VIT | Vidyalankar Institute of Technology
Accredited A+ by NAAC

Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Computer Engineering with Multidisciplinary Minor

Third Year Scheme & Syllabus

(R-2023)

(As per AICTE guidelines, with effect from the Academic Year 2025-26)

Preamble

The National Education Policy (NEP) framework aims to break the mould from teacher centric to student centric educational practices. It empowers the students with flexibility in terms of choosing courses across different faculties and mode of learning.

This multidisciplinary approach will encourage learners to follow their passion and inherent interests. The learner is free to learn at a pace that he/ she is comfortable with, and this enables lifelong learning. It also enhances the scope for holistic personality development.

This premise is truly reflected in preamble of the NEP document, "The future of nation is decided in the classrooms of the schools and colleges today".

Details of implementation:

NEP curriculum framework enables us to accelerate change, redesign systems with equity in mind, respond to feedback, encourage collaboration, catch and pollinate ideas and create a culture of research and development. It will allow us to offer the required academic flexibility which will focus on improving competency level of students with diverse strengths.

The curriculum planned by VIT has vertical Programme Courses consisting of Program Core Courses (PCC) of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. This vertical also includes Program Elective Courses (PEC) which offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique program elective courses based on industrial requirements and organizing them into tracks is a special feature of this curricula ensuring employability.

The vertical Multidisciplinary Courses consists of Open Elective Courses (OEC) and Multidisciplinary Minor (MDM). Special vocational and skill development courses are included as a part of Skill courses vertical that make student capable to work in industrial environment.

The student is expected to demonstrate their ability through course in Experiential Learning Courses (ELC) vertical like internships/On Job Training, Community Engagement Project, Real Industry Project/ research problem. Our curriculum also introduces Social Service Internship and Internship with other institutes of repute along with courses like Design Thinking. This will lead to creation of products and/ or patents through this program.

For holistic development of students, apart from technical courses, Ability Enhancement Courses, Entrepreneurship/Economics/Management Courses, Indian Knowledge System and Value Education courses from vertical Humanities and Social Science and Management develop the required soft-skills and attitude amongst learners.

In Liberal Learning vertical. courses like Various Dance Forms, Global citizenship Education, Facets of Astronomy etc. aims to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses.

In addition, our framework offers Honors/ Honours by Research/ Double Minor (Multidisciplinary Minor and Specialization Minor) degree in each UG programme of engineering. It includes specialized courses along with field/ domain study that make student capable of working on industry relevant problems.

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 **Preferred Semester: V**

Course Structure and Assessment Guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
PC_PCC	PCCE10T	Artificial Intelligence	Theory	2	15	20	40	075
PC_PCC	PCCE10P	Artificial Intelligence Lab	Practical	1	25	-	25	050
PC_PCC	PCCE12T	Software Engineering	Theory	2	15	20	40	075
PC_PCC	PCCE12P	Web Design Lab	Practical	1	25	-	25	050
PC_PCC	PCCE14	Cloud Computing Lab	Practical	1	25	-	25	050
PC_PCC	PCCE15	System Programming and Compiler Design	Theory	3	20	30	50	100
PC_PCC	PCCE16T	Distributed Systems	Theory	2	15	20	40	075
PC_PCC	PCCE16P	Distributed Systems Lab	Practical	1	25	-	25	050
PC_PEC	PECEXX*	Programme Elective-1	As per list below	3	As per list below			
MDC_MDM	MDMXX#	MDM Course1 of chosen Title	As per list below	4	45	30	50	125
Total Credits				**20**				
Course credits completed during the previous inter-semester break will appear in this semester's marksheet								
MDC_OE	OEC01	Collaborative Inter-Institute Studies	As per offering institute	4	125	-	-	125

*Selection based on the subset of courses made available by the Institute for the semester.
#Selection based on the MDM Title chosen by the student.
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.

Guidelines for Programme Elective Courses and Specialization Certificate – Refer Appendix-A

Learners are required to go through the Appendix-A carefully before selecting the Programme Elective courses. Detailed guidelines regarding Programme Elective courses, specialization tracks and courses relevant to each track are given in Appendix-A.

Programme Elective-1 Courses (PECEXXT and PECEXXP)

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)	PECE02T	Data Warehousing and Data Mining	Theory	2	15	20	40	075
	PECE02P	Data Warehousing and Data Mining Lab	Practical	1	25	-	25	050
Data Science (DS)	PECE02T	Data Warehousing and Data Mining	Theory	2	15	20	40	075
	PECE02P	Data Warehousing and Data Mining Lab	Practical	1	25	-	25	050
Internet of Things (IoT)	PECE03T	Modern Sensors for Internet of Things	Theory	2	15	20	40	075
	PECE03P	Modern Sensors for Internet of Things lab	Practical	1	25	-	25	050
Computer Security (CSec)	PECE04T	Computer and Network Security	Theory	2	15	20	40	075
	PECE04P	Computer and Network Security Lab	Practical	1	25	-	25	050

[#]For details of Specialization Certificate, refer Appendix-A

Guidelines for Multidisciplinary Elective Courses and Minor Degree – Refer Appendix-B

Learners are required to go through the Appendix-B carefully before selecting the Multidisciplinary Elective courses. Detailed guidelines regarding Multidisciplinary Elective courses, Minor Degree Titles and courses relevant to each MD M Title are given in Appendix-B.

Multidisciplinary Elective Course1 (MDMXX)

MD M Title	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Bioinformatics	MDMBI01	Introduction to Bioinformatics	Theory+ Tutorial	4	45	30	50	125
Innovation, Entrepreneurial and Venture Development	MDMIE01	Foundations of Innovation and Entrepreneurship	Theory+ Tutorial	4	45	30	50	125
Business Development, Marketing and Finance	MDMBD01	Introduction to Business Development and Marketing Principles	Theory+ Tutorial	4	45	30	50	125
Robotics	MDMRB01	Fundamentals of Robotics and Control	Theory+ Practical	4	45	30	50	125

Guidelines for Award of Honours/ Honours by Research / Double Minor (Multidisciplinary and Specialization) Degree

Before the end of Semester 5, learners are required to go through the Honours/ Honours by Research/ Specialization Minor Degree Programme document carefully to opt for Honours/ Honours by Research/ Double Minor Degree. Learners willing to opt for Honours/ Honours by Research/ Specialization Minor degree programme are required to satisfy the eligibility criteria stated in the document.

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

Course Structure and Assessment Guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
PC_PCC	PCCE13T	Machine Learning	Theory	2	15	20	40	075
PC_PCC	PCCE13P	Machine Learning Lab	Practical	1	25	-	25	050
PC_PCC	PCCE18	Machine Vision using Python	Practical	1	25	-	25	050
HSSM_VEC	VECXX*	Any HSSM_VEC course	Theory	2	As per list below			
PC_PEC	PECEXX*	Programme Elective-2	As per list below	3	As per list below			
PC_PEC	PECEXX*	Programme Elective-3	As per list below	3	As per list below			
PC_PEC	PRJCE01	Specialization-Based Project	Practical	2	25	-	50	075
ELC_PRJ	PRJCE02	Project-1 (Synopsis)	Theory	2	50	-	25	075
MDC_MDM	MDMXX#	MDM Course2 of chosen Title	As per list below	4	45	30	50	125
Total Credits				**20**				

*Selection based on the subset of courses made available by the Institute for the semester.
#Selection based on the MDM Title chosen by the student.
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.

