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

Information Technology

With Multidisciplinary Minor

Third Year Scheme & Syllabus

(As per NEP 2020, with effect from the Academic Year 2025-2026)

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 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 Program Courses consisting of 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 Professional 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 professional 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 (OE) courses and multidisciplinary minor (MD M) courses. 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 vertical like internships/On Job Training, Community Engagement Project, Real Industry Project/ research problem. Our curriculum also introduces Social Service Internship and Internship with institutes abroad 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 to core courses, professional and open electives; our framework offers honor degree in each 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 Information Technology
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Third Year B. Tech. Information Technology **Preferred Semester: V**

Course Structure and Assessment Guidelines

NEP-Vertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
PC_PCC	PCIT10T	Data warehousing & Mining	Theory	2	15	20	40	075
	PCIT10P	Data warehousing & Mining Lab	Practical	1	25	-	25	050
	PCIT15T	Machine Learning	Theory	2	15	20	40	075
	PCIT15P	Machine Learning Lab	Practical	1	25	-	25	050
	PCIT12T	Software Engineering with WDL	Theory	2	15	20	40	075
	PCIT12P	Software Engineering with WDL Lab	Practical	1	25	-	25	050
	PCIT03T	Computer Graphics	Theory	2	15	20	40	075
	PCIT03P	Computer Graphics Lab	Practical	1	25	-	25	050
PC_PEC	PEITXXT	Professional Elective-1	Theory	2	15	20	40	075
	PEITXXT	Professional Elective-1 Lab	Practical	1	25	-	25	050
MDM	MDMXX	As per MDM course list	Theory+ Tutorial	4	45	30	50	125
HSSM_VEC	VEC02	E-waste and Environmental Management	Theory	2	15	20	40	075
Total Credits				**21**				
Course credits completed during the previous inter-semester break will appear in this semester's marksheet								
MDC_OEC	OEC01	Collaborative Inter-Institute Studies	As per course	4	125	-	-	125

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

*Selection based on the subset of courses made available by the Institute for the semester.

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 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 Professional Elective Courses and Specialization Certificate – Refer Appendix-A

Important Note 1: Learners are required to go through the Appendix-A carefully before selecting the Professional Elective courses. Detailed guidelines regarding Professional Elective courses, specialization tracks and courses relevant to each track are given in Appendix-A.

Professional Elective-1 Courses (ITXX)

Course Code	Course Name	Specialization Track Name#
PEIT21T	Artificial Intelligence	Artificial Intelligence & Machine Learning (AIML)
PEIT21P	Artificial Intelligence Lab	
PEIT22T	Advanced Database Management System	Data Science
PEIT22P	Advanced Database Management System Lab	
PEIT23T	Modern Sensors for IoT	IoT
PEIT23P	Modern Sensors for IoT Lab	
PEIT24T	Computer and Network Security	Cyber Security (CSec)
PEIT24P	Computer and Network Security Lab	

#For details of Specialization Certificate, refer Appendix-A

Third Year B. Tech. Information Technology **Preferred Semester: VI**

Course Structure and Assessment Guidelines

NEP-Vertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
PC_PCC	PCIT13T	Cloud Computing	Theory	2	15	20	40	075
	PCIT13P	Cloud Computing Lab	Practical	1	25	-	25	050
	PCIT14T	Software Testing & Quality Assurance	Theory	2	15	20	40	075
	PCIT14P	Software Testing & Quality Assurance Lab	Practical	1	25	-	25	050
	PCIT16P	DevOps Lab	Practical	2	50	-	25	075
PC_PEC	PEITXXT	Professional Elective-2	Theory	2	15	20	40	075
	PEITXXT	Professional Elective-2 Lab	Practical	1	25	-	25	050
	PEITXXT	Professional Elective-3	Theory	2	15	20	40	075
	PEITXXT	Professional Elective-3 Lab	Practical	1	25	-	25	050
	PRJIT05	Specialization-Based Project	Practical	2	25	-	50	075
Project	PRJIT02	Project-1 (Synopsis)	Theory	1	25		25	050
MDM	MDMXX	As per MDM course list	Theory+ Tutorial	4	45	30	50	125
Total Credits				**21**				

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination
*Selection based on the subset of courses made available by the Institute for the semester.

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.

Multidisciplinary Elective Course2 (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	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

Professional Elective-2 Courses (ITXX)

Course Code	Course Name	Specialization Track Name#
PEIT25T	Soft Computing	Artificial Intelligence & Machine Learning (AIML)
PEIT25P	Soft Computing Lab	
PEIT26T	Data & Feature Engineering	Data Science
PEIT26P	Data & Feature Engineering Lab	
PEIT27T	Principles of IOT	IoT
PEIT27P	Principles of IOT Lab	
PEIT28T	System Security and Ethical Hacking	Cyber Security (CSec)
PEIT28P	System Security and Ethical Hacking Lab	

#For details of Specialization Certificate, refer Appendix-A

Professional Elective-3 Courses (ITXX)

Course Code	Course Name	Specialization Track Name#
PEIT29T	Probabilistic Graphical Model	Artificial Intelligence & Machine Learning (AIML)
PEIT29P	Probabilistic Graphical Model Lab	
PEIT29T	Probabilistic Graphical Model	Data Science
PEIT29P	Probabilistic Graphical Model Lab	
PEIT31T	Embedded System Design with tiny OS	IoT
PEIT31P	Embedded System Design with tiny OS Lab	
PEIT32T	Digital Forensics	Cyber Security (CSec)
PEIT32P	Digital Forensics Lab	

#For details of Specialization Certificate, refer Appendix-A

Third Year B. Tech. Information Technology - 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**				

Course Name: Data Warehousing and Mining

Course Code: PCIT10T & PCIT10P

Vertical/ Sub-Vertical: PCC

K-S-A Mapping: Knowledge and Skills

Pre-requisite required: PCIT07T (Database Management Systems)

Pre-requisite for: Data Analytics and Visualization

Recommended Semester: 5

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT10T	2	-	2	-
IT10P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT10T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT10P)	25 (50%)	-	25 (50%)	50 (100%)

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

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.

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:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall and explain the fundamental concepts and architecture of data warehousing, data lakes, and data mining.	Remembering
CO2	Design dimensional data warehouse schemas (star, snowflake) and describe the ETL (Extract, Transform, Load) process involved in building and maintaining a data warehouse.	Understanding
CO3	Perform data preprocessing and visualization tasks to prepare datasets for mining, including data cleaning, transformation, and exploratory analysis.	Applying
CO4	Analyze and compare various data mining algorithms (classification, clustering, association) for solving real-world problems, selecting the most appropriate approach.	Analysing
CO5	Evaluate the effectiveness of implemented data mining solutions, interpret results, and propose improvements or optimizations for enhanced decision-making.	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to data warehouse and ETL Process	**Contents:** 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. ***Self-Learning Topics***: *OLAP operations; aggregate fact tables; comparison of DW tools.*	8
2	Introduction to Data Lakes	**Contents:** Definition, key attributes of data lake, challenges, functionalities, architecture, Curating data lakes, Data Lake vs. data warehouse ***Self-Learning Topics***: *Real-world case studies of data lakes; tools for curating data lakes.*	3
3	Data Exploration and Data Preprocessing	**Contents:** 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. Introduction to Text Mining ***Self-Learning Topics:*** *Advanced data visualization tools; handling missing or noisy data.*	5
4	Classification		5

		Content: Introduction to data mining techniques, Classification: Decision Tree Induction, Naïve Bayesian Classification. Regression: Simple and multiple ***Self-Learning Topics:*** *Decision tree pruning; advanced regression techniques.*	
5	Clustering	**Content:** Clustering: Partition based: K-means, Hierarchical Methods (Agglomerative, Divisive). ***Self-Learning Topics:*** *Evaluation metrics for clustering; use cases in customer segmentation.*	4
6	Mining frequent patterns and associations	**Contents:** Basic Concepts: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent Itemset. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from requent Itemset, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats. ***Self-Learning Topics:*** *Improving Apriori efficiency; real-world applications of association mining.*	5
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Design a data warehouse schema using dimensional modeling (star, snowflake, fact tables).
2.	Create a full data warehouse schema and detail ETL steps (extraction, transformation, loading).
3.	Execute OLAP operations (roll-up, drill-down, slice, dice) to explore multidimensional data.
4.	Use tools like Python (Matplotlib, Seaborn), Tableau, or Power BI to visualize datasets with boxplots, bar charts, and scatterplots.
5.	Use Python to apply regression models for predicting numeric outcomes on datasets.
6.	Build and evaluate a decision tree classifier using the ID3 algorithm on sample data.
7.	Apply K-means clustering to segment data and analyze cluster patterns.

Course Name: Machine Learning

Course Code: PCIT11T & PCIT11P

Vertical/ Sub-Vertical: PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: VSEC03 (Skill Based Lab-Python)

Pre-requisite for: Next Gen AI & ML

Recommended Semester: 5

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
PCIT11T	2	-	2	-
PCIT11P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (PCIT11T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (PCIT11P)	25 (50%)	-	25 (50%)	50 (100%)

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

Preamble:

Machine Learning is a rapidly evolving field that enables systems to learn from data and improve their performance without being explicitly programmed. This course provides a comprehensive introduction to the foundational concepts of machine learning, covering supervised, unsupervised, and reinforcement learning techniques. Students will explore key algorithms such as regression, classification, clustering, and neural networks, along with essential concepts like feature selection, dimensionality reduction, model evaluation, and optimization. Through theoretical understanding and practical applications, the course aims to equip learners with the skills necessary to design, implement, and assess machine learning models for real-world problem-solving across various domains.

