability: A Systems Approach" by Tony Clayton and Nicholas Radcliffe.

Course Name: Operations Research

Course Code: OE25

Category: Open Elective

Preamble:

This course discusses various tools in scientific management.

Course Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Course Outcomes:

Learner will be able to…
CO1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
CO2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
CO3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
CO4. Understand the applications of integer programming and a queuing model and compute important performance measures

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Operations Research	**Introduction to Operations Research**: Introduction, Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation	15

		of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem:** Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the steppingstone method and MODI method. **Assignment Problem:** Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem:** Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
2	Queuing models	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	6
3	Simulation	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	6
4	Dynamic programming	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stagecoach/Shortest Path, cargo loading and Reliability problems.	6
5	Game Theory	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	6
6	Inventory Models	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	6
Total			**45**

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Name: IPR and Patenting

Course Code: OE26

Category: Open Elective

Preamble:

This course discusses legal rights that can be registered with a legal authority in some presentable or tangible form which can be sold or bought or licensed, like physical property given to creator or innovator to harvest the economic benefits on their invention or creation.

Course Objectives:

- To understand intellectual property rights protection system
- To promote the knowledge of Intellectual Property Laws of India as well as international treaty procedures
- To get acquainted with Patent search and patent filing procedure and application

Course Outcomes:

Learners will be able to…

- Understand Intellectual Property assets
- Assist individuals and organizations in capacity building
- Work for development, promotion, protection, compliance, and enforcement of Intellectual
- Property and Patenting

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 Intellectual Property Rights (IPR):	Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	6
2	Enforcement of Intellectual Property Rights:	Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, international agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	8
3	Emerging Issues in IPR:	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc	6
4	Basics of Patents:	Definition of Patents, Conditions of patentability, Patentable and nonpatentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	8
5	Patent Rules:	Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	9
6	Procedure for Filing a Patent (National and International):	Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	8
Total			**45**

Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Name: Research Methodology

Course Code: OE27

Category: Open Elective

Preamble:

This course offers "An overview of research methodology including basic concepts employed in quantitative and qualitative research methods. Includes computer applications for research.

Pre-requisites: Nil

Course Objectives:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

Course Outcome:

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyze and report data
- Present complex data or situations clearly
- Review and analyze research findings

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 and Basic Research Concepts	Introduction and Basic Research Concepts 1.1 Research – Definition: Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	10
2	Types of Research	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	8
3	Research Design and Sample Design	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	9
4	Research Methodology	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	8
5	Ethics in Research	Ethics in Research Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher.	5
6	ICT Tools for Research	ICT Tools for Research: Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and	5

		graphical presentation of research data and software tools. Web search: Introduction to Internet, use of Internet and www, using search engines and advanced search tools.	
Total			**45**

Textbooks:

1 Donald Cooper and PS Schindler (2009) Business Research Methods, 9th edition, Tata McGraw Hill.
2 Kothari C. R Research Methodology
3 Uma Sekaran (2010) Research Methods for Business, 4th edition, Wiley.
4 Ranjit Kumar (2009) Research Methodology, 2nd edition, Pearson Education
5 Naresh Malhotra and S Dash (2009) Marketing Research, 5th edition, Pearson Prentice Hall.
6 Michael V. P Research Methodology.
7 Fred N. Kerlinger: Foundations of Behavioral Research.

Reference books

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Course: Renewable Energy Management

Course Code: OE28

Category: Open Elective

Preamble:

Renewable Energy Management focuses on the development, implementation, and management of renewable energy projects. This course aims to equip students with the knowledge and skills required to effectively manage renewable energy resources, assess their impact, and implement sustainable energy solutions. The curriculum covers various renewable energy technologies, their applications, and the economic, environmental, and policy aspects of renewable energy systems.

Pre-requisites:
Nil

Course Outcomes:

- Understand the principles and technologies of various renewable energy sources.
- Analyse the economic, environmental, and social impacts of renewable energy projects.
  Evaluate and design renewable energy systems for specific applications.
- Develop strategies for the integration and management of renewable energy in the energy mix.
- Understand the policies, regulations, and incentives related to renewable energy.
- Gain practical skills in renewable energy project planning, implementation, and management.