List of Value Education Courses (VECXX)

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
VEC02	E-waste and Environmental Management	Theory	2	15	20	40	075
VEC03	Universal Human Values	Theory	2	25	-	50	075
VEC04	Responsibility Towards Sustainable Environment	Theory	2	25	-	50	075
VEC05	Four Pillars of Democratic Nation	Theory	2	25	-	50	075

Programme Elective-2 Courses (PECEXXT and PECEXXP)

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)	PECE01T	Soft Computing	Theory	2	15	20	40	075
	PECE01P	Soft Computing Lab	Practical	1	25	-	25	050
Data Science (DS)	PECE06T	Advanced Databases	Theory	2	15	20	40	075
	PECE06P	Advanced Databases Lab	Practical	1	25	-	25	050
Internet of Things (IoT)	PECE11T	Embedded Systems Design and Tiny OS	Theory	2	15	20	40	075
	PECE11P	Embedded Systems Design and Tiny OS Lab	Practical	1	25	-	25	050
Computer Security (CSec)	PECE08T	System Security and Ethical Hacking	Theory	2	15	20	40	075
	PECE08P	System Security and Ethical Hacking Lab	Practical	1	25	-	25	050

#For details of Specialization Certificate, refer Appendix-A

Programme Elective-3 Courses (PECEXXT and PECEXXP)

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)	PECE10	Probabilistic and Graphical Model	Theory + Tutorial	3	40	20	40	100
Data Science (DS)	PECE10	Probabilistic and Graphical Model	Theory + Tutorial	3	40	20	40	100
Internet of Things (IoT)	PECE22T	Principles of Internet of Things	Theory	2	15	20	40	075
	PECE22P	Principles of Internet of Things Lab	Practical	1	25	-	25	050
Computer Security (CSec)	PECE21T	Digital Forensics	Theory	2	15	20	40	075
	PECE21P	Digital Forensics Lab	Practical	1	25	-	25	050

[#]For details of Specialization Certificate, refer Appendix-A

Multidisciplinary Elective Course-2 (MDMXX)

MDM Title	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Bioinformatics	MDMBI02	Algorithms and Data Structures in Bioinformatics	Theory+ Tutorial	4	45	30	50	125
Innovation, Entrepreneurial and Venture Development	MDMIE02	Startup Planning and Development	Theory+ Tutorial	4	45	30	50	125
Business Development, Marketing and Finance	MDMBD02	Financial Basics for Engineers and Technopreneurs	Theory+ Tutorial	4	45	30	50	125
Robotics	MDMRB02	Machine Vision and Robotic Perception	Theory+ Practical	4	45	30	50	125

Third Year B. Tech. Computer Engineering - Summer Break

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
OJT01	Industry Internship 1	Internship	5	75	-	75	150
Total Credits			**05**				

*150+ hours of industry internship to be done during inter semester break between semester 6 and semester 7.

NOTE: As per Institute guidelines, the results of courses completed in inter-semester break will appear in the marksheet of the next semester.

Detailed Syllabus of Third Year Semester-V

Course Name: Artificial Intelligence

Course Code: PCCE10T

Vertical_Sub-Vertical: PC_PCC

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 and Engineering Mathematics-III

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	4

Module No.	Module Name	Content	No of Hours
		Statistical Learning methods	
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: PCCE10P

Vertical_Sub-Vertical: PC_PCC

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: Software Engineering

Course Code: PCCE12T

Vertical_Sub-Vertical: PC_PCC

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 Fundamentals Ali 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: PCCE12P

Vertical_Sub-Vertical: PC_PCC

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:

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 Fundamentals Ali 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: Cloud Computing Lab

Course Code: PCCE14

Vertical_Sub-Vertical: PC_PCC

Preamble:

This course will make students understand the essentials of cloud computing, 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:

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

Sr No.	Content
	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: PCCE15

Vertical_Sub-Vertical: PC_PCC

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: PCCE16T

Vertical_Sub-Vertical: PC_PCC

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	--

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: PCCE16P

Vertical_Sub-Vertical: PC_PCC

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: Data Warehousing and Data Mining

Course Code: PECE02T

Vertical_Sub-Vertical: PC_PEC

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

Course Objectives:

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

Course Outcomes:

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

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

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

CO3: To introduce concepts and fundamentals of data lakes

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

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

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

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

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

Module No.	Module Name	Content	No of Hours
		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:

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

Course Name: Data Warehousing & Data Mining Lab

Course Code: PECE02P

Vertical_Sub-Vertical: PC_PEC

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

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: PECE03T

Vertical_Sub-Vertical: PC_PEC

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

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.

Course Name: Modern Sensors for Internet of Things Lab

Course Code: PECE03P

Vertical_Sub-Vertical: PC_PEC

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: Computer and Network Security

Course Code: PECE04T

Vertical_Sub-Vertical: PC_PEC

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

Course Objectives:

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

Course Outcomes:

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

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

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

Module No.	Module Name	Content	No of Hours
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: Computer and Network Security Lab

Course Code: PECE04P

Vertical_Sub-Vertical: PC_PEC

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

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.

Course Title: Introduction to Bioinformatics

Course Code: MDMBI01

Vertical/Sub-Vertical: MDC_MDM

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: NIL

Course Objectives:

- To enable learners to understand the basic principles of bioinformatics.
- Build foundational understanding of biology, types of biological data, and the role of computing in biology.

Course Outcomes:

Students will be able to:
CO1: Explain foundational molecular biology concepts and their relevance to bioinformatics, including DNA, RNA, proteins, and gene functions.
CO2: Access, compare, and utilize various biological databases and sequence file formats to retrieve and analyze genomic and proteomic data effectively.
CO3: Apply key sequence alignment algorithms and computational techniques to analyze biological sequences and construct phylogenetic relationships.
CO4: Implement bioinformatics algorithms and data structures to solve problems in genomics, proteomics, and systems biology, including gene prediction and motif discovery.
CO5: Evaluate current applications and emerging trends in bioinformatics, including personalized medicine, big data analytics, ethical issues, and the integration of AI/ML technologies in biological research.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBI01	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

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	Basics of Molecular Biology	• Structure and function of DNA, RNA, and proteins • Central Dogma of Molecular Biology (Replication, Transcription, Translation) • Codons and genetic code • Types of genes (structural, regulatory) • Mutations and their biological effects.	8
2	Biological Database	Types: Primary, Secondary, Specialized databases, GenBank, EMBL, DDBJ – comparative study, UniProt, PDB, RefSeq, Ensembl, Sequence file formats (FASTA, GenBank, GFF, SAM/BAM), Querying biological databases (using NCBI Entrez, EBI search tools)	8
3	Sequence Analysis	Types of biological sequences: DNA, RNA, Protein, Pairwise and Multiple Sequence Alignment (MSA), Scoring matrices (PAM, BLOSUM), Tools: BLAST, FASTA, ClustalW, Applications: gene finding, phylogeny, structure prediction	8
4	Genomics & Human Genome Project	Genome organization and structure, Sequencing techniques: Sanger, Next Generation Sequencing (NGS), Nanopore, Applications: disease gene identification, forensic genomics, Human Genome Project: goals, achievements, ethical issues, Comparative genomics	12
5	Applications of Bioinformatics	Bioinformatics in personalized medicine, Drug discovery and vaccine design, Agriculture and animal genomics Role of AI/ML in bioinformatics	9
		Total	**45**

Reference books:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laborator Press, New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

Course Title: Foundations of Innovation and Entrepreneurship

Course Code: MDMIE01

Vertical_Sub-Vertical: MDC_MDM

Preamble:

This course provides a foundational understanding of how innovation emerges, how entrepreneurs identify and act on opportunities, and how new ventures can be developed to address real-world challenges. It explores the intersection of creativity, strategic thinking, and risk-taking, emphasizing both individual initiative and collaborative problem-solving.