Course Objectives:

- To introduce the fundamental concepts and types of machine learning such as supervised, unsupervised, and reinforcement learning, including essential data preprocessing and dimensionality reduction techniques.
- To develop the ability to apply core machine learning algorithms including regression, classification (e.g., SVM, Random Forest), clustering, and neural networks to solve real-world problems.
- To build analytical skills for evaluating and optimizing machine learning models using performance metrics, ensemble techniques, and optimization strategies.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	**Recall key concepts and terminology related to machine learning and its various techniques.** *(Remembering)*	Remembering
CO2	Explain the principles behind supervised, unsupervised, and reinforcement learning methods**.** *(Understanding)*	Understanding
CO3	Apply appropriate machine learning algorithms to basic data-driven problems. *(Applying)*	Applying
CO4	Analyze the performance and behavior of machine learning models using standard evaluation metrics. *(Analyzing)*	Analysing
CO5	Design and optimize machine learning solutions for real-world scenarios using advanced techniques and tools. *(Evaluating)*	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Machine Learning	**Contents:** 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. **Self-Learning Topics:** Use of PCA in image data; real-world ML applications; feature engineering techniques.	6
2	Supervised Learning-I	**Contents:** 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 **Self-Learning Topics:** Implement SVM with scikit-learn; visualize SVM decision boundaries; explore random forest feature importance.	6
3	Supervised Learning-II	**Content:** Evaluation of classifiers: Accuracy, Precision, Recall, F1 score, TPR, TNR, Confusion matrix, ROC, Overfitting, Underfitting, Variance, Bias, Bias-Variance Trade-off, Concepts of regularization (L1 and L2) and generalization, Hyperparameter Tuning, Ensemble Learning: Basic concept, Stacking, Bagging, Boosting, Random Forest, AdaBoost, GBM, XG Boost	6

		Self-Learning Topics: Build ensemble models using Python; interpret ROC and AUC plots; study overfitting mitigation methods.	
4	Unsupervised Learning	**Content:** 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 **Self-Learning Topics:** Use DBSCAN for customer segmentation; visualize clusters with silhouette scores; compare clustering methods.	6
5	Introduction to Neural Networks	**Content:** Biological neuron, models of a neuron, Introduction to Neural networks, network architectures (feedforward, feedback etc.), Perceptron, training a Perceptron, Multilayer Perceptron, Limitations of MLP. **Self-Learning Topics:** Understand biological neuron structure, learn mathematical neuron models, grasp neural network basics, compare network architectures, study Perceptron and its training, explore Multilayer Perceptron, understand backpropagation, identify limitations of Perceptron and MLP.	4
6	Introduction to optimization	**Contents:** Introduction to optimization in ML, Role of Loss Functions and Optimization. Case Study. **Self-Learning Topics:** Study Adam, RMSProp optimizers; analyze deep learning loss functions; review optimization case studies.	2
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Load a dataset, handle missing values, encode categorical data, normalize features, and visualize data distributions.
2.	Implement logistic regression to classify binary outcomes and plot the decision boundary.
3.	Apply Random Forest for classification and analyze performance across different values of trees.
4.	Apply LDA for supervised dimensionality reduction and visualize the transformed space.
5.	Implement and compare AdaBoost and Gradient Boosting classifiers on a standard dataset.
6.	Generate ROC curves, compute AUC values, and compare classifiers visually.
7.	Assess whether a dataset has a clustering tendency and evaluate clustering quality.
8.	Train a simple MLP using scikit-learn and analyze accuracy and convergence.

Course Name: Software engineering with WDL

Course Code: PCIT12T & PCIT12P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: NA

Pre-requisite for: STQA

Recommended Semester: 5

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT12T	2	-	2	-
IT12P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT12T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT12P)	25 (50%)	-	25 (50%)	50 (100%)

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

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.

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:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	***Remember*** *fundamental concepts of web technologies , and foundational software development life cycle (SDLC) models such as Waterfall, Incremental, and Spiral.*	Remembering
CO2	***Understand*** *the software requirement engineering process, including requirement types, elicitation techniques, and agile methodologies like Scrum and Extreme Programming.*	Understanding
CO3	***Apply*** *HTML5, CSS3, and JavaScript to develop user-centric web interfaces following established interaction design heuristics and frontend development best practices.*	Applying
CO4	**Analyse** software process models, estimation techniques such as COCOMO, and project metrics to determine suitable approaches for diverse software project scenarios.	Analysing
CO5	**Evaluate** software quality assurance strategies including testing techniques, risk mitigation plans (RMMM), and configuration management processes.	Evaluating
CO6	**Create** a responsive web application using HTML, CSS, and JavaScript, integrating principles of project scheduling, task decomposition (WBS), and version control systems.	Creating

Detailed Syllabus: zz

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	6
2	The Software Process	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	6
3	Requirements Engineering and Analysis	Requirements Engineering and Analysis Requirement, Types of Requirements, Requirement Gathering , Requirement Engineering Task, SRS (Software Requirement Specification)	4
4	Software Estimation and Scheduling	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	Design Engineering Software Design Concepts, Interaction Design , Design Golden Rules and Heuristics.	3
6	Software Testing and Risk Management	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**

Suggested List of Practicals:

Sr No.	Title of Practical

1	Project Selection and Conceptualization
2	Create Simple web page using HTML5
3	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.
4	Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contain alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters in length). 3. E-mail id (should not contain any invalid characters 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).
5	Prepare SRS for the Project topic (Private study/Home work)
6	Prepare DFD-Data flow diagram for the Project topic (Private study/Home work)
7	Prepare Use case diagram for the Project topic (Private study/Home work) Prepare Sequence Activity diagram for the Project topic (Private study/Home work)
8	Prepare Component and Deployment diagram for the Project topic (Private study/Home work)
9	Prepare WBS and Gantt Chart for the Project topic
10	Prepare Test Case plan for Project topic
11	Prepare RMMM Document for Project topic
12	Mini Project

Course Name: Computer Graphics

Course Code: PCIT03T & PCIT03P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: VSEC01T (Structured Programming)

Pre-requisite for: IT68T **(**UX Design, Evaluation and ARVR)

Recommended Semester: 5

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
PCIT03T	2	--	2	--
PCIT03P	--	2	--	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (PCIT03T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (PCIT03P)	25 (50%)	-	25 (50%)	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 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.

Preamble:
The goal of the course is to introduce students to the technical concepts behind creating synthetic computer-generated images, focusing on underlying mathematical concepts covering geometrical and attribute related features. This course attempts to uncover various 2D and 3D rendering techniques.

Course Objectives:

• To enable learners to understand the basics of computer graphics, including the principles of image representation, display technology, and color models.
• To enable learner to understand 2D and 3D geometric transformations, including translation, scaling, rotation, orthographic and perspective projection.

• To enable learners to design and implement graphical user interfaces (GUIs) for software applications.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Explain the core concepts of 2D and 3D computer graphics, including coordinate systems and geometric transformations.	Remembering
CO2	Apply scan conversion and polygon filling techniques to generate and manipulate basic graphical primitives.	Applying
CO3	Analyze visible surface detection algorithms and implement illumination and shading models for realistic rendering.	Analysing
CO4	Utilize and analyze viewing, clipping, and projection techniques to display 2D and 3D scenes accurately.	Analysing
CO5	Design and evaluate graphics systems and algorithms involving curves, surfaces, and display architectures.	Evaluating

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction and Overview of Graphics System.	Definition and Representative uses of Computer Graphics, Classification of application areas, Overview of Coordinate Systems, Definition of Scan Conversion, Rasterization and Rendering. Raster Scan & Random Scan Displays, Architecture of Raster Graphics System with display processor, Architecture of Random Scan Systems. ***Self-Learning Topics***: *Display devices, Resolution and its effect on display*	2
2	Raster Algorithms.	Scan Conversions of Point, Line, and Circle: DDA Algorithm and Bresenham Algorithm for Line Drawing, Midpoint Algorithm for Circle. Aliasing, Antialiasing Techniques like Pre and Post Filtering, Super Sampling, and Pixel Phasing. Filled Area Primitives: Scanline Polygon Fill Algorithm, Inside Outside Tests, Boundary Fill and Flood fill Algorithm ***Self-Learning Topics***: Bradenham's circle drawing algorithm, Midpoint ellipse drawing algorithm	8
3	Two Dimensional Geometric Transformations, Viewing and Clipping.	**Contents:** Basic transformations: Translation, Scaling, Rotation. Matrix Representation and Homogeneous Coordinates, Composite Transformation. Viewing Transformation Pipeline and Window to Viewport Coordinate Transformation. Clipping Operations: Point Clipping, Line Clipping Algorithms: Cohen–Sutherland, Midpoint Subdivision, Liang–Barsky, Polygon Clipping Algorithms: Sutherland–Hodgeman and Weiler – Atherton Algorithm	8

		Self-Learning Topics: Cyrus Beck polygon clipping algorithm	
4	Three-Dimensional Object Representations, Geometric Transformations and 3D Viewing.	**Contents:** Boundary Representation and Space Partitioning Representation: Polygon Surfaces, Bezier Curve B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve. 3D-Transformations: Translation, Rotation, Scaling and Reflection. Composite Transformations: Rotation about an Arbitrary Axis. 3D-Transformation Pipeline Projections– Parallel and Perspective Projection and their types. ***Self-Learning Topics***: Hilbert curve,	6
5	Visible Surface Detection.	**Contents:** Classification of Visible Surface Detection Algorithm, Back Surface Detection Method: Depth Buffer Method, Scan Line Method, Area Subdivision Method.	4
6	Illumination Models and Surface Rendering	**Contents:** Basic Illumination Models: Diffused reflection, Phong Specular Reflection Model, Halftone and Dithering Techniques, Polygon Rendering: Constant shading, Gouraud Shading, Phong Shading. ***Self-Learning Topics***: NIL	2
Total			**30**

Sr. No.	List of experiments
1	Implement DDA Line Drawing algorithms and Bresenham algorithm.
2	Implement midpoint Circle algorithm.
3	Implement Area Filling Algorithm: Boundary Fill, Flood Fill, Scan line Polygon Fill
4	Implement Curve: Bezier for n control points, B Spline (Uniform)
5	Implement Fractal (Koch Curve).
6	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.
7	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.
8	Implement polygon clipping algorithm.
9	Program to perform surface rendering using Open GL functions.

Course Name: Artificial Intelligence

Course Code: PEIT21T

Category: PEC (AIML)

Preamble:

Intelligent machines have replaced human capabilities in many areas. Artificial intelligence is the intelligence exhibited by machines or software. It emphasizes creating intelligent machines that work and react like humans.