Course Scheme:

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

Assessment Guidelines:

Head of Learning	ISA	MSE	Project	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:

Mod No.	Module Name	Content	No. of hrs.
1	Introduction to Renewable Energy	• Overview of global and national energy scenarios • Importance and benefits of renewable energy • Types of renewable energy sources: solar, wind, biomass, hydro, a geothermal • Comparison between renewable and non-renewable energy • Current trends and future prospects in renewable energy	7
2	Solar Thermal Energy	• Principles of solar thermal energy conversion • Solar collectors: flat plate, evacuated tube, and concentrating collectors • Solar thermal applications: water heating, space heating, and industrial processes • Solar thermal power plants: parabolic troughs, solar towers, and dish Stirling systems • Economic and environmental aspects of solar thermal energy	6
3	Solar Photovoltaics	• Principles of photovoltaic energy conversion • Types of photovoltaic cells: monocrystalline, polycrystalline, and thin film • Design and components of photovoltaic systems: modules, inverters, and batteries • Performance analysis of PV systems: efficiency, shading, and temperature effects • Grid integration and energy storage for PV systems	6
4	Wind Energy	• Fundamentals of wind energy conversion • Wind turbine types, components, and operation • Wind farm design and site selection • Environmental and social impacts of wind energy projects • Economic analysis and policy considerations for wind energy	6
5	Biomass, Hydro and Geothermal Energy	**Biomass & Bio Energy** • Biomass resources and conversion technologies • Bioenergy production: biogas, biofuels, and biomass power generation • Waste-to-energy systems • Environmental and economic aspects of bioenergy • Policies and incentives for bioenergy development **Hydro Energy** • Principles of hydro power generation • Small-scale and large-scale hydro power plants **Geothermal Energy** • Geothermal energy resources and extraction methods • Applications and challenges of geothermal energy • Environmental and economic considerations for hydro and geothermal energy	9
6	Renewable Energy and Management Policy	• Energy management principles and practices • Renewable energy project planning and management • Integration of renewable energy into the grid • Policies, regulations, and incentives for renewable energy • Case studies of successful renewable energy projects	11
		Total	45

Textbooks:

1. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
2. "Renewable Energy Systems: The Earthscan Expert Guide to Renewable Energy Technologies for Home and Business" by David Thorpe
3. "Energy Management Handbook" by Wayne C. Turner and Steve Doty

Reference Books:

1. "Solar Engineering of Thermal Processes" by John A. Duffie and William A. Beckman
2. "Wind Energy Explained: Theory, Design and Application" by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers
3. "Biomass to Renewable Energy Processes" by Jay Cheng
4. "Hydropower: Renewable Energy for a Sustainable Future" by Dirk Aschenbach
5. "Geothermal Energy: Renewable Energy and the Environment" by William E. Glassley
6. "Renewable Energy Policy and Politics: A Handbook for Decision-Making" by Volker M. Quaschning

Course Name: Energy Audit and Management

Course Code: OE29

Category: Open Elective

Preamble:
Energy Audit is a systematic approach for decision-making in energy management to balance the total energy inputs with its use. The objective of Energy Management is to achieve and maintain optimum energy procurement and utilization to minimize energy costs/waste without affecting production & quality with minimum environmental effects.

Pre-requisites: Nil

Course Objectives:

- To understand the importance energy security for sustainable development and the
- fundamentals of energy conservation.
- To introduce performance evaluation criteria of various electrical and thermal installations to
- facilitate the energy management
- To relate the data collected during performance evaluation of systems for identification of
- energy saving opportunities.

Course Outcomes:
Student will be able to:

- To identify and describe present state of energy security and its importance.
- To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
- To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
- To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
- To analyse the data collected during performance evaluation and recommend energy saving measures

Course Scheme:

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

Assessment Guidelines:

Head	**ISA**	**MSA**	**ESA**	**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	Energy Scenario	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	5
2	Energy Audit Principles	Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	10
3	Energy Management and Energy Conservation in Electrical System	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
4	Energy Management and Energy Conservation in Thermal Systems	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
5	Energy Performance Assessment	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis	5
6	Energy conservation in Buildings:	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	5
Total			**45**

Reference Books:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy
5. Research Institute (TERI).
6. Energy Management Principles, C.B.Smith, Pergamon Press
7. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont
8. Press
9. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
10. www.energymanagertraining.
11. http://www.bee-india.nic.in

Course Name: Bioinformatics

Course Code: OE30

Category: Open Elective

Preamble:
This course is designed with the objective of equipping students with a robust understanding of the integration between biology and computational science, key bioinformatics concepts, methodologies, and applications. Through a combination of theoretical knowledge and practical applications, students will develop a holistic understanding of how computational methods can enhance the comprehension of biological processes. It also emphasizes on real-world biological questions and research challenges, empowering them to make meaningful contributions to the rapidly evolving field of bioinformatics.