Pre-requisites: NIL

Course Objectives:

- To introduce the foundational concepts of innovation and entrepreneurship.
- To build awareness of opportunity recognition, creativity, and idea validation.
- To expose students to business modelling and startup ecosystems.

Course Outcomes:

Students will be able to:

CO1: Understand key entrepreneurial trends and innovation drivers

CO2: Apply ideation tools to identify entrepreneurial opportunities.

CO3: Create basic business models using Business Model Canvas.

CO4: Evaluate entrepreneurial case studies and pitch early-stage ideas.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMIE01	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

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 Entrepreneurship	• Definition, importance, and scope • Types of entrepreneurs • Entrepreneurial mindset and characteristics	8
2	Innovation Basics	• Types of innovation (product, process, business model) • Disruptive vs. incremental innovation • Design Thinking fundamentals	8
3	Idea Identification & Evaluation	• Creativity and ideation tools (brainstorming, SCAMPER, mind-mapping) • Problem-solving frameworks • Validating ideas	10
4	Business Model Design	• Business Model Canvas • Value Proposition Design • Customer Segments and Customer Discovery	6
5	Entrepreneurial Ecosystem	• Role of incubators, accelerators, and funding bodies • Startup India, Atal Innovation Mission, etc	7
		Total	**45**

Tutorials (1 Credit):

- Case studies on startups
- Group exercises on ideation
- Hands-on practice with the Business Case presentation
- Ideation workshops
- Business culture studies exercises
- Group discussion and presentations

Reference books:

- Steve Blank, The Startup Owner's Manual, K&S Ranch Publishing Inc
- Alexander Osterwalder, Business Model Generation, John Wiley and Sons
- Peter F. Drucker, Innovation and Entrepreneurship, HarperCollins Publishers Inc

Course Title: Introduction to Business Development and Marketing Principles

Course Code: MDMBD01

Vertical_Sub-Vertical: MDC_MDM

Preamble:

The objective of this course is to introduce engineering students to the fundamentals of business development and marketing using a customer centric lens. Students will learn how to conceptualize a basic business idea, understand market needs, and align engineering innovations with customer demand.

Pre-requisites: NIL

Course Objectives:

- Understand basic business structures and concepts.
- Identify customer needs and conduct basic market research.
- Learn fundamentals of marketing strategy in a technology-driven world.
- Appreciate the role of engineering in business innovation.

Course Outcomes:

Students will be able to:

CO1: Explain key concepts in business development and marketing relevant to engineers.
CO2: Conduct simple market research and competitor analysis for a tech-based idea.
CO3: Draft a basic value proposition and elevator pitch.
CO4: Identify business opportunities through innovation in telecom and electronics domains.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBD01	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

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.

Module No.	Module Name	Content	No. of Hours
1	Foundations of Business	Types of businesses, vision-mission-goals, legal forms of business, introduction to entrepreneurship.	8
2	Marketing Essentials	Needs vs wants, Segmentation, targeting, positioning, Marketing mix (4Ps), digital vs traditional marketing.	8
3	Customer Focus	Basics of customer journeys, personas	7
4	Technology Product Planning	Basics of product lifecycle, innovation funnel, idea screening.	10
5	Market Research Basics	Research Types, Research steps, Sampling, Surveys, interviews, SWOT, competitor analysis.	6
6	Business Idea Pitch	Business idea pitch, value proposition canvas, storytelling.	6
		Total	**45**

Textbooks:

1. Marketing Management by Kotler

Reference Books:

1. Marketing Basics PDF by MIT Open Courseware

Course Name: Fundamentals of Robotics and Control

Course Code: MDMRB01

Vertical_Sub-Vertical: MDC_MDM

Preamble:

This course introduces the foundational principles of robotics, including kinematics, dynamics, and control systems. The course explores real-world robotic applications and the growing role of automation in modern industries. Students will gain hands-on experience with robotic systems and process automation tools. The course integrates Robotic Process Automation (RPA) to bridge physical and digital automation domains.

Pre-requisites:

1. Engineering Mathematics-I
2. Engineering Mathematics-II
3. Structured Programming
4. Object Oriented Programming

Course Objectives:

- Understand the foundational principles of robotics, including kinematics, dynamics, and control of robotic systems.
- Apply basic control strategies such as PID to robotic manipulators and mobile robots
- Explore the role of Robotic Process Automation (RPA) as a complementary software-based automation technique and build simple RPA workflows.

Course Outcome:

Students will be able to:

CO1: Explain the components and types of robotic systems and their applications.
CO2: Derive and apply forward and inverse kinematics for simple manipulators.
CO3: Analyze and implement feedback control systems, including PID controllers
CO4: Simulate basic robotic arm motion and trajectory control using software tools.
CO5: Describe the fundamentals of Robotic Process Automation (RPA) and its uses in industry.
CO6: Develop a basic RPA workflow to automate a simple rule-based software task.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
MDMRB01	3	2	3	1

Assessment guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Practical	45	30	50	125

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.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Introduction to Robotics	• Types of robots: manipulators, mobile robots, humanoids • Robot anatomy: joints, links, actuators, sensors • Applications in manufacturing, healthcare, and services	06
02	Kinematics of Robotic Manipulators	• Coordinate systems and transformations, • Denavit–Hartenberg (D-H) parameters, • Forward and inverse kinematics for 2-DOF and 3-DOF arms	09
03	Dynamics and Trajectory Planning	• Basic concepts in robot dynamics (torque, inertia – overview), • Joint and Cartesian trajectory planning, • Linear and cubic interpolation	06
04	Control of Robotic Systems	• Introduction to control systems, • PID control: tuning, implementation, and real-time control, • Stability and feedback concepts	08
05	Introduction to Robotic Process Automation	• What is RPA, Difference from physical robotics, • Components of an RPA system: bots, orchestrators, recorders, • Overview of popular RPA tools (e.g., UiPath)	06
06	RPA Workflow Design and Integration	• Creating simple bots to automate tasks (e.g., Excel, web forms), • Control structures, data handling, and triggers in RPA, • Conceptual integration: using RPA to initiate physical robot actions	10
		Total	**45**

Suggested List of Value-Added Home Assignments:

1. Research a real-life robotic system (e.g., Da Vinci surgical robot, warehouse AGVs, Boston Dynamics' Spot). Analyze its components, sensing and actuation methods, and control logic. Propose a reconfiguration or redesign for a different application.
2. Design a 2-DOF or 3-DOF manipulator in MATLAB or Python. Simulate a simple pick-and-place routine.
3. Design a time-optimized trajectory considering joint velocity and acceleration limits for trajectory planning for a Robotic Painter
4. Implement a PID controller to stabilize an inverted pendulum model. Simulate using MATLAB/Python
5. Identify a repetitive digital task in your daily academic/work life. Automate them using tools
6. Create an RPA bot that responds to an email, form submission, or file upload.