Pre-requisites: NIL

Course Objectives:

1. Understand Artificial Intelligence
2. Know and use various problem-solving methods
3. Acquire and use knowledge representation methods in AI
4. Understand and design Artificial intelligence Agents
5. Know and identify AI applications
6. Design and apply Artificial Intelligence in community

Course Outcomes:

Learner will be able to:

CO1: To understand the basics of Artificial Intelligence

CO2: To know and use various problem-solving methods

CO3: To acquire and use knowledge representation methods in AI

CO4: To understand and design Artificial intelligence Agent

CO5: To know and identify AI applications

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, Intelligent systems • Categorization of Intelligent Systems • Characteristics of AI • Current Trends in AI	4
2	Intelligent Agents	• Agents and Environment, Structure of Agents, Types of agents, Learning agent, • Agent communication • Negotiation and Bargaining • Argumentation among Agents • Trust and Reputation in Multi-agent systems	5
3	Problem Solving Methods	• Uninformed search Breadth First Search, Depth First Search, Depth First iterative deepening, • Informed Search Greedy best first, A*, Heuristic search • Adversarial Search Game playing, alpha beta pruning, Min-Max search • Local search algorithms and optimization Hill climbing search, Genetic algorithms,	6
4	Knowledge Representation	• Knowledge Representation, brief overview of propositional logic, FOL syntax and semantic, forward chaining and backward chaining • Unification, resolution, • Uncertain knowledge and Engineering : knowledge in uncertain domain, semantics of belief network, simple inference in belief network	6
5	Planning and Learning	• Planning :Planning problem, Partial order planning, Hierarchical planning, Conditional planning • Learning : Forms of Learning, Theory of learning, PAC learning, Introduction to statistical learning	5
6	Artificial Intelligence Applications with Real Time USECASE	Students are supposed to study any AI Application and provide insights about the concepts used in respective application.	4
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: PEIT21P

Category: PCE (AIML)

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

Pre-requisites: NIL

Course Objectives:

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

Course Outcomes:

Learner will be able to:

CO1: To understand and conceptualize basic ideas and techniques in artificial Intelligence

CO2: To know and use various problem-solving methods

CO3: To acquire and choose appropriate knowledge representation methods in AI

CO4: To understand and design Artificial intelligence Agents

CO5: To know and identify AI applications

CO6: To design and develop Artificial Intelligence Applications in real world scenarios

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

Suggested List of Practicals:

Sr No.	Title of Practical
1	One case study on AI applications published in IEEE/ACM/ Springer Journals
2	Program on uninformed search methods (BFS)

3	Program on uninformed search methods (DFS)
3	Program on informed search methods (A*)
4	Program on game playing assignments (MinMax)
5	Program on First order logic
6	Project (Develop any small AI Application)

Course Name: Advanced Database Management System

Course Code: PEIT22T

Category: PEC (Data Analytics)

Preamble:

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

Pre-requisites: DBMS

Objective:

1. To impart knowledge related to query processing and query optimization phases of a database management system.
2. To learn advanced techniques for data management and to overview emerging data models like Temporal, Mobile, and Spatial database.
3. To introduce advanced database models like distributed databases.
4. To create awareness of how enterprise can organize and analyse large amounts of data by creating a Data Warehouse.
5. To understand the process of data extraction, transformation and loading. 6 To understand the concept of Big data and NoSQL databases.
6. To learn different IR models and queries in IR Systems

Course Outcomes:

Learner will be able to:

CO1: Measure query costs and design alternate efficient paths for query execution.

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

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

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

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

Course Scheme:

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

Assessment guidelines:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**

Theory	15	20	40	075

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Query Processing and Optimization	Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions. Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression Estimating Statistics of Expression Results Choice of Evaluation Plans. Self-learning Topics: Solve problems on query Optimization	6
2	Access Control Mechanism	Discretionary Access Control Based on Granting and Revoking Privileges. Mandatory Access Control and Role Based Access Control, Remote Database access protocol. Self-learning Topics: Learn Data Security concepts like Authentication, Authorization and encryption.	6
3	Distributed Databases	Introduction: Distributed Data Processing, Distributed Database System: Architecture, Types, Design Issues. Data Fragmentation, Allocation in distributed databases. Self-learning Topics: Query Optimization in Distributed Databases	6
4	Enhanced Data Models	Active Database Concepts and Triggers, Temporal Database, Spatial Database, Introduction to Deductive Databases Self-learning Topics: Case Study like: "Temporal Dynamics in Information Retrieval: Modelling Temporal Relevance and Query Intent Shifts Over Time"	6
5	**Introduction to Information Retrieval**	Retrieval Models, Types of Queries in IR Systems, Text Preprocessing Self-learning Topics: Case Study like "Information retrieval evaluation in practice"	6
Total			**30**

Textbooks:

[1]. Korth, Slberchatz,Sudarshan, :"Database System Concepts", 6th Edition,

McGraw – Hill

[2]. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.

[3]. Theraja Reema, "Data Warehousing", Oxford University Press.

[4]. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

[1] Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India.

[2] Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modelling", 3rd Edition. Wiley India.

[3] Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 9th Edition

Course Name: Advanced database Management System Lab

Course Code: PEIT22P

Category: PEC (Data Analytics)

Preamble:

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

Pre-requisites: DBMS

Objective:

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

Course Outcomes:

Learner will be able to:

CO1: Design database schemas using EER model techniques and implement them using SQL.

CO2: Demonstrate proficiency in writing advanced SQL queries and understand query optimization principles.

CO3: Develop skills in accessing and manipulating databases through JDBC in Java programs.

CO4: Understand query evaluation plans, indexing strategies, and their impact on database performance.

CO5: Implement distributed database solutions, including partitioning strategies, for scalability and performance.

Course Scheme:

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

Assessment guidelines:

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

Suggested list of experiments:

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

Textbooks:

[1]. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson/Addision wesley, 2007

[2]. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011

Reference Books:

[1] T. Özsu 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: Modern Sensors for Internet of Things

Course Code: PEIT23T

Category: PEC (IoT)

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:

Sr. No.	Module name	Content	No of Hours
1	Sensors Fundamentals and Characteristics	Sensor Classification, Physical Principles of Sensors- Resistive, capacitive, inductive sensors, Optical, magnetic, and thermal sensors, Sensor Characteristics, Performance and Types, Error Analysis characteristics- Sensitivity, accuracy, precision, range, and resolution. Response time and stability, Applications in various fields and criteria to select sensor	5
2	Types of sensors	Optical Sensors- Photodetectors and phototransistors, Fiber optic sensors, Imaging sensors. Mechanical Sensors- Strain gauges and pressure sensors, Accelerometers and gyroscopes, Ultrasonic sensors. Chemical and Biological Sensors- Electrochemical sensors, gas sensors, humidity and temperature sensors, Biosensors	6
3	Data acquisition and Signal Conditioning	Analog and Digital data acquisition system, Data logger, Amplification, filtering, and Analog-to-Digital conversion, Noise reduction techniques, Calibration methods	5
4	Wireless Sensor Networks	Basics of wireless communication, Network topologies and protocols, Bluetooth, ZigBee, Ultra Wide Band (UWB), Near Field Communication (NF) and RFID, WiFi and IEEE 802.11architecture, applications in IoT.	6

5	IoT Systems Integration and communication protocols	Introduction to IoT, Integrating sensors with microcontrollers (e.g., Arduino, Raspberry Pi), Communication protocols (I2C, SPI, UART),	4
6	Sensor applications	On board automobile sensing system, Home automation and Environment monitoring system, Biomedical sensing system, Radio sensing for industrial applications,	4
Total			**30**

Textbooks:

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

Reference Books:

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

Course Name: Modern Sensors for Internet of Things Lab

Course Code: PEIT23P

Category: PEC (IoT)

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 types of sensors and their application.
- To understand communication protocol and their use in sensor network.

- To understand various types of 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 sensors and their important characteristics.
- Testing and Calibration of sensors.
- Identification of Sensitivity, range, resolution, Response time parameters of sensors
- Develop a system to record one of the physical parameters 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 system using one or more sensor and a communication protocol.

Textbooks:

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

Reference Books:

1. Edited by Qusay F Hasan, Atta ur rehman Khan, Sajid A madani, “Internet of Things Challenges, Advances, and Application”, CRC Press

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

Course Name: Computer & Network Security

Course Code: PEIT24T

Category: PEC (Cyber Security)

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:

Computer Networks- IT06T, Operating system- IT05T

Course Objectives:

- Basic concepts of computer networks and security
- Various cryptography algorithms including secret key management and different authentication techniques.
- Different types of malicious software 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 networks and infer the use of firewalls and security protocol.

Course Outcomes:

Learner will be able to:

CO1: Explain the fundamentals concepts of computer security and network security.

CO2: Identify the basic cryptographic techniques using classical and block encryption methods.

CO3: Study and describe the system security malicious software.

CO4: Describe the Network layer security, Transport layer security and application layer security.

CO5: Explain the need of network management security and illustrate the need for NAC.

CO6: Identify the function of an IDS and firewall for system security.

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

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

5	Network Management Security and Network Access Control	Network Management Security and Network Access Control: Network Management Security:SNMPv3, NAC: Principle elements of NAC, Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control	4
6	System Security	System Security: IDS, Firewall Design Principles, Characteristics of Firewalls, Types of Firewalls	2
Total			**30**

Textbooks:

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

Reference Books:

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

Course Name: Computer & Network Security Lab

Course Code: PEIT24P

Category: PEC (Cyber Security)

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:

Computer Networks- IT06T, Operating system- IT05T

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:

CO1: Illustrate symmetric cryptography by implementing classical ciphers.

CO2: Demonstrate Key management, distribution and user authentication.

CO3: Explore the different network reconnaissance tools to gather information about networks.

CO4: Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.

CO5: Use open-source tools to scan the network for vulnerabilities and simulate attacks

CO6: 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.