Pre-requisites:

- Basic Knowledge of Computers and Biology

Course Objectives:

- To enable learners to understand the basic principles of bioinformatics.
- To provide a foundational understanding of key bioinformatics concepts, including biological data types and analysis methods.
- To develop the skills necessary for analyzing and interpreting genomic and proteomic datasets using computational techniques.
- To familiarize students with essential bioinformatics tools and databases, enabling effective selection and application in research.
- To encourage the integration of bioinformatics approaches into biological research, fostering the ability to formulate and test hypotheses.

Course Outcomes:

Learner will be able to:

- Understanding of foundational bioinformatics concepts.
- Comprehending and applying knowledge of basic principles of mathematics and statistics.
- Implementing efficient and reliable bioinformatics solutions by optimizing the usage of existing tools.
- Apply problem-solving skills to multivariate methods in bioinformatics.
- Search and apply bioinformatics tools to analyze and interpret biological data

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 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 Bioinformatics	Basics of Biology: Characteristics and Principles of cells, DNA and chromosome, genes and the genomes. Types of biological data, Sequencing Methods: DNA & Protein, Genomic Sequencing, and Human Genome Project Overview and scope of Bioinformatics, Computers in biology, medicine & different problems in biology, Applications of Bioinformatics	9
2	Biological databases and their classification	Based on storage techniques (Flat, Relational, Object Oriented). Based on data (Primary, Secondary, Specialized and Composite). Search engines: Entrez& SRS Sequence databases: NCBI, EMBL, DDBJ Structural Databases: PDB Protein Databases: PIR, SWISS PROT Other Databases: Chemical and Drug Molecule Databases	9
3	Algorithms in Bioinformatics	Sequence Alignment: Heuristic Method (BLAST, FASTA) Pairwise Sequence Alignment: Local and Global Alignment (Dynamic programming Methods: Needleman Wunch Algorithm, Smith Waterman Algorithm.), Multiple Sequence Alignment: CLUSTAL W, Phylogenetic Analysis.	9
4	Introduction to drug designing	History of drug design, Stages of drug discovery and development; Drug properties, likeness. Preparation of Protein Structure: In silico Structure Prediction - Homology Modeling; Threading; Fold Recognition. Ab initio modeling; Model refinement and validation	10

		Molecular Visualization Software: Methods for representing biological data, 3D Structure Viewers Concept of pharmacophore mapping and pharmacophore based Screening	
5	Computer aided drug designing	High throughput Virtual Screening and Molecular Docking: Rigid and Flexible Docking Analysis of Protein-Ligand interactions Quantitative Structure Activity Relationship (QSAR) (3D-QSAR approaches like COMFA and COMSIA.) Molecular Mechanics and Molecular Dynamics Simulations: Understanding the structural stability of protein and protein-ligand complex ADMET analysis	8
Total			**45**

Suggested list of Assignments:

1. Retrieving sequences, it's structural and functional data from the set of databases.
2. Analyzing sequences through alignment tools - BLAST, FASTA and CLUSTAL s.
3. 3D Protein modelling, validation and visualization
4. Protein ligand interaction by docking techniques
5. Designing a potential drug candidate.

Suggested List of Value-Added Home Assignments:

1. Mapping genes to biological pathways and analyze their interactions.
2. Construct and interpret a phylogenetic tree.

Suggested Online Courses:

1. Bioinformatics: Algorithms and Applications, offered by NPTEL Swayam, https://onlinecourses.nptel.ac.in/noc21_bt06/preview
2. Bioinformatics: Introduction and Methods, offered by Peking University through Coursera, https://coursesity.com/r/site/bioinformatics-introduction-and-methods-

Reference Books:

1. Bioinformatics and Functional genomics, Jonathan Pevsner, Wiley Blackwell, 2015, Third edition.
2. Bioinformatics: Sequence and genome analysis, David mount, Cold Spring Harbor, N.Y press, 2004, Second edition.
3. Strategies for Organic Drug Discovery Synthesis and Design, Daniel Lednicer, Wiley International Publishers, 1998, Second Edition.
4. Essential Bioinformatics, Jin Xiong, Cambridge University Press, 2006, First Edition.

Course Name: Nanotechnology

Course Code: OE31

Category: Open elective

Preamble:
The course aims to provide a comprehensive understanding of nanotechnology fundamentals, its scientific principles, fabrication techniques, applications in engineering, and the ethical considerations associated with its usage. Students will explore how nanotechnology can be applied to different fields of engineering, including electronics, materials science, biomedical applications, and energy.