Reference Books / Articles

1. Robert Shilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
2. John J. Craig, Introduction to Robotics–Mechanics &Control Pearson Education, India, Third Edition, ,2009.
3. Katsuhiko Ogata, Modern Control Engineering
4. Alok Mani Tripathi, Learning Robotic Process Automation
5. Fu, Gonzales and Lee, Robotics, Robotics, McGraw Hill, SecondEdition,2011.
6. Staughard, Robotics and AI, Prentice Hall of India.
7. Grover, Wiess, Nagel, Oderey Industrial Robotics, , McGraw Hill.
8. Walfram Stdder, Robotics and Mechatronics, Mc Graw Hill, New York 2008.
9. Saeed B Niku, Introduction to Robotics, Pearson Education.
10. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications

Detailed Syllabus of Third Year Semester-VI

Course Name: Machine Learning

Course Code: PCCE13T

Vertical_Sub-Vertical: PC_PCC

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: PCCE13P

Vertical_Sub-Vertical: PC_PCC

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:

Python Programming

Course Objectives:

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

Course Outcomes:

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

Course Scheme:

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

Assessment guidelines:

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

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

Suggested List of Practicals:

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

Course Name: Machine Vision Using Python

Course Code: PCCE18

Vertical_Sub-Vertical: PC_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:

Python Programming – ESEC03

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
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	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.

Detailed Syllabus (Experiment Topics):

Topic No.	Experiment based on 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: PECE01T

Vertical_Sub-Vertical: PC_PEC

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 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.	8
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: PECE01P

Vertical_Sub-Vertical: PC_PEC

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	050

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: PECE06T

Vertical_Sub-Vertical: PC_PEC

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, après 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: PECE06P

Vertical_Sub-Vertical: PC_PEC

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:

PCCE05P - 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 and Tiny OS

Course Code: PECE11T

Vertical_Sub-Vertical: PC_PEC

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	-

Assessment Guidelines:

Head	ISA	MSA	ESE	Total (Passing @40% of 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	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 Systems Design and Tiny OS Lab

Course Code: PECE11P

Vertical_Sub-Vertical: PC_PEC

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	050

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: PECE08T

Vertical_Sub-Vertical: PC_PEC

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 (PCCE11T),
Operating system (PCCE07T) and
Computer & Network Security (PECE04T)

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: PECE08P

Vertical_Sub-Vertical: PC_PEC

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 Lab (PCCE11P),
Operating system Lab (PCCE07P) and
Computer & Network Security Lab (PECE04P)

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	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Lab	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	Developing and implementing malwares : Creating a simple keylogger in python, creating a virus, creating a trojan.
2	Conducting reconnaissance and footprinting exercises Using tools for information gathering: Nmap, Maltego
3	Scanning networks for open ports and services Enumerating system and network resources Tools: Nessus, OpenVAS, Nikto
4	Exploiting vulnerabilities in systems and networks Post-exploitation techniques: privilege escalation, lateral movement Tools: Metasploit, Cobalt Strike, Empire
5	Identifying and exploiting common web application vulnerabilities Tools: Burp Suite, OWASP ZAP, SQLMap
6	Hacking wireless networks: WEP, WPA, WPA2 Exploiting mobile device vulnerabilities: Android, iOS Tools: Aircrack-ng, Wireshark, Android Debug Bridge (ADB)
7	Conducting social engineering exercises -Assessing physical security controls Tools: Social-Engineer Toolkit (SET), Lockpicking tools
8	Digital forensics exercises- Incident response simulations Tools: EnCase, Autopsy, Volatility
9	Penetration Testing using Metasploit and metasploitable,
10	Mini project

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 and Graphical Models (PGM)

Course Code: PECE10

Vertical_Sub-Vertical: PC_PEC

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-IV (BSC07) & Machine Learning (PCCE13T)

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:

Learners 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. Self-Learning: Discrete Random Variables, Continuous Random Variables: Binomial, Poisson, Uniform, Normal, Mean/ Expectation, Variance, SD and Covariance.	4
2	Bayesian Network Model and Inference	Directed Graph Model: Bayesian Network-Structure and Semantics, Exploiting Independence Properties, Naive Bayes Model, Bayesian Network Model, Basic Independencies in Bayesian Networks, Conditional Independence and d-Separation, Bayesian Network Semantics, Graphs and Distributions. Exact inference: Variable Elimination, Conditioning, CPD's and its types, Inference with Structured CPDs. Self-Learning: Local Probabilistic Models: Tabular CPDs, Deterministic CPDs, Context Specific CPDs, Generalized Linear Models.	5
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. Self-Learning: Exact inference variable elimination: Graph Theoretical Analysis for Variable Elimination, Conditioning.	6

Module No.	Module Name	Content	No of Hours
4	Hidden Markov Model and Inference	Structure of HMM: States, Observations, Probabilities, Template Based Graph Model: HMM- Temporal Models, Template Variables and Template Factors, Directed Probabilistic Models, Undirected Representation, Structural Uncertainty.	6
5	Learning and Taking Actions and Decisions	Learning Graphical Models: Goals of Learning, Density Estimation, Specific Prediction Tasks, Knowledge Discovery. Learning as Optimization: Empirical Risk, 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.	6
6	Applications	Application of Bayesian Networks: Classification, Forecasting, Decision Making. Application of Markov Models: Cost Effectiveness Analysis, Relational Markov Model and its Applications, Application in Portfolio Optimization. Application of HMM: Speech Recognition, Part of Speech Tagging, Bioinformatics.	3
		Total	**30**

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.

Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

Course Name: Principles of Internet of Things

Course Code: PECE22T

Vertical_Sub-Vertical: PC_PEC

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 Security considerations in IoT applications	5

Module No.	Module Name	Content	No. of Hours
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: PECE22P

Vertical_Sub-Vertical: PC_PEC

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:

Students 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 data collected.
CO3: Use different IoT simulators and correlate working of IoT protocols.
CO4: Select an 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 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: PECE21T

Vertical_Sub-Vertical: PC_PEC

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:

Computer 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 forensics, report after investigation.

Course Outcomes:

Learners will be able to:
CO1: Recognize the need of digital forensics and define the concept of digital evidence and incident response
CO2: Apply 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: PECE21P

Vertical_Sub-Vertical: PC_PEC

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:

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

Course Outcomes:

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

Course Name: Specialization-Based Project

Course Code: PRJCE01

Vertical_Sub-Vertical: PC_PEC

Preamble:

The Specialization-Based Project course provides students with hands-on experience in applying engineering principles to solve defined problems. It emphasizes innovation, design thinking, and teamwork, preparing students for real-world engineering challenges. Students are encouraged to ideate, prototype, test, and present feasible solutions, promoting critical thinking and professional competencies in line with graduate attributes.

Pre-requisites:

Basic background of programming courses, fundamentals of Data structures and Algorithms.

Course Objectives:

Students will be able to:

- To promote independent learning, problem-solving, and creative thinking through project work.
- To identify and define a technical problem relevant to current trends or societal needs.
- To design and develop a working model, simulation, or software solution.
- To cultivate teamwork, time management, and professional ethics.
- To improve skills in technical writing, project documentation, and oral presentation.

Course Outcomes:

Students will be able to:
CO1: Identify a meaningful technical problem and define its scope and objectives.
CO2: Design a technical solution through simulation, modeling, or prototyping.
CO3: Apply domain knowledge, tools, and techniques to implement and test the project.
CO4: Demonstrate teamwork, ethics, and consideration for environmental or societal aspects.
CO5: Communicate project outcomes effectively through reports, presentations, and demos.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	50	75

Course Name: Project-1 (Synopsis)

Course Code: PRJCE02

Vertical_Sub-Vertical: ELC_PRJ

Preamble:

The Project – I (Synopsis) course aims to guide students through the initial stages of their capstone project journey. This phase emphasizes research orientation, problem identification, and proposal development. Students are expected to explore real-world or emerging problems, conduct literature surveys, formulate clear problem statements, and prepare a comprehensive project synopsis. The course builds a foundation for successful implementation in the subsequent Major Project-II, encouraging analytical thinking, innovation, and systematic planning..