Multidisciplinary Minors

Track: Bioinformatics

Course Name: Introduction to Bioinformatics

Course Code: MDMBI01

Vertical/ Sub-Vertical: MDM

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: NIL

Pre-requisite for: Algorithms and Data Structures in Bioinformatics (MDMBI01)

Recommended Semester: Sem III (R2024), Sem V(R2023)

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (MDMBI01)	15 (~20%)	20 (~30%)	50 (~50%)	100 (100%)

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

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

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:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level

CO1	Explain foundational molecular biology concepts and their relevance to bioinformatics, including DNA, RNA, proteins, and gene functions.	Understanding
CO2	Access, compare, and utilize various biological databases and sequence file formats to retrieve and analyze genomic and proteomic data effectively.	Applying
CO3	Apply key sequence alignment algorithms and computational techniques to analyze biological sequences and construct phylogenetic relationships.	Applying
CO4	Implement bioinformatics algorithms and data structures to solve problems in genomics, proteomics, and systems biology, including gene prediction and motif discovery.	Applying
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.	Analyse

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Basics of Molecular Biology	**Contents:** • 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. ***Self-Learning Topics***: *Overview of transcription factors, epigenetics, and recent genetic editing technologies (CRISPR).*	8
2	Biological Databases	**Contents:** 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) ***Self-Learning Topics****: Meta-databases and integrative resources (e.g., UniProt, INSD)*	8
3	Sequence Analysis	**Contents:** 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 ***Self-Learning Topics****:* Evolutionary models used in sequence analysis	8
4	Genomics & Human Genome Project	**Content:** 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

		***Self-Learning Topics**: Public repository of genomic data*	
5	Applications of Bioinformatics	**Content:** Bioinformatics in personalized medicine, Drug discovery and vaccine design, Agriculture and animal genomics Role of AI/ML in bioinformatics	9
Total			45

TextBooks and Resources:

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

Track: Innovation and Entrepreneurship

Course Title: Foundations of Innovation and Entrepreneurship

Course Code: MDMIE01

NEP Vertical_Basket: 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 enhance entrepreneurial ideas.
CO3: Create basic business models using modern tools.
CO4: Evaluate entrepreneurial case studies and pitch early-stage ideas and take critical feedback.

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	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 Case presentation	• Business Model Canvas • Value Proposition Design • Customer Segments and Customer Discovery	6
5	Leveraging the 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 Name: Introduction to Business Development and Marketing Principles

Course Code: MDMBD01

Category: Minor Degree Course (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:

None

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:

Student 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:

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

Assessment Guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	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 journey, 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 OpenCourseWare

Course Name: Fundamentals of Robotics and Control

Course Code: BMMDM1T

Category: Multidisciplinary Minor (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.

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.

Pre-requisites:

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

Course Outcome:

The 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:

Contact Hours		**Credits Assigned**
Theory	Practical	Total
03	--	03

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory+ Tutorial	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 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

Third Year B. Tech. Information Technology **Preferred Semester: VI**

Course Structure and Assessment Guidelines

NEP-Vertical	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
PC_PCC	PCIT13T	Cloud Computing	Theory	2	15	20	40	075
	PCIT13P	Cloud Computing Lab	Practical	1	25	-	25	050
	PCIT12T	Software Testing & Quality Assurance	Theory	2	15	20	40	075
	PCIT12P	Software Testing & Quality Assurance Lab	Practical	1	25	-	25	050
	PCIT16P	DevOps Lab	Practical	2	50	-	25	75
PC_PEC	PEITXXT	Professional Elective-2	Theory	2	15	20	40	075
	PEITXXT	Professional Elective-2 Lab	Practical	1	25	-	25	050
	PEITXXT	Professional Elective-3	Theory	2	15	20	40	075
	PEITXXT	Professional Elective-3 Lab	Practical	1	25	-	25	050
	PRJIT05	Specialization-Based Project	Practical	2	25	-	50	75
Project	PRJIT02	Project-1 (Synopsis)	Theory	1	25		25	50
MDM	MDXXX	As per MDM course list	Theory+ Tutorial	4	45	30	50	125
Total Credits				**21**				

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination
*Selection based on the subset of courses made available by the Institute for the semester.

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

Professional Elective-2 Courses (ITXX)

Course Code	Course Name	Specialization Track Name#
PEIT25T	Soft Computing	Artificial Intelligence & Machine Learning (AIML)
PEIT25P	Soft Computing Lab	
PEIT26T	Data & Feature Engineering	Data Analytics
PEIT26P	Data & Feature Engineering Lab	
PEIT27T	Principles of IoT	IoT
PEIT27P	Principles of IoT Lab	

PEIT28T	System Security & Ethical Hacking	Cyber Security (CSec)
PEIT28P	System Security & Ethical Hacking Lab	

#For details of Specialization Certificate, refer Appendix-A

Professional Elective-3 Courses (ITXX)

Course Code	Course Name	Specialization Track Name#
PEIT29T	Probabilistic Graphical Model	Artificial Intelligence & Machine Learning (AIML)
PEIT29P	Probabilistic Graphical Model Lab	
PEIT29T	Probabilistic Graphical Model	Data Analytics
PEIT29P	Probabilistic Graphical Model Lab	
PEIT31T	Embedded System Design with Tiny OS	IoT
PEIT31P	Embedded System Design with Tiny OS Lab	
PEIT32T	Digital Forensic Theory	Cyber Security (CSec)
PEIT32P	Digital Forensic Lab	

#For details of Specialization Certificate, refer Appendix-A

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination
*Selection is based on subset of courses offered by the Institute for the semester.

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.

Appendix-A

Guidelines for Professional Elective Courses and Specialization Certificate

Professional Elective courses are designed to meet industrial requirements. All learners must opt for 5 professional elective courses (both Theory and Practical Components) as a part of minimum requirement for B.Tech. degree.

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

1. Artificial Intelligence and Machine Learning (AIML)
2. Data Analytics(DA)
3. Cyber Security
4. IoT (CSL)

From semester 5 to semester 8, learners can take courses from any track. **However, if learners complete all professional elective courses from the same chosen track from semester 5 to semester 8, they will be eligible to receive a Specialization Certificate from the Institute.**

Learners who choose professional elective courses from different specialisation tracks from semester 5 to semester 8 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 Data Science

Course Name: Cloud Computing

Course Code: PCIT13T

Category: Core

Preamble:

This course introduces students to Cloud technology, with detailed technical introduction to two widely used technology stacks i.e. Virtualization and Cloud services. The course will also offer in-depth understanding of theoretical underpinnings, applications, and best practices and research activities

Pre-requisites:

Operating System (IT05T), Computer Network (IT06T)

Course Objectives:

- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students with a sound foundation of Cloud computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios.
- To enable students to explore some important cloud computing driven commercial systems and applications.
- To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Outcomes:

Learner will be able to:

CO1: Explain the basics concepts of cloud computing like service models, deployment models and its architecture.

CO2: Describe and apply virtualization in cloud computing.

CO3: Use and analyze different cloud computing services.

CO4: Understand and apply various services provided by Amazon Web Services cloud platform.

CO5: Discuss the functionality of Openstack cloud platform & Severless computing.

CO6: Recognize and examine the security and privacy concerns in cloud computing.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Tutorial	Theory	Tutorial
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 cloud computing	Need for cloud computing and its components, Types of cloud, characteristics of cloud computing, deployment models, service models, advantages and disadvantages of Cloud Computing.	2
2	Virtualization	Characteristics of virtualized environment, structures of virtualization, implementation levels of virtualization, mechanisms of virtualization, pros and cons of virtualization, virtualization vs cloud computing, Xen and KVM architecture.	4
3	Cloud Computing Services	SPI Model of Cloud computing, Everything as a Service (XaaS): Database as a Service, Storage as a Service, Security as a Service, Collaboration as a Service, Monitoring as a Service, Network as a Service, Disaster Recovery as a service, Identity management as a Service, Analytics as a Service and Backup as a Service.	4
4	Exploring the Components of Amazon Web Services	Introduction to the AWS Cloud, AWS core services by categories. Compute Service: Introduction to EC2, EC2 Instances, EC2 Amazon Machine Images, Instance Types, Instance Lifecycle. Storage Service: Introducing S3, working with Buckets, setting bucket security, S3 event and notification, bucket properties, working with Elastic Block Store Volumes, Object Storage Vs Block Storage, Archives versus backups, Introduction to Glacier. Virtual Private Cloud: Introduction, Subnet, Elastic Network Interfaces, Internet Gateways, Route Tables, Security Groups. CloudWatch: Introduction, CloudWatch Metrics, CloudWatch Alarms. Database as a Service: Introduction to Amazon Relational Database Service (RDS), Database Engines, Database Instance Classes, Backup and Recovery, Non-relational (No-SQL) Databases, Types of Nonrelational Databases, Introduction to DynamoDB, Features, Partition and Hash Keys.	10
5	Open source Cloud Platform	Introduction to Openstack cloud platform, Components and modes of Operations, Architecture of Openstack cloud platform. Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile cloud computing. Serverless Computing: Introduction, Working with Serverless environment, Basics of severless events and functions, AWS Lambda.	5
6	Security in Cloud Computing	What is security, why is it required in cloud computing, Different types of security in cloud, attacks, and vulnerabilities, IaaS security, PaaS security, SaaS security, trust boundary, Introduction to Identity and access Management (IAM), IAM Challenges, IAM Definition, IAM Architecture and Practice, Privacy: What Is Privacy? What Are the Key Privacy Concerns in the Cloud?, Legal and Regulatory Implications	5

Total	**30**

Textbook:

1.. Barrie Sosinsky, " Cloud Computing Bible ", Wiley Publication, Second Edition.

2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, " Cloud Computing Black Book ", Dreamtech Press

Reference Books:

1. Thomas Erl,Robert Cope,Amin naserpour, " Cloud Computing Design Patterns ", 2 Edition Pearson Publication publisher.

2. Judith Hurwitz, "Cloud Computing for Dummies ", Wiley Publication 2 Edition.

E-sources:

1. https://swayam.gov.in/nd1_noc20_cs55/preview
2. https://www.udemy.com/courses/search/?duration=long%7CextraLong&price=price-free&q=cloud%20computing&src=ukw
3. https://www.udemy.com/course/introduction-to-cloud-computing-on-amazon-aws-for-beginners/
4. https://www.udemy.com/course/azure-fundamentals-lab/
5. https://www.udemy.com/course/amazon-web-services-for-web-hosting-cloud-computing/

Course Name: Cloud Computing Lab

Course Code: PCIT13P

Category: Core

Preamble:

This course introduces students to Cloud technology, with detailed technical introduction to two widely used technology stacks i.e. Virtualization and Cloud services. The course will also offer in-depth understanding of theoretical underpinnings, applications, best practices and research activities

Pre-requisites:

Operating System Lab (IT05P), Computer Network Lab (IT06P)

Course Objective:

- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students a sound foundation of Cloud computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios.
- To enable students to explore some important cloud computing driven commercial systems and applications.
- To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Outcomes:

Learner will be able to:

CO1: Explain the basics concepts of cloud computing like service models, deployment models and its architecture.