Pre-requisites:
Nil

Course Objectives:

- To enable learners to understand the basic principles and concepts of nanotechnology.
- To enable learners to explain the properties and behavior of materials at the nanoscale.
- To enable learners to describe the fabrication and characterization techniques used in nanotechnology.
- To enable learners to explore the applications of nanotechnology in various engineering fields.
- To enable learners to analyze the societal and ethical implications of nanotechnology advancements.

Course Outcomes:

Learner will be able to:

- Understand nanotechnology fundamentals.
- Analyze nanoscale phenomena
- Understand and apply key nanofabrication methods for creating nanoscale structures and devices.
- Understand the principles behind various characterization techniques for nanoscale materials.
- Explore engineering applications of nanotechnology.
- Evaluate ethical, environmental, and societal Impacts.

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 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 Nanotechnology	Definition, scope, and multidisciplinary nature of nanotechnology. Historical development of nanotechnology and key breakthroughs. Types of nanomaterials: nanoparticles, nanotubes, nanowires, quantum dots, and nanocomposites. Nanoscale dimensions: importance of size, surface area, and quantum effects. Exploration of nanotechnology's role in various industries (electronics, medicine, energy, etc.).	9
2	Properties of Nanomaterials	In-depth study of the physical, chemical, electrical, optical, and mechanical properties of nanomaterials. Surface energy, surface-to-volume ratio, and its impact on material properties. Detailed study of quantum confinement and its influence on electrical and optical properties. Toxicity and environmental concerns of nanomaterials: impact on living organisms and ecosystems.	9
3	Nanofabrication Techniques	Comprehensive overview of top-down and bottom-up nanofabrication methods. In-depth study of lithographic techniques: photolithography, electron-beam lithography. Advanced deposition techniques: Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), Physical Vapor Deposition (PVD). Molecular self-assembly, nanoimprint lithography, and soft lithography techniques.	9
4	Characterization of Nanomaterials	Detailed study of key characterization tools: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM). Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), X-ray diffraction (XRD). Optical spectroscopy and Raman spectroscopy techniques. Importance of precision and resolution in nanomaterial characterization.	6

5	Applications of Nanotechnology in Engineering	Nanotechnology in Electronics: nanoscale transistors, quantum dots, and nanomaterials for next-gen electronics. Energy Applications: nanomaterials for solar cells, energy storage, supercapacitors, and batteries. Biomedical Applications: drug delivery, diagnostic tools, nanomedicine, and tissue engineering. Environmental Applications: nanotechnology in water purification, air filtration, and pollution control. Mechanical and Civil Engineering: nanocomposites, self-cleaning surfaces, and smart materials.	8
6	Societal, Ethical, and Environmental Implications	Ethical issues related to nanotechnology: privacy concerns, nanotoxicology, and regulation. Environmental impacts of nanomaterials: nanowaste management and recycling. Public perception of nanotechnology and its societal impacts. Responsible innovation and future directions for ethical development of nanotechnology. Regulatory frameworks for nanomaterials in India and worldwide.	4
Total			**45**

Suggested list of Assignments:

1. Explore one specific application of nanotechnology in any engineering field (e.g., electronics, medicine, or energy).
2. Comparative Analysis of Nanoscale vs. Bulk Properties.
3. Design of a Nanofabrication Process for a device.
4. Nanomaterials Characterization Report interpretation.
5. Propose a simple nanotechnology-based solution for an engineering challenge in your chosen field.
6. Ethical and Environmental Implications of Nanotechnology.

Suggested List of Value-Added Home Assignments:

1. Reviewing Nano products and new technologies.
2. Novel technical paper writing based on recent advancements.
3. Problem Based Learning on Nano sensor development.

Suggested Online Courses:

1. Nanotechnology : Introduction, Essentials, and Opportunities
    a. https://www.udemy.com/course/nanotechnology/?couponCode=IND21PM
2. Nanotechnology: A Maker's Course
    a. https://www.coursera.org/learn/nanotechnology

Reference Books:

1. Marc Madou, "Fundamentals of Microfabrication", CRC Press, 1997.
2. Charles P. Poole and Frank J. Owens, "Introduction to Nanotechnology", Wiley-Interscience, 2003.
3. Sulabha Kulkarni, "Nanotechnology: Principles and Practices", Springer, 2015.
4. R.S. Tiwari and A. Gosh, "Nanomaterials and Nanotechnology", S. Chand & Company, 2017.
5. Patricia I. Dolez, "Nanoengineering: Global Approaches to Health and Safety Issues", Elsevier, 2015.

(Draft Copy of Third Year Syllabus (R-2022), Subject to approval of Academic Council, Vidyalankar Institute of Technology.)