Pre-requisites:

Basic knowledge of core Computer Engineering subjects such as Programming, Data Structures, Software Engineering, and familiarity with emerging technologies (AI/ML, Blockchain, Web/Mobile Development, etc.).

Course Objectives:

Students will be able to:

- Understand the process of identifying research-worthy or application-based project topics.
- Analyze and review relevant literature and technologies related to the chosen domain.
- Formulate a clear problem definition and propose feasible solutions or system architecture.
- Prepare a detailed project proposal with objectives, scope, methodology, and expected outcomes.
- Demonstrate skills in project planning, documentation, and oral presentation.

Course Outcomes:

Students will be able to:

CO1: Identify and define a significant project problem based on societal, industrial, or research needs.
CO2: Conduct a comprehensive literature review to support the problem definition and methodology.
CO3: Propose a well-structured technical solution, including architecture or design model.
CO4: Plan project execution with proper scheduling, tools, and resource identification.
CO5: Present and defend the project synopsis with clarity in written and oral formats.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	4	0	2

Assessment guidelines:

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

Course Name: E-waste and Environment Management

Course Code: VEC02

Vertical_Sub-Vertical: HSSM_VEC

Preamble:

Environmental Education helps learners to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future. It encourages character building and develop positive attitudes and values.

Pre-requisites:

Nil

Course Objectives:

- To introduce the effective mechanism to regulate generation, collection, storage, transport, import, export, recycling, treatment and disposal of e-wastes and their legislative rules.
- This course will help the participants to understand why and how to manage e-waste in an environmentally sound manner and how action on e-waste could be taken in their own life, business, or organization.
- To instigate sustainable practices, green innovations, e-waste recovery and inclusive recycling business models.
- To present innovative research on technological solutions to reduce hazard by design.

Course Outcomes:

Learner will be able to:
CO1: Understand need and concept of e-waste management & recycling
CO2: To gain the knowledge of legislative rules and regulations related to E-waste management.
CO3: Recognize the tools and technologies required for e-waste recycling assessment and monitoring.
CO4: Address contemporary issues and analyse the local and global impact of computing and engineering solutions on individuals, organizations, and society
CO5: Apply the knowledge about E-waste management in routine daily life to minimize the hazards.

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	Overview of E-waste & its management	Introduction, toxicity due to hazardous substances in e-waste and their impacts, domestic e-waste disposal, e-waste management, technologies for recovery of resource from electronic waste, guidelines for environmentally sound management of e-waste, occupational and environmental health perspectives of recycling e-waste in India.	6
2	E-Waste Recycling	Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials. Recovery of materials from e-waste, recovery of metals from e-waste	5
3	Exposure pathway of pollutants emitted from Recycling of E-Waste	Environmental and public health issues E-waste health risk assessment	4
4	E-Waste Management Rules of India (2011 and 2016 Rules)	Regulations in India - Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs. E-waste Management: Case Studies and Unique Initiatives from around the World The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive	6
5	Technological Advances to overcome Environmental problems	Concept of Green Buildings, Various indoor air pollutants and their effects on health. Carbon Credit: Introduction and general concept. Disaster Management: Techniques of Disaster Management to cope up with (i) Earthquake and (ii) Flood. Remote sensing and GIS – Introduction and its applications	4

Module No.	Module Name	Content	No. of Hours
		in environment sector	
6	Environmental Assessment and Management	Environment Impact Assessment (EIA), Introduction to various symbols, Environmental audit and Eco-labelling, ISO - 14001, 18001 and 31001 Pollution Control Legislation- Functions and powers of Central and State Pollution Control Board. Environmental Clearance, Consent and Authorization Mechanism.	5
Total			**30**

Suggested Online Courses:

1. Beyond Sustainable Development Goals (SDGs): Addressing Sustainability and Development, offered by University of Michigan - https://www.coursera.org/learn/beyond-the-sustainable-development-goals-addressing-sustainability-and-development
2. Environmental Management & Ethics offered by Technical University of Denmark (DTU) - https://www.coursera.org/learn/environmental-management-ethics
3. Introduction to Sustainability offered by University of Illinois at Urbana-Champaign- https://www.coursera.org/learn/sustainability

Text Books:

1. G. Tyler Miller Jr. and Scott Spoolman, "Environmental Science", 13th Edition, Brooks/Cole, 2011

Reference Books:

1. Keerthinarayana and Daniel Yesudian, "Environmental Science and Engineering", 1st Edition, Hi-Tech Publications, 2008
2. G.M. Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt Ltd., 2005
3. Anubha Kaushik and C.P. Kaushik, "Environmental Science and Engineering, 3rd Edition, New Age International, 2010
4. Boyle G., "Renewable Energy: Power for a Sustainable Future", Oxford publication, UK 3rd edition, 2012
5. Erach Bharucha, "Text Book of Environmental Studies", Universities Press (India) Pvt. Ltd., 2005
6. Johri R., "E-waste: implications, regulations, and management in India and current global best practices", TERI Press, New Delhi.
7. Krishnamoorthy B., "Environmental Management, Text Book and Cases", PHI Learning (P) Ltd., New Delhi.
8. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.
9. MSW Management Rules 2016, Govt. of India, available online at CPCB website.
10. Hester R.E., and Harrison R.M., "Electronic Waste Management", Science, 2009.
11. Fowler B., "Electronic Waste" – 1st Edition (Toxicology and Public Health Issues), Elsevier, 2017

Course Name: Universal Human Values

Course Code: VEC03

Vertical_Sub-Vertical: HSSM_VEC

Preamble:

The present education system has become largely skill-based. The prime emphasis is on science and technology. However, science and technology can only help to provide the means to achieve what is considered valuable in terms of facilities. Value Education is a crucial missing link in the present education system. Because of this deficiency, most of our efforts may prove to be counterproductive and serious crises at the individual, societal and environmental level are manifesting.
Values and skill complement each other. Values mean importance or participation and skills mean qualities, training, and capabilities. To fulfil our aspirations both values and skills are necessary. When we identify and set the right goals and produce in right direction, this is known as value domain, the domain of wisdom. Basically, we must know what really is useful to achieve human happiness, the happiness to all and for all the time.
And when we learn and practices to actualize this goal to develop the techniques to make this happen in real life, in various dimensions of human Endeavour, this is known as domain of skills. Hence, there is an essential bonding between values and skills for the success of any human endeavor.
For a happy and successful life, it is important to know, explore, verify and practice universal human values, professional ethics.

Prerequisite:

NIL

Course Objective:

- To help the student to see the need for developing a holistic perspective of life.
- To sensitize the student about the scope of life – individual, family, society and nature/existence.
- Strengthening self-reflection.
- To develop more confidence and commitment to understand, learn and act accordingly.