CO2: Describe and apply virtualization in cloud computing.

CO3: Use and analyze different cloud computing services.

CO4: Understand and apply various services provided by Amazon Web Services cloud platform.

CO5: Discuss the functionality of Openstack cloud platform & Severless computing.

CO6: Recognize and examine the security and privacy concerns in cloud computing.

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/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.

Suggested list of experiments:

Sr. No.	List of experiments
1	Introduction and overview of cloud computing.
2	To study and implement Hosted Virtualization using VirtualBox & KVM
3	To study and Implement Infrastructure as a Service using AWS/Microsoft Azure
4	To study and Implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service.
5	To study and Implement Storage as a Service using Own Cloud/ AWS S3, Glaciers/ Azure Storage
6	To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/ MongoDB/ Firebase
7	To study and implement Identity and Access Management (IAM) practices on AWS/Azure cloud.
8	Mini-project: Design a Web Application hosted on public cloud platform [It should cover the concept of IaaS, PaaS, DBaaS, Storage as a Service, Security as a Service etc]

Text Books:

1.. Barrie Sosinsky, " Cloud Computing Bible ", Wiley Publication, Second Edition.

2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, " Cloud Computing Black Book ", Dreamtech Press

Reference Books:

1. Thomas Erl,Robert Cope,Amin naserpour, " Cloud Computing Design Patterns ", 2 Edition Pearson Publication publisher.

2. Judith Hurwitz, "Cloud Computing for Dummies ", Wiley Publication 2 Edition.

Course Name: Software Testing & Quality Assurance

Course Code: PCIT12T

Category: Core

Preamble:

Software Testing and Quality Assurance ensures software reliability, functionality, and user satisfaction. By implementing rigorous testing methodologies and best practices, software professionals identify and resolve defects early in development. This process not only validates software performance but also promotes customer trust and business success through consistent, high-quality product delivery.

Pre-requisites: Software Engineering with WDL- IT12T

Course Objectives:

- To understand the fundamental concepts and importance of software testing and quality assurance in the software development lifecycle.
- To explore various software testing methodologies and techniques, including manual and automated testing approaches.
- To develop skills in designing comprehensive test plans, cases, and scripts to ensure thorough validation of software applications.
- To emphasize the role of quality assurance in delivering reliable, high-performance software products that meet customer requirements and industry standards.

Course Outcomes:

Learner will be able to:

CO1: Recall the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.

CO2: Understand the software testing techniques to Gain hands-on experience with manual testing, black-box testing, and white-box testing, to identify and document software defects.

CO3: Apply software standards and learn best practices for identifying documenting Test cases and plans

CO4: Analyze Test processes for automation with tools like selenium IDE

CO5: Evaluate the Test cases and Test plan for Specialized test environment

CO6: Design comprehensive test cases and detailed test plans that cover a wide range of scenarios to ensure Quality Assurance as per standards.

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 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	Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Effective Software Testing vs Exhaustive Software Testing, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation,	3
2	Testing Techniques	Dynamic Testing: Black Box Testing: Boundary Value Analysis, Equivalence Class Testing, Error Guessing. White Box Testing Techniques: need, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop Testing, Mutation testing. Static Testing. Validation Activities: Unit Testing, Integration Testing, System, Acceptance Testing. Regression Testing	6
3	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test Specification. Software Metrics: need, definition and Classification of software matrices., function point and test point analysis. Efficient Test Suite Management	6
4	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc.	6
5	Testing for Specialized Environment	Agile Testing, Agile Testing Life Cycle, Testing in Scrum phases, Challenges in Agile Testing Testing Web based Systems: Web based system, web technology evaluation, traditional software and web based software, challenges in testing for web based software, testing web based testing	6
6	Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO9000:2000, SIX sigma, Software quality management	3
Total			**30**

Textbooks:

1. Software Testing Principles And Practices ,Naresh Chauhan ,Oxford Higher Education
2. Software Testing And Quality Assurance Theory And Practice , Kshirasagar Naik, Priyadarshi Tripathy Wiley Publication

Reference Books:

1. Effective Methods For Software Testing Willam E. Perry , Wiley Publication
2. Software Testing Concepts and Tools, Nageswara Rao Pusuluri , Dreamtech press

Course Name: Software Testing and Quality Assurance Lab

Course Code: PCIT12P

Category: Core

Preamble: This course introduces students to Software testing and quality assurance which is very important in this digital era due to dependency on online platforms, quality of a software is to be achieved with the help of different software testing strategies.

Pre-requisites: Software engineering with WDL lab (IT12P)

Course Objectives:

- Introduce learners to advanced testing tools and technologies used for automation, performance testing, and security testing.
- To foster a mindset of continuous improvement and collaboration in software testing to achieve high-quality outcomes.
- To develop skills in designing comprehensive test plans, cases, and scripts to ensure thorough validation of software applications.
- To emphasize the role of quality assurance in delivering reliable, high-performance software products that meet customer requirements and industry standards.

Course Outcomes:

Learner will be able to:

CO1: Recall the reasons for bugs and analyze the principles in software testing to prevent and remove bugs.

CO2: Understand various test processes for Software improvement using penetration testing to identify vulnerabilities in software applications and ensure they are secure against potential threats.

CO3: Apply the software testing techniques to Gain hands-on experience with manual testing, black-box testing, and white-box testing, to identify and document software defects.

CO4: Analyze Test processes for automation with tools like selenium IDE

CO5: Evaluate the Test cases and Test plan for quality assurance

CO6: Design comprehensive test cases and detailed test plans that cover a wide range of scenarios, including edge cases, to ensure thorough software validation.

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 institute level and published to the learners before the commencement of the semester.

Suggested List of Practical:

Sr No.	Title of Practicals
1	BUG Identification in Real world Applications
2	Study of Manual Testing
3	Study of White box Testing
4	Study of Black box testing
5	Study of Test case and Test plan design
6	Study of Penetration Testing
7	Study of Testing Automation Testing using Selenium IDE
8	Study Agile Testing.
9	case study on Open-source testing tools
10	Study of software quality standards

Textbooks:

1. Software Testing Principles And Practices ,Naresh Chauhan ,Oxford Higher Education
2. Software Testing And Quality Assurance Theory And Practice , Kshirasagar Naik, Priyadarshi Tripathy Wiley Publication

Reference Books:

1. Effective Methods For Software Testing Willam E. Perry , Wiley Publication
2. Software Testing Concepts and Tools Nageswara Rao Pusuluri , Dreamtech press

Course Name: DevOps Lab

Course Code: PCIT16P

Category: Core

Preamble:

Study of DevOps sets the stage for a holistic approach to software development and delivery, where collaboration, automation, and continuous improvement are the guiding principles in achieving greater agility, efficiency, and resilience in the modern digital era.

Pre-requisites:

Operating System lab (IT05P), Software Engineering with Web Development lab (IT09P).

Course Objectives:

- To understand DevOps practices which aims to simplify Software Development Life Cycle.
- To be aware of different Version Control tools like GIT, CVS or Mercurial.
- To Integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment.
- To be familiarized with selenium tool, which is used for continuous testing of applications deployed.
- To use Docker to Build, ship and manage applications using containerization.
- To understand the concept of Infrastructure as a code and install and configure Ansible tool.

Course Outcomes:

Learner will be able to

CO1: To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet your business requirements

CO2: To obtain complete knowledge of the "version control system" to effectively track changes augmented with Git and GitHub

CO3: To understand the importance of Jenkins to Build and deploy Software Applications on server environment

CO4: Understand the importance of Selenium and Jenkins to test Software Applications

CO5: To understand concept of containerization and Analyze the Containerization of OS images and deployment of applications over Docker

CO6: To Synthesize software configuration and provisioning using Puppet or Ansible.

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

Suggested List of Practical:

Sr No.	Title of Practical
1.	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2.	To understand Version Control System / Source Code Management, install git and create a GitHub account.
	To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet
3.	To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to set up a build Job.
4.	To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
5.	To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
6.	To Setup and Run Selenium Tests in Jenkins Using Maven.
7.	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
8.	To learn Dockerfile instructions, build an image for a sample web application / Mini Project Application using Dockerfile.
9.	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
10.	To learn Software Configuration Management and provisioning using Puppet Blocks (Manifest, Modules, Classes, Function)
11.	To provision a LAMP/MEAN Stack using Puppet Manifest.

Textbooks:

1. DevOps Bootcamp, Sybgen Learning

2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.

3. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", AddisonWesley- Pearson Publication.

4. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication.

Reference Books:

1. Sanjeev Sharma and Bernie Coyne," DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers", Apress Publication.
3. Joakim Verona, "Practical DevOps", Pack publication
4. Puppet 5 Essentials - Third Edition: A fast-paced guide to automating your infrastructure by Martin Alfke Packt Publishing; 3rd Revised edition (September 13, 2017)
5. Alan Clements, "Principles of Computer Hardware", 4th edition, Oxford University Press
6. Natalia Olifer & Victor Olifer, "Computer Networks: Principles, Technologies & Protocols for Network Design", Wiley India
7. Larry L.Peterson, Bruce S.Davie, "Computer Networks: A Systems Approach", 2nd Edition, The Morgan Kaufmann Series in Networking

Detailed Syllabus of Professional Electives

Professional Elective-2 Courses (ITXX)

Course Name: Soft Computing

Course Code: PEIT25T

Category: PEC (AIML)

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), needs 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 their 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	8

		Un-Supervised Learning algorithms: Hebbian Learning, Winner take all, Self Organizing Maps, Learning Vector Quantization.	
6	Hybrid system	Introduction to Hybrid Systems, Adaptive Neuro Fuzzy Inference System (ANFIS).	4
Total			**30**

Text Books:

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

Reference Books:

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

Course Name: Soft Computing Lab

Course Code: PEIT25P

Category: PEC (AIML)

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 their applications.
- Solving single-objective optimization problems using GAs.
- Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).
- Applications of Soft computing to solve problems in varieties of application domains.

Course Outcomes:

Learners will be able to learn:

CO1: Explain the fundamentals of soft computing, its constituents, and its adaptability.