Course Outcomes:

Learner will be able to:
CO1: Learner will become more aware of themselves and their surroundings.
CO2: Learners will be more responsible in life and will able to handle critical problems.
CO3: Learners will develop better critical ability.
CO4: Learners will be more sensible towards commitment.
CO5: Learner will be able to apply human values in day to day life.
CO6: Learner will become a responsible citizen.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	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
1	Introduction to Value Education	Need for Value Education Basic Guidelines for Value Education The Content of Value Education The Process of Value Education Starting to observe inside What is Self-exploration? What is its Purpose? Content of Self-exploration Process of Self-exploration Natural Acceptance What is the State today? What is the way out? What do we need to do?
2	The Basic Human Aspirations Continuous Happiness and Prosperity	Continuous Happiness and Prosperity Our Basic Aspirations Exploring Happiness and Prosperity A Look at the Prevailing Notions of Happiness and Prosperity Some Possible Questions/Confusions Basic Requirements for Fulfilment of Human Aspirations What is our State today? Why are we in this State? - Living with Wrong Assumptions What is the Solution? The Need for Right Understanding Our Program: Understand and Live in Harmony at all Levels of Living Our State today Our Natural Acceptance for Harmony at all Levels of our Living Human and Animal Consciousness
3	Understanding the Human Being as Co-	Human Being is more than just the Body Understanding Myself as Co-existence of the Self and the Body

	existence of Self ('I') and Body	Understanding Needs of the Self and Needs of the Body Understanding the Activities in the Self and the Activities in the Body Understanding the Self (I) as the Conscious Entity, the Body as the Material Entity Exercise on distinguishing Needs of the Self ('I') and Body Exercise on Distinguishing Activities of the Self (I) and Body Understanding the Body as an Instrument of 'I' (I' being the Seer, Doer and Enjoyer) Why should I study Myself? Getting to know the Activities in the Self (I) How are the Activities in T Related! The Activities in 'I' are Continuous Effects of the Problem.... What then is the Solution? Result of Realization and Understanding Living with Definiteness Our Body A Self-organized Unit Harmony of T with the Body: Sanyama and Svasthya What is our State today? What is the way out? Understanding and Living with Sayama Correct Appraisal of our physical needs
4	Harmony in the Family, Society, Nature- Understanding Values in Human Relationships	Family as the Basic Unit of Human Interaction Harmony in the Family. Justice (Nyaya) What is the State today? Values in Human Relationships Trust (Visvasa) Respect (Sammana The Basis for Respect Assumed Bases for Respect Today The Problems due to Differentiation Difference between Attention' and 'Respect' What is the way out? Affection (Sneha) Care (Mamand) Guidance (Vatsalya) Reverence (Shraddha) Glory (Gaurava) Gratitude (Kritagayta) Love (Prema) Harmony from Family to World Family: Undivided Society Extending Relationship from Family to Society Identification of the Comprehensive Human Goal Where are we today?

		Programs Needed to Achieve the Comprehensive Human Goal: The Five Dimensions of Human Endeavour Education-Right Living (Siksha Sanskara) Health-Self-regulation (Svasthya-Sanyama) Justice-Preservation (Nyaya-Suraksha) Production-Work (Utpadana-Karya) Exchange-Storage (Vinimaya-Kosa) What is our State today? Harmony from Family Order to World Family Order: Universal Human Order The Four Orders in Nature Interconnectedness and Mutual Fulfilment (Parasparta aur Paraspara Purakata) Recyclability and Self-regulation in Nature Undertanding the Four Orders Things (Vastu) Activity (Kriya) Innateness (Dharana) Natural Characteristic (Sabha) Basic Activity Conformance Human Beings-our State today What is way out
5	Implications of the Right Understanding	Values in Different Dimensions of Human Living Universal Values naturally emerging from the Right Understanding Definitiveness of Ethical Human Conduct Identification of Snama leading to Svatantrata and Swarajya Development of Human Consciousness Implications of Value-based Living Identification of Comprehensive Human Goal Vision for the Holistic Alternative Basis for Humanistic Education and Humanistic Constitution Universal Human Order and its Implications
6	Professional Ethics Journey towards the Holistic Alternative	Profession-In the Light of Comprehensive Human Goal Ensuring Competence in Professional Ethics- The current Scenario Inherent Contradictions and Dilemmas and their Resolution Appreciating the Need for Self-Exploration Facilitating the Understanding of Harmony at various Levels Steps for Evolution at the Individual Level Steps for Transition at the Level of Family Society and Profession Promoting Mass Awareness and moving towards Humanistic Education Evolving Holistic Models of Living

		Amending Policies, Programs and Social Systems in tune with Comprehensive Human Goal Is the Transition too Difficult? Concluding Remarks
Total Hours = 30		

Reference Books:

1. A Foundation course in Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria Excel books.

Course Name: Responsibility towards sustainable environment

Course Code: VEC04

NEP Vertical _Basket: HSSM_VEC

Preamble:

This course introduces learners with an aim to focus on holistic personality development, a wide platter of General Education courses is offered to First Year Engineering students. These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Demonstrate effective oral communication
CO2: Demonstrate the ability to think critically and creatively
CO3: Apply quantitative reasoning concepts and skills to solve problems
CO4: Illustrate the ability to self-reflect and access relevant ethical values

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	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
1	Responsibility towards sustainable environment	Sustainability, Pillars of sustainability, social equity, economic development, environmental protection, cultural/human sustainability. Sustainable development, United nation's sustainable development goals. Sustainable Environment, long term health of ecosystem, renewable resources, Global warming, protection of species diversity and ecological structure, Low carbon economy. Being responsible towards sustainable environment, dos and don'ts, Smart City – city functions, economic growth, quality of life, technology used.
Total Hours = 30		

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Four Pillars of Democratic Nation

Course Code: VEC05

NEP Vertical _Basket: HSSM_VEC

Preamble:

This course introduces learners with an aim to focus on holistic personality development, a wide platter of General Education courses is offered to First Year Engineering students. These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Demonstrate effective oral communication
CO2: Demonstrate the ability to think critically and creatively
CO3: Apply quantitative reasoning concepts and skills to solve problems
CO4: Illustrate the ability to self-reflect and access relevant ethical values

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	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
1	Four Pillars of Democratic Nation	The term 'Democracy', History of democracy, Indian Democracy, Responsibility of good citizen. Legislature – Six major functions of legislature Executive - President, Vice-President, Prime Minister, Cabinet Minister, Secretaries, and Civil services Judiciary – Indian Juridical system, Indian Constitution, Court structure Media - The basic right of freedom of speech and expression, Print Media and digital media
Total Hours = 30		

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Title: Algorithms and Data Structures in Bioinformatics

Course Code: MDMBI02

Vertical_Sub-Vertical: MDC_MDM

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 various data structures and algorithms 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: Introduction to Bioinformatics (MDMBI01)

Course Objectives:

- To introduce the foundational concepts of innovation and entrepreneurship.
- To build awareness of opportunity recognition, creativity, and idea validation.
- To expose students to business modelling and startup ecosystems.

Course Outcomes:

Students will be able to:

.CO1: Apply fundamental data structures and algorithms (arrays, trees, graphs, hashing, etc.) to solve computational problems in bioinformatics.

CO2: Analyze and implement sequence alignment algorithms for comparing DNA, RNA, and protein sequences, including global, local, and heuristic approaches.

CO3: Construct and interpret phylogenetic trees using distance-based and character-based algorithms for evolutionary analysis.

CO4: Use algorithmic and statistical models, such as HMMs and motif-finding tools, to predict genes and regulatory elements in genomic sequences.

CO5: Design and evaluate scalable bioinformatics workflows and pipelines using big data technologies and cloud platforms for handling large-scale genomic datasets.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBI02	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

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	Review of Data Structures and Algorithms	Arrays, strings, stacks, queues, Graphs and trees: DFS/BFS with examples from biological data, Suffix trees, suffix arrays, tries, Hashing techniques for genome indexing	8
2	Sequence Alignment Algorithms	Needleman-Wunsch algorithm (global alignment) Smith-Waterman algorithm (local alignment) Space optimization (Hirschberg's algorithm) Heuristic alignment methods (BLAST internals) Complexity analysis of sequence alignment algorithms Self-Learning Topics: Recent advances in sequence alignment techniques	10
3	Phylogenetic Tree Construction	Multiple Sequence Alignment (MSA) pre-processing Distance-based methods: UPGMA, Neighbor-Joining Character-based methods: Maximum Parsimony, Maximum Likelihood,Tree visualization tools: MEGA, iTOL Self-Learning Topics: Bayesian approaches in phylogenetics	10
4	Gene Prediction and Motif Finding	Regulatory elements in genomes Basics of Hidden Markov Models (HMMs) Motif discovery tools (MEME, FIMO) Promoter and enhancer identification Use of regular expressions in motif searches Self-Learning Topics: Deep learning methods for gene prediction	10
5	Big Data in Bioinformatics	Challenges of large-scale genomic and multi-omics data, Hadoop and Spark frameworks for bioinformatics, Bioinformatics pipelines: Snakemake, Nextflow,Cloud platforms for genomics: AWS, Google Genomics, Case studies: 1000 Genomes Project, Cancer Genome Atlas Self-Learning Topics: Emerging big data technologies in bioinformatics	7
		Total	**45**

Reference books:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

Course Title: Startup Planning and Development

Course Code: MDMIE02

Vertical_Sub-Vertical: MDM

Preamble:

This course provides a foundational understanding of how innovation emerges, how entrepreneurs identify and act on opportunities, and how new ventures can be developed to address real-world challenges. It explores the intersection of creativity, strategic thinking, and risk-taking, emphasizing both individual initiative and collaborative problem-solving.

Pre-requisites: NIL

Course Objectives:

- To develop skills for building, validating, and planning a new venture.
- To understand basic startup finance, legalities, and market strategy.
- To enable students to create business plans and investor pitches.

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Course Outcomes:
Students will be able to:
CO1: Design MVPs and apply lean startup methods
CO2: Conduct market and competitor analysis.
CO3: Prepare financial models and pitch decks.
CO4: Understand legal frameworks and intellectual property

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMIE02	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

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	Lean Startup Methodology	• MVP (Minimum Viable Product) • Pivoting and iteration • Build-Measure-Learn loop	8
2	Market Research and Strategy	• TAM-SAM-SOM analysis • Competitive analysis • Go-to-market strategy	8
3	Startup Finance	• Basics of financial modelling • Unit economics, pricing, and revenue models • Funding sources: bootstrapping, angels, VCs, crowdfunding	10
4	Legal & Regulatory Aspects	• Company formation: types and registration • IPR basics: patents, trademarks, copyrights • Compliance and taxation	6
5	Business Plan Development	• Writing an effective business plan • Pitch deck essentials	7
		Total	**45**

Tutorials (1 Credit):

- Building a mock startup pitch deck
- Simulated investor pitch
- Budgeting and forecasting exercises

Reference books:

1. Peter Thiel ,Zero to One: Notes on startups, or how to build the future, Crown Business 2014
2. E,ric Ries The Lean Startup, Crown Business 2011
3. Brad Feld ,Venture Deals, Wiley Publications

Course Title: Financial Basics for Engineers and Technopreneurs

Course Code: MDMBD02

Vertical_Sub-Vertical: MDC_MDM

Preamble:

The objective of this course is to equip students with basic financial skills needed to evaluate and manage technical projects or business ventures. It covers the principles of cost analysis, budgeting, financial statements, and introduction to funding models.
Pre-requisites: Introduction to Business Development and Marketing Principles

Course Objectives:

- Learn basic financial terminology and concepts.
- Understand components of a budget and perform break-even analysis.
- Analyse financial viability of a project or startup.
- Gain exposure to funding options.

Course Outcomes:
Student will be able to:

CO1: Interpret and analyse basic financial statements (P&L, balance sheet).
CO2: Prepare a project cost sheet and conduct break-even analysis.
CO3: Explain sources of capital and funding stages for startups.
CO4: Apply budgeting techniques to engineering project proposals

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Tutorial
MDMBD02	3	1	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Tutorial	45	30	50	125

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 Finance	Financial definitions, roles in business, overview of income, expenses, assets, liabilities, cash flows.	8
2	Costing and Budgeting	Types of costs (fixed/variable), project budgeting, break-even analysis, basic forecasting.	8
3	Financial Statements	Structure and interpretation of P&L, balance sheet, cash flow statements.	10
4	Time Value of Money	Simple vs compound interest, Net Present Value (NPV), Internal Rate of Return (IRR) concepts.	6
5	Funding Sources	Equity, debt, bootstrapping, angel investment, venture capital, crowdfunding.	7
6	Financial Decision Making	Financial ratios (ROI, ROE), pricing basics, cost-benefit analysis, breakeven models.	6
		Total	**45**

Textbooks:

1. Finance for Non-Finance Managers, by: V.G. Narayanan, Publisher: Cengage India, ISBN: 9789353501786
2. Finance for Non-Financial Managers by Gene Siciliano, McGraw Hill, Second Edition, (pdf available online)

Reference Books:

1. Introduction to Finance - Yale Online Course
2. Investopedia - Financial Statements Guide

Course Name: Machine Vision and Robotic Perception

Course Code: MDMRB02

Vertical_Sub-Vertical: MDC_MDM

Preamble:

This course introduces the fundamentals of computer vision and perceptual systems in robotics. It focuses on enabling robots to sense, interpret, and act upon their environment using visual inputs. Students will explore feature detection, image processing, 3D vision, and sensor fusion techniques. Hands-on activities and simulations bridge theory with real-world robotic perception applications.

Course Objectives:

- To introduce fundamental concepts in machine vision and perception relevant to autonomous robots.
- To equip students with techniques for image processing, object detection, and feature extraction.
- To develop the ability to integrate vision systems into robotic control and decision-making.

Pre-requisites:

Fundamentals of Robotics and Control (MDMRB01)

Course Outcome:

The students will be able to:

CO1: Explain the principles of image formation and the role of cameras in robotic vision systems.
CO2: Apply basic image processing techniques for feature extraction and noise reduction.
CO3: Detect and match key visual features for use in localization and object recognition.
CO4: Analyse depth and motion using stereo vision and 3D reconstruction techniques.
CO5: Implement object detection and scene understanding in robotic applications.
CO6: Integrate visual data with other sensor modalities for robust robotic perception.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
MDMRB02	3	2	3	1

Assessment guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory + Practical	45	30	50	125

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.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Introduction to Machine Vision	Role of vision in robotics, camera models, perspective projection, image formation, lens distortions	06
02	Image Processing Basics	Grayscale and color models, filtering, edge detection, noise reduction, histogram equalization	08
03	Feature Extraction and Matching	Interest point detection (Harris, FAST), descriptors (SIFT, SURF, ORB), template matching, homographies	07
04	3D Vision and Depth Estimation	Stereo vision, structure from motion, depth cameras, triangulation, visual odometry	08
05	Object Detection and Scene Understanding	Image segmentation, object classification (traditional and CNN-based), scene interpretation, semantic mapping	08
06	Sensor Fusion and Perception Systems	Integration of vision with other sensors (IMU, LIDAR), Kalman and particle filters, SLAM fundamentals, case studies	08
Total			**45**

Suggested List of Value-Added Home Assignments:

1. Design a vision-based system that can detect traffic violations like red-light running or illegal turns using video footage.
2. Use a stereo camera or simulated stereo images to generate a 3D point cloud and reconstruct a small indoor environment.
3. Create a system that inspects manufactured parts (e.g., PCB boards, bottles, machined components) and flags defects or anomalies using image processing.
4. Develop a mobile robot that can autonomously locate and scan barcodes or QR codes placed in a room to log inventory data.
5. Implement a system that uses AprilTags or ArUco markers to help a robot localize itself within an indoor environment.
6. Build a system that allows a robot to respond to hand gestures (like stop, go, turn) using a webcam and gesture recognition model.