CO2: Apply fuzzy set theory and design membership functions for imprecise data.

CO3: Develop fuzzy inference systems using Mamdani and Sugeno models for decision-making.

CO4: Solve optimization problems using genetic algorithms and their operators.

CO5: Implement neural network algorithms for supervised and unsupervised learning tasks.

CO6: Design hybrid systems like ANFIS by integrating neural networks and fuzzy logic.

Course Scheme:

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

Assessment Guidelines:

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

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

Suggested List of Practical's:

Sr No.	Suggested Topic(s)
1.	Study of Fuzzy set and Theory
2.	Implementing basic fuzzy Operations
3.	Implementation of fuzzy set close to N
4.	Study of the Fuzzy toolbox.
5.	Implementing Train Controller problem
6.	Implementing Washing machine problem
7.	Implementing Water purification problem
10.	Implementing Tipper problem
11.	Implementing the Perceptron learning rule.
12.	Implementing the Curve Fitting using Genetics algorithm.
13.	Development of an Adaptive Neuro-Fuzzy Inference System (ANFIS)
14.	Backpropagation Algorithm for Multilayer Perceptrons.

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: Data & Feature Engineering

Course Code: PEIT26T

Category: PEC (Data Analytics)

Preamble:

Data is the cornerstone of any machine learning project, and its quality and structure greatly influence the performance of predictive models. In this course, we delve into the fundamental principles and techniques of data and feature engineering, essential skills for anyone working with data-driven solutions. From understanding data types and formats to transforming raw data into informative features, this course equips students with the knowledge and tools necessary to prepare data for analysis and modelling.

Pre-requisites:

Engineering Mathematics-V (BS12)

Objective:
1. To understand the importance of data and feature engineering in machine learning and data analysis.
2. To learn techniques for collecting, cleaning, and preprocessing raw data.
3. To explore methods for transforming and encoding features to make them suitable for machine learning algorithms.
4. To gain hands-on experience with popular tools and libraries used in data and feature engineering.

Course Outcomes:

Learner will be able to:
CO1: Develop understanding of Data Analytics Process

CO2:. Learn how visual representations enhance data analysis by facilitating the interpretation and communication of complex information.

CO3: Acquire skills in summarizing and visualizing data distributions, identifying patterns, and detecting anomalies through hands-on exploration.

CO4: Showcase their ability to adapt visualization techniques to address varied analytical challenges by demonstrating versatility in creating a wide range of visualizations.

CO5: Well-prepared to excel in data analytics and visualization by mastering best practices and adapting to emerging trends.

Course Scheme:

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

Assessment guidelines:

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Data and Feature Engineering	Overview of data preprocessing and feature engineering, Data quality assessment and cleaning techniques, Exploratory Data Analysis (EDA) for feature understanding, Introduction to feature engineering concepts and importance	5
2	Data Cleaning and Preprocessing Techniques	Handling missing data: imputation strategies, removal, and augmentation, Outlier detection and treatment methods, Data validation and quality assurance, encoding categorical variables: one-hot encoding, label encoding, target encoding. Data transformation techniques: log transformation, box-cox transformation, Practical application of data cleaning and preprocessing techniques	5
3	Exploratory Data Analysis (EDA)	EDA in the Data Science Process-1: different data sourcing and data cleaning techniques in EDA, EDA in the Data Science Process-2: univariate analysis, bivariate analysis and multivariate analysis in EDA. Techniques for summarizing and visualizing data distributions: categorial, Numerical, Temporal Exploring relationships between variables: correlation analysis, scatter plots, uncovering patterns and anomalies in data through visualization, Hands-on exercises using Matplotlib and Seaborn for EDA	6
4	Statistical Analysis and Hypothesis Testing	Introduction to statistical concepts: measures of central tendency, dispersion, etc. Hypothesis testing: t-tests, chi-square tests, ANOVA, Hands-on exercises using Python for statistical analysis	4
5	Data Visualization Techniques	Principles of effective data visualization, Creating interactive visualizations using tools, Visualization for storytelling and communication of insights Visualizing geospatial data: maps, choropleth maps, etc. Time series visualization techniques Customizing visualizations for specific audiences and purposes.	5
6	Best Practices and Future Trends in Data Analytics and Visualization	Data governance and ethics: ensuring data privacy and security. Collaboration and communication: strategies for effective teamwork and project management. Tools and techniques for collaborative data exploration and visualization	5

		Generative visualization: using generative models to create novel visualizations. Explainable AI: techniques for interpreting and explaining complex machine learning models.	
Total			**30**

Textbooks:

[1] L. Pierson, "Data Science For Dummies," Wiley, 1st ed., March 2015. [Online]. Available: ISBN: 1118841557, 978-1118841556.

[2] C. N. Knaflic, "Storytelling with Data: A Data Visualization Guide for Business Professionals," Wiley, 2015. [Online]. Available: ISBN: 9781119002253.

[3] W. Fagen-Ulmschneider, "Data Analysis with Python: A Modern Approach," CRC Press, 2020. [Online]. Available: ISBN: 9781138585836.

[4] EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data," Wiley, 2015. [Online]. Available: ISBN: 9781118876138.

References Books:

[1] E. R. Tufte, "The Visual Display of Quantitative Information," Graphics Press, 2001. [Online]. Available: ISBN: 9780961392147.

[2] S. Murray, "Interactive Data Visualization for the Web," O'Reilly Media, 2017. [Online]. Available: ISBN: 9781491921289.

[3] H. Wickham and G. Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data," O'Reilly Media, 2017. [Online]. Available: ISBN: 9781491910399.

Course Name: Data & Feature Engineering Lab

Course Code: PEIT26P

Category: PEC (Data Analytics)

Preamble:

The Data & Feature Engineering Lab provides hands-on experience in applying data preprocessing and feature engineering techniques to real-world datasets. Students will learn to collect, clean, preprocess, and transform data to prepare it for analysis and modeling. In the feature engineering process, you start with your raw data and use your own domain knowledge to create features that will make your machine learning algorithms work. In this module we explore what makes a good feature. Through practical exercises and projects, students will develop proficiency in using tools and libraries commonly employed in data engineering tasks.

Prerequisites:

Skill Based Lab-Python

Objective:

- Gain practical experience in collecting and preprocessing data for analysis.
- Learn various techniques for handling missing data, outliers, and categorical variables.

- Understand the importance of feature engineering in improving model performance.
- Develop skills in implementing data transformation and feature extraction methods.
- Apply learned concepts and techniques to real-world datasets through hands-on projects.

Course Outcomes:

Learner will be able to:

CO1: Students will be able to collect, clean, preprocess, and transform real-world datasets for analysis and modelling purposes.

CO2:. Students will gain insight into various features of engineering techniques and their application in improving model performance.

CO3: Students will be able to analyze and interpret the impact of different data transformation methods on model performance.

CO4: students will be able to Perform feature engineering using BigQuery ML, Keras, and TensorFlow.

CO5: Students will develop the skills to create new features and engineer existing ones to enhance the predictive power of machine learning models.

CO6: Students will apply learned concepts and techniques to solve real-world problems through hands-on projects and case studies, thereby gaining practical experience in data and feature engineering.

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

Suggested list of experiments:

Sr. No.	List of experiments
1	Feature Engineering Project: 1. Obtain a dataset containing relevant information 2. Define metadata 3. Create a preprocessing function 4. Implement feature engineering techniques to improve model performance. 5. Perform univariate analysis to understand the distributions of individual variables 6. Generate a constant graph with the required transformations
2	Data Transformation Project: Applying advanced data transformation techniques to prepare data for modeling. 1. Handle missing values, outliers, and inconsistencies in the dataset.

	2. Ensure data integrity and accuracy by resolving any discrepancies. 3. Apply Transformation operations such as Standard Scaling, Minmax 4. Transform categorical variables into numerical representations using techniques like one-hot encoding or target encoding.
3	Conduct statistical tests, such as t-tests or chi-square tests, to assess the significance of relationships between variables
4	Build the production data pipeline by: 1. Performing feature selection 2. Ingesting the dataset 3. Generating the statistics of the dataset 4. Creating a schema as per the domain knowledge 5. Creating schema environments 6. Visualizing the dataset anomalies 7. Preprocessing, transforming and engineering your features 8. Tracking the provenance of your data pipeline using ML Metadata
5	**Comprehensive Data & Feature Engineering Project:** Integrating all learned concepts to clean, preprocess, and engineer features for a predictive modeling task

Textbooks:

[1]. "Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists" by Alice Zheng and Amanda Casari.

[2] "Practical Data Science with Python" by Andreas C. Müller and Sarah Guido

[3] "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron

[4] "Building Machine Learning Powered Applications: Going from Idea to Product" by Emmanuel Ameisen

Reference Books:

[1]. "Applied Predictive Modeling" by Max Kuhn and Kjell Johnson

[2] Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems" by Martin Kleppmann

[3] "Python Data Science Handbook" by Jake VanderPlas

[4] "Data Science from Scratch: First Principles with Python" by Joel Grus

Course Name: Principles of IoT

Course Code: PEIT27T

Category: PEC (IoT)

Preamble:

Embedded System is 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 systems 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	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	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 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 models, 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: Principles of IoT Lab

Course Code: PEIT27P

Category: PEC (IoT)

Preamble: Embedded System is 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 the concept of tiny machine learning and Real Time Operating System for design of embedded systems.

Pre-requisites:

- C Programming
- Object Oriented Programming
- Microprocessor and microcontroller

Course Objectives:

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

Course Outcomes:

Student will be able to:

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

CO2: Apply the fundamental concepts of embedded system design.

CO3: Use communication interface for design of embedded system.

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

CO5: Use fundamental concepts of tiny machine learning.

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

Course Scheme:

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

Assessment Scheme:

Head	ISA	MSA	ESA	Total
Practical	25	-	25	50

Suggested List of Practical:

All practical will be project based with focus on following application

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

Textbooks:

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

Reference Books:

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

Course Name: System Security & Ethical Hacking

Course Code: PEIT28T

Category: PEC (Cyber Security)

Preamble:

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

Pre-requisites:

Computer Networks- IT06T, Operating system- IT05T, Computer & Network Security- IT24T

Course Objectives:

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

Course Outcomes:

Learner will be able to:

CO1: Explain the fundamentals concepts of system security.