Recommended Online Courses:

1. Computer Vision Specialization (by University of Buffalo) https://www.coursera.org/specializations/computer-vision
2. Computer Vision, https://www.udacity.com/course/computer-vision-nanodegree--nd891

3. OpenCVBootcamp,https://opencv.org/university/free-opencv-course/?utm_source=google&utm_medium=cpc&utm_campaign=WW_tut_OBC&utm_term=best%20opencv%20tutorial&gad_source=1&gad_campaignid=21004628838&gbraid=0AAAACbv-xhUM70mKirK31LiktTRipo8G&gclid=Cj0KCQjw9O_BBhCUARIsAHQMjS7VA3JEdz8KONvGanFNC7KAqSt2HModiDtp5hB_PJKX_oKTK80pNxQaAlcVEALw_wcB

Reference Books / Articles

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 1st Edition, 2011.
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer, Second Edition, 2017.
3. Adrian Kaehler and Gary Bradski, Learning OpenCV 4: Computer Vision with Python and OpenCV Library, O'Reilly Media, 1st Edition, 2019.
4. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, Fourth Edition, 2018.
5. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, Second Edition, 2004.
6. Sudeep Sarkar, Computer Vision: A First Course, Cambridge University Press, First Edition, 2022

Appendix-A

Guidelines for Programme Elective Courses and Specialization Certificate

Programme Elective courses are designed to meet industrial requirements. All learners must opt for 6 Programme Elective courses (both Theory and Practical component) as a part of requirement for B.Tech. degree.

Specialization Certificate is introduced in order to build competency of learners in the chosen domain. Department of Computer Engineering offers the following specialization tracks:

1. Artificial Intelligence and Machine Learning (AIML)
2. Data Science (DS)
3. Internet of Things (IoT)
4. Computer Security (CSec)

Learners can take courses from any track. **However, if learners complete all Programme Elective Courses from the same chosen track, they will be eligible to receive a Specialization Certificate from the Institute.**

Learners who choose Programme Elective courses from different specialisation tracks will not be eligible for a Specialization Certificate.

It should be noted that there are no additional credit requirements for these specialisations.

AIML track: Courses to be chosen for specialization in Artificial Intelligence and Machine Learning

Semester	Course Code	Course Name
V	PECE02T	Data Warehousing and Data Mining
V	PECE02P	Data Warehousing and Data Mining Lab
VI	PECE01T	Soft Computing
VI	PECE01P	Soft Computing Lab
VI	PECE10	Probabilistic and Graphical Model
VII	PECE05T	Natural language processing
VII	PECE05P	Natural language processing Lab
VII	PECE09T	Advance Machine Learning
VII	PECE09P	Advance Machine Learning Lab
VII	PECE13T	Deep learning
VII	PECE13P	Deep learning Lab

DS track: Courses to be chosen for specialization in Data Science

Semester	Course Code	Course Name
V	PECE02T	Data Warehousing and Data Mining
V	PECE02P	Data Warehousing and Data Mining Lab
VI	PECE06T	Advanced Databases
VI	PECE06P	Advanced Databases Lab
VI	PECE10	Probabilistic and Graphical Model
VII	PECE07T	Text, Web & Social Media Analytics
VII	PECE07P	Text, Web & Social Media Analytics Lab
VII	PECE14T	Big Data Analytics

Semester	Course Code	Course Name
VII	PECE14P	Big Data Analytics Lab
VII	PECE18T	Recommendation System
VII	PECE18P	Recommendation System Lab

IoT track: Courses to be chosen for specialization in Internet of Things

Semester	Course Code	Course Name
V	PECE03T	Modern Sensors for Internet of Things
V	PECE03P	Modern Sensors for Internet of Things Lab
VI	PECE11T	Embedded Systems Design and Tiny OS
VI	PECE11P	Embedded Systems Design and Tiny OS Lab
VI	PECE22T	Principles of Internet of Things
VI	PECE22P	Principles of Internet of Things Lab
VII	PECE17T	IoT & Edge Computing
VII	PECE17P	IoT & Edge Computing Lab
VII	PECE19T	IoT Security & Trust
VII	PECE19P	IoT Security & Trust Lab
VII	PECE20T	Industrial IoT
VII	PECE20P	Industrial IoT Lab

CSec track: Courses to be chosen for specialization in Computer Security

Semester	Course Code	Course Name
V	PECE04T	Computer and Network Security
V	PECE04P	Computer and Network Security Lab
VI	PECE08T	System Security and Ethical Hacking
VI	PECE08P	System Security and Ethical Hacking Lab
VI	PECE21T	Digital Forensics
VI	PECE21P	Digital Forensics Lab
VII	PECE12T	Web Application Security
VII	PECE12P	Web Application Security Lab
VII	PECE15T	Malware Analysis
VII	PECE15P	Malware Analysis Lab
VII	PECE16T	Mobile and Wireless Security
VII	PECE16P	Mobile and Wireless Security Lab

Appendix-B

Guidelines for Multidisciplinary Elective Courses and Minor Degree

In alignment with the NEP objectives and the evolving demands of the engineering profession, the introduction of a Multidisciplinary Minor Degree within the Undergraduate Engineering Programme aims to foster academic breadth, innovation, and cross-domain competency. These guidelines are formulated to support the structured integration of multidisciplinary elective courses, enabling students to pursue focused study in areas beyond their core engineering discipline.

Department of Computer Engineering offers the following Multidisciplinary Minor Degree Titles for B.Tech. Computer Engineering students:

1. Bioinformatics (BI)
2. Innovation, Entrepreneurial and Venture Development (IE)
3. Business Development, Marketing and Finance (BD)
4. Robotics (RB)

It should be noted that it is mandatory to choose one Multidisciplinary Minor (MD M) Degree Programme as a part of B.Tech. Computer Engineering degree.

Bioinformatics (BI): Courses to be completed successfully for MD M in Bioinformatic.

Semester	Course Code	Course Name
V	MDMBI01	Introduction to Bioinformatics
VI	MDMBI02	Algorithms and Data Structures in Bioinformatics
VII	MDMBI03	Machine Learning Applications in Bioinformatics

Innovation, Entrepreneurial and Venture Development (IE): Courses to be completed successfully for MD M in Innovation, Entrepreneurial and Venture Development.

Semester	Course Code	Course Name
V	MDMIE01	Foundations of Innovation and Entrepreneurship
VI	MDMIE02	Startup Planning and Development
VII	MDMIE03	Innovation Management and Scaling Startups

Business Development, Marketing and Finance (BD): Courses to be completed successfully for MD M in Business Development, Marketing and Finance.

Semester	Course Code	Course Name
V	MDMBD01	Introduction to Business Development and Marketing Principles
VI	MDMBD02	Financial Basics for Engineers and Technopreneurs
VII	MDMBD03	Strategic Marketing and Business Planning

Robotics (RB): Courses to be completed successfully for MD M in Robotics (RB).

Semester	Course Code	Course Name
V	MDMRB01	Fundamentals of Robotics and Control
VI	MDMRB02	Machine Vision and Robotic Perception
VII	MDMRB03	Intelligent Mobile Robotics