CO2: Implementing the concepts of cryptography in securing the infrastructure.

CO3: Explain the importance of network and web security.

CO4: Understand in brief the concepts of Mobile and cloud security.

CO5: Explain the concept of Ethical hacking and cybercrimes.

CO6: Understand the legal aspects of Ethical hacking.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical

2	-	2	-

Assessment guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to System Security and Access Control and Authentication	Overview of system security principles, Threat landscape and cybersecurity trends, Legal and ethical considerations in cybersecurity, Access control models: DAC, MAC, RBAC, Authentication methods: passwords, biometrics, MFA, Role-based access control (RBAC)	6
2	Cryptography and Data Protection	Basics of cryptography: encryption, decryption, Symmetric and asymmetric encryption algorithms, Data integrity and confidentiality mechanisms	4
3	Network and Web Security	Firewalls and intrusion detection/prevention systems (IDS/IPS), Secure network protocols: SSL/TLS, SSH, Wireless network security: WPA, WPA2, WPA3, Common web vulnerabilities (SQL injection, XSS), Web application firewalls (WAF), Secure coding practices	6
4	Cloud and Mobile Security	Security challenges in cloud computing, Cloud service models (IaaS, PaaS, SaaS), Cloud security controls and best practices, Mobile device management (MDM), Mobile application security, Secure communication protocols.	8
5	Cybercrime and Ethical Hacking	Introduction to Cybercrime, Types of Cybercrime, Classification of Cybercriminals, Role of computer in Cybercrime, Prevention of Cybercrime. Ethical Hacking, Goals of Ethical Hacking, Phases of Ethical Hacking, Difference between Hackers, Crackers and Phreakers, Rules of Ethical Hacking	4

6	Ethical hacking legal aspects	Laws and regulations related to hacking and cybersecurity, Ethical hacking code of conduct, Case studies and ethical dilemmas in hacking	2
Total			**30**

Textbooks:

1. Gupta, "IT Infrastructure & Its Management", First Edition, Tata McGraw-Hill Education.

2. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education

3. Computer Security, Dieter Gollmann, Third Edition, Wiley Publications.

4 Data Communications and Networking, Forouzan, Fourth Edition, Mc Graw Hill Publication

5 Wireless Networks, P. Nicopolitidis, M.S. Obaidat, G.I Papadimitriou, A.S Pomportsis, Wiley Publications

Reference Books:

1. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education

2. CCNA Security Study Guide, Tim Boyle, Wiley Publications

3. Introduction to Computer Security, Matt Bishop, Pearson.

Course Name: System Security & Ethical Hacking Lab

Course Code: PEIT28P

Category: PEC (Cyber Security)

Preamble:

This lab course provides hands-on experience in system security and ethical hacking, allowing students to apply theoretical concepts in a practical setting. Through a series of guided exercises and simulations, students will develop skills in identifying vulnerabilities, conducting security assessments, and implementing countermeasures to protect computer systems and networks.

Pre-requisites:

Computer Networks Lab- IT06P, Operating system Lab- IT05P, Computer & Network Security Lab- IT24P

Course Objectives:

1. Apply theoretical knowledge of system security and ethical hacking in practical scenarios.
2. Gain hands-on experience with security tools and techniques used in ethical hacking.
3. Develop skills in identifying and mitigating security vulnerabilities.
4. Cultivate ethical and responsible behavior in the practice of ethical hacking.

Course Outcomes:

Learner will be able to:

LO1: Understand how to create malwares

LO2: Demonstrate Reconnaissance and foot printing phase of ethical hacking.

LO3: Demonstrate Scanning phase of ethical hacking.

LO4: Use tools like metasploit, empire etc for exploiting vulnerabilities.

LO5: Use open-source tools to scan the network for vulnerabilities and simulate attacks

LO6: Understand how to implement digital forensic strategy to solve a Hacking case.

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	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:

4. "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy" by Patrick Engebretson
5. "Hacking: The Art of Exploitation" by Jon Erickson
6. "Metasploit: The Penetration Tester's Guide" by David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni

7. "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" by Michael Sikorski and Andrew Honig
8. "Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto
9. "Gray Hat Hacking: The Ethical Hacker's Handbook" by Daniel Regalado, Shon Harris, Allen Harper, Chris Eagle, Jonathan Ness, and Branko Spasojevic
10. "Network Security Essentials: Applications and Standards" by William Stallings

Reference Books:

1. "The Hacker Playbook: Practical Guide to Penetration Testing" by Peter Kim
2. "Penetration Testing: A Hands-On Introduction to Hacking" by Georgia Weidman
3. "Violent Python: A Cookbook for Hackers, Forensic Analysts, Penetration Testers, and Security Engineers" by TJ O'Connor
4. "Cybersecurity and Cyberwar: What Everyone Needs to Know" by Peter W. Singer and Allan Friedman"Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems" by Chris Sanders.

Professional Elective-3 Courses (ITXX)

Course Name: Probabilistic Graphical Model

Course Code: PEIT29T

Category: PEC (AIML)

Preamble:

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

Pre-requisites:

Engineering Mathematics-V & Machine Learning

Course Objectives:

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

Course Outcomes:

Learner will be able to:

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

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

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

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

Models,

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

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

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Introduction to Probability & Graph Theory**	Introduction to Probability Theory: Probability Theory, Basic Concepts in Probability, Probability Axioms and Properties, Conditional Probability and Independence, Discrete Random Variables: Binomial, Poisson, Continuous Random Variables: Uniform, Normal, , Continuous Spaces, Expectation, Variance and Covariance. Introduction to Graphs: Graph Definitions and Types, Graph Representation: Adjacency Matrix and List, Subgraphs, Paths and Trails, Cycles and Loop.	4
	Bayesian Network Model and	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.	

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

Textbooks:

- Daphne Koller and Nir Friedman, "Probabilistic Graphical Models: Principles and Techniques",

Cambridge, MA: The MIT Press, 2009 (ISBN 978-0-262-0139- 2).

- David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 1st edition, 2011.
- Martin Wainwright and Michael Jordan, M., "Graphical Models, Exponential Families, and Variational Inference", 2008.

Reference books:

- 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: Probabilistic Graphical Model Lab

Course Code: PEIT29P

Category: PEC (AIML)

Preamble:

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

Pre-requisites:

Skill Based Lab-Python

Course Objectives:

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

Course Outcomes:

Learner will be able:

CO1: To simulate and analyze probabilistic phenomena, applying statistical methods to real-world data.
CO2: To apply graph algorithms to solve problems in connectivity, shortest paths, and network flows, demonstrating analytical skills in network analysis.

CO3: Evaluate Bayesian networks from data, performing probabilistic inference and decision analysis in uncertain environments.

CO4: Use factor graphs and inference algorithms to model and analyze complex probabilistic relationships in data.

CO5: implement algorithms for sequence analysis, decode hidden states using HMMs, and apply them in tasks such as speech recognition and biological sequence analysis.

Course Scheme:

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

Assessment guidelines:

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

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

Suggested List of Practical's:

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

Course Name: Probabilistic Graphical Model

Course Code: PEIT29T

Category: PEC (Data Analytics)

Preamble:

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

Pre-requisites: Engineering Mathematics-V & Machine Learning

Course Objectives:

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

Course Outcomes:

Learner will be able to:

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

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

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

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

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

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

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

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

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

Textbooks:

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

edition, 2011.

- Martin Wainwright and Michael Jordan, M., "Graphical Models, Exponential Families, and Variational Inference", 2008.

Reference books:

- Finn Jensen and Thomas Nielsen, "Bayesian Networks and Decision Graphs (Information Science and Statistics)", 2nd Edition, Springer, 2007.

Course Name: Probabilistic Graphical Model Lab

Course Code: PEIT29P

Category: PEC (Data Analytics)

Preamble:

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

Pre-requisites:

Skill Based Lab-Python

Course Objectives:

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

Course Outcomes:

Learner will be able:

CO1: To simulate and analyze probabilistic phenomena, applying statistical methods to real-world data.
CO2: To apply graph algorithms to solve problems in connectivity, shortest paths, and network flows, demonstrating analytical skills in network analysis.

CO3: Evaluate Bayesian networks from data, performing probabilistic inference and decision analysis in uncertain environments.

CO4: Use factor graphs and inference algorithms to model and analyze complex probabilistic relationships in data.

CO5: implement algorithms for sequence analysis, decode hidden states using HMMs, and apply them in tasks such as speech recognition and biological sequence analysis.

Course Scheme:

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

Assessment guidelines:

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

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

Suggested List of Practical's:

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

Course Name: Embedded System Design with Tiny OS

Course Code: PEIT31T

Category: PEC (IoT)

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
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. Arshdeep Bahga 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: Embedded System Design with Tiny OS Lab

Course Code: PEIT31P

Category: PEC (IoT)

Preamble:

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

Pre-requisites:

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

Course Objectives:

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

Course Outcomes:

Student will be able to:

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

Course Scheme:

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

Assessment Guidelines:

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

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

Suggested List of Practical's:

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

Mini Projects / Case Study :-

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

1. Smart home automation system

2. Healthcare management system

3. Smart traffic management system & so on…

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

Text Books / Reference Books

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly publication, 2016

2. Joakim Verona," Practical DevOps", PACKT publishing, 2016

3. Honbo Zhou," The internet of things in the cloud", CRC press, Taylor and Francis group, 2012

4. Perry Lea," Internet of things for architects", PACKT publishing, 2018

Course Name: Digital Forensics

Course Code: PEIT32T
Category: PEC (Cyber Security)
Preamble:
This course introduces students to the principles, techniques, and methodologies of digital forensics. It covers the investigation and analysis of digital evidence, including file systems, network traffic, and digital devices. Emphasis is placed on legal and ethical considerations, as well as practical hands-on experience with forensic tools and techniques.
Pre-requisites:
Cryptography and Network Security
Course Objectives:

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

Course Outcomes:
Learner will be able to:
CO1: Recognize the need of digital forensics and define the concept of digital evidence and incident response

CO2: Apply the knowledge of computer forensics using different tools and techniques.
CO3: Detect the network attacks and analyse the evidence.
CO4: Apply the knowledge of computer forensics using different tools and techniques.
CO5: List the method to generate legal evidence and supporting investigation reports
CO6: Understand the legal framework in Digital forensics

Course Scheme:

Contact Hours		Credit Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Digital Forensics	Introduction to Digital Forensics, Need and Objectives of Digital Forensics, Types of Digital Forensics, Process of Digital Forensics, Benefits of Digital Forensics, Chain of Custody, Anti Forensics. Digital Evidence and its Types, Rules of Digital Evidence. Incident Response, Methodology of Incident Response, Roles of CSIRT in handling incident.	4
2	Computer Forensics	Introduction to Computer Forensics, Evidence collection (Disk, Memory, Registry, Logs etc), Evidence Acquisition, Analysis and Examination (Window, Linux, Email, Web, Malware) , Challenges in Computer Forensics, Tools used in Computer Forensics.	6
3	Network Forensics	Introduction, Evidence Collection and Acquisition (Wired and Wireless), Analysis of network evidence (IDS, Router,), Challenges in network forensics, Tools used in network forensics	6
4	Mobile Forensics	Introduction, Evidence Collection and Acquisition, Analysis of Evidence, Challenges in mobile forensics, Tools used in mobile forensics	4
5	Report Generation	Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report.	4
6	Introduction to Legal Frameworks	Overview of legal principles in digital forensics Sources of law relevant to digital evidence (statutory, case law, regulations), Jurisdictional considerations in digital investigations, Admissibility of digital evidence in court Rules of evidence (e.g., hearsay, authentication, best evidence rule) Chain of custody requirements and documentation, GDPR (General Data Protection Regulation) and its implications for digital forensics, HIPAA (Health Insurance Portability and Accountability Act) considerations, Other relevant privacy laws and their impact on digital investigations, Challenges with encryption and decryption Anti-forensic techniques and legal implications	6
Total			**30**

Textbooks:

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

Reference Books:

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

Course Name: Digital Forensics Lab

Course Code: PEIT32P

Category: Program Elective Course (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- IT06P

Operating system Lab- IT05P

Computer & Network Security Lab- IT24P

Course Objectives:

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

Course Outcomes:

Learner will be able to:

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

Course Scheme:

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

Assessment guidelines:

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

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

based on the nature of the course. Faculty may propose 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	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: Major Project I

Course Code: PRJIT02

K-S-A Mapping: Knowledge & Skill

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
PRJIT02	1	-	1	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
PRJIT02	25 (50%)	-	25(50%)	50 (100%)

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

Preamble:

The project work facilitates the students to develop and prove Technical, Professional andEthical skills and knowledge gained during graduation program by applying them from problem identification, analyzing the problem and designing solutions.

Course Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Develop the understanding of the problem domain through extensive review of literature.	Understanding
CO2	Identify and analyze the problem in detail to define its scope with problem-specific data.	Analysing
CO3	Know various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.	Applying
CO4	Design solutions for real-time problems that will positively impact society and environment.	Creating
CO5	Develop clarity of presentation based on communication, teamwork and leadership skills.	Evaluating

CO6	Inculcate professional and ethical behaviour.	Evaluating

Guidelines for Major Project:

Project orientation can be given at the end of sixth semester to give all instructions related to project domains, theme, process of group formation and guide allocation.

1. **Group Formation and Guide allocation:**
   - Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than two or more than four students, as it is a group activity.
   - 3 Guide and domain preferences will be taken from students.
   - Guide will select 2-3 groups from the pool of groups who give preference to him/her.
   - We also take care of mapping students preferred domain with guide expertise for guide allocation.

2. **Project Topic Selection**
   - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
   - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
   - Students can certainly take ideas from anywhere but be sure that they should evolve them in the unique way to suit their project requirements.
   - Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.

3. **Topic Finalization:**
   - Students should come up with atleast 2-3 project ideas for the Internal topic approval process which will be conducted in front of the panel members of faculty.
   - Guide along with other expert panel members will take decision regarding final selection of projects.
   - Topic approval with industry expert will also be conducted to validate the project idea.
   - The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
   - The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects).
   - Use of latest technology or modern tools can be encouraged.

4. **Review/progress monitoring:**

Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
Review/progress monitoring committee may consider following points for assessment based on either one year major project as mentioned in general guidelines.

One-year project:

- In semester VII entire theoretical solution shall be ready, including components/system selection and cost analysis, building of working prototype.
- Two reviews will be conducted based on presentation given by students group.
- First shall be for finalization of problem and proposed solution of the problem.

- Second shall be on readiness of working and testing of prototype to be conducted.
- In semester VIII expected work shall be procurement of testing and validation of results based on work completed in an odd semester.
- First review is based on improvements in testing and validation results cum demonstration for publication to be conducted.
- Second review shall be based on paper presentation in conference/journal or copyright or Indian patent in last month of the said semester.
- In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels.

5. Project Report Format:

- At the end of semester, each group needs to prepare a project report as per the guidelines issued by the Mumbai university.
- A project report should preferably contain at least following details:
- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System o Analysis/Framework/ Algorithm
- Design details o Methodology (your approach to solve the problem) Proposed System
- Experimental Set up o Details of Database or details about input to systems or selected data
- Performance Evaluation Parameters (for Validation)
- Software and Hardware Set up o Implementation Plan for Next Semester
- Timeline Chart for Term1 and Term-II (Project Management tools can be used.)
- References

Desirable

Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.)

6. In Semester Assessment (ISA):

Distribution of marks for term work shall be done based on following:

- Weekly progress reporting to guide (Individual Project Work Contribution): 10M
- Marks awarded by review committee during review 1 and 2 (average of two): 10M
- Project Report quality: 5M

The final certification and acceptance of ISA ensures the satisfactory performance on the above aspects.

7. Oral and Practical:

- At the end of the semester major project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Suggested quality evaluation parameters are as follows:

- Quality of problem selected

- Clarity of problem definition and feasibility of problem solution
- Relevance to the specialization / industrial trends
- Originality
- Clarity of objective and scope
- Quality of analysis and design
- Quality of written and oral presentation
- Individual as well as teamwork

Track: Bioinformatics

Course Name: Algorithms and Data Structures in Bioinformatics

Course Code: MDMBI02

Vertical/ Sub-Vertical: MDM

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: - Introduction to Bioinformatics (MDMBI01)

Pre-requisite for: - Machine Learning Applications in Bioinformatics (MDMBI03)

Recommended Semester: Sem IV(R2024),Sem VI(R2023)

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 (MDMBI02)	15 (~20%)	30 (~30%)	50 (~50%)	100 (100%)

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

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

Course Objectives:

- To enable learners to understand the basic data structures for Bioinformatics.
- Build foundational understanding of various algorithms

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Apply fundamental data structures and algorithms (arrays, trees, graphs, hashing, etc.) to solve computational problems in bioinformatics.	Apply

CO2	Analyze and implement sequence alignment algorithms for comparing DNA, RNA, and protein sequences, including global, local, and heuristic approaches.	Analyse
CO3	Construct and interpret phylogenetic trees using distance-based and character-based algorithms for evolutionary analysis.	Applying
CO4	Use algorithmic and statistical models, such as HMMs and motif-finding tools, to predict genes and regulatory elements in genomic sequences.	Applying
CO5	Design and evaluate scalable bioinformatics workflows and pipelines using big data technologies and cloud platforms for handling large-scale genomic datasets.	Evaluate

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Review of Data Structures and Algorithms	**Contents:** Arrays, strings, stacks, queues, Graphs and trees: DFS/BFS with examples from biological data, Suffix trees, suffix arrays, tries, Hashing techniques for genome indexing ***Self-Learning Topics***: *Advanced indexing data structures in genomics*	8
2	Sequence Alignment Algorithms	**Contents:** 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	**Contents:** 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	**Content:** 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	**Content:** Challenges of large-scale genomic and multi-omics data, Hadoop and Spark frameworks for	7

		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	
Total			45

Books and Resources :

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

Track: Bioinformatics

Course Name: Startup Planning and Development

Course Code: MDMIE02

Vertical/ Sub-Vertical: MDM

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: - Foundations of Innovation and Entrepreneurship (Sem V)

Pre-requisite for: - Innovation Management and Scaling Startups

Recommended Semester: Sem IV(R2024),Sem VI(R2023)

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.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Design MVPs and apply lean startup methods.	Apply / Analyze
CO2	Conduct market and competitor analysis.	Analyze
CO3	Prepare financial models and pitch decks.	Create
CO4	Understand legal frameworks and intellectual property.	Understand

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	10
3	**Startup Finance**	• Basics of financial modelling • Unit economics, pricing, and revenue models	

		• Funding sources: bootstrapping, angels, VCs, crowdfunding	
4	**Legal & Regulatory Aspects**	• Company formation: types and registration • IPR basics: patents, trademarks, copyrights • Compliance and taxation	
5	**Business Plan Development**	• Writing an effective business plan • Pitch deck essentials	

Tutorials (1 Credit):

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

Assessment Methods:

- Class participation & assignments (20%)
- Mid-term exam (20%)
- Business Plan project (30%)
- Final exam (30%)

Recommended Reading:

- Zero to One by Peter Thiel
- The Lean Startup by Eric Ries
- Venture Deals by Brad Feld

Course Name: Financial Basics for Engineers and Technopreneurs

Course Code: MDMBD02

Category: Minor Degree Course (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 analyze 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:

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

Assessment Guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	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**

PO Mapping by Module:

- Module 1: PO11, PO1
- Module 2: PO4, PO11
- Module 3: PO2, PO11
- Module 4: PO1, PO4
- Module 5: PO6, PO11
- Module 6: PO11, PO12

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: BMMDM2T

Category: Multidisciplinary Minor (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 (BMMDM1T)

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: Analyze 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:

Contact Hours		Credits Assigned
Theory	Practical	Total
03	--	03

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory+ Tutorial	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 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

Module No.	Module Name	Module Contents	No. of Hours
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:

7. Design a vision-based system that can detect traffic violations like red-light running or illegal turns using video footage.
8. Use a stereo camera or simulated stereo images to generate a 3D point cloud and reconstruct a small indoor environment.
9. Create a system that inspects manufactured parts (e.g., PCB boards, bottles, machined components) and flags defects or anomalies using image processing.
10. Develop a mobile robot that can autonomously locate and scan barcodes or QR codes placed in a room to log inventory data.
11. Implement a system that uses AprilTags or ArUco markers to help a robot localize itself within an indoor environment.
12. 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