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

Final Year Scheme & Syllabus

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

Preamble

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

The curriculum comprises courses from various categories like basic sciences, humanities and social sciences, engineering sciences, general education and branch specific courses including professional electives and open electives. The curriculum has core courses of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. These courses are completed by third year of the engineering programme that enables learners to prepare for higher education during their final year. Professional elective courses, that begin from third year of programme, offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique professional elective courses based on industrial requirements and organizing them into tracks is a salient feature of this curricula ensuring employability. Open Elective courses cover multi-disciplinary, special skill development, project management and similar knowledge that make learner capable to work in industrial environment.

For holistic development of learners, apart from technical courses, Humanities and Social Science courses develop the required soft-skills and attitude amongst learners. Our curriculum also introduces Social Service Internship and Internship with institutes abroad along with courses like Design Thinking, Yoga and Meditation, Indian Traditional Knowledge System under General Education category. These general education courses aim to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses. In addition to this, the curriculum is augmented with Life Enrichment audit courses for knowledge inspiring experience.

Additionally, curriculum provides add-on Honours/Minor degree that involves field/ domain study. Learner can avail this degree by completing requirement of additional 18 credits.

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

Chairman, Board of Studies
Department of Information Technology
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Final Year B. Tech. Information Technology **Semester: VII**

Course Structure and Assessment guidelines

Course		Head of Learning	Credits	Assessment guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
ITXXT	Professional Elective-4	Theory	2	15	20	40	075
ITXXP	Professional Elective-4 Lab	Practical	1	25	-	25	050
ITXXT	Professional Elective-5	Theory	2	15	20	40	075
ITXXP	Professional Elective-5 Lab	Practical	1	25	-	25	050
ITXXT	Professional Elective-6	Theory	2	15	20	40	075
ITXXP	Professional Elective-6 Lab	Practical	1	25	-	25	050
OEXX*	Any two from the offered Open Elective courses	Theory	3	20	30	50	100
OEXX*		Theory	3	20	30	50	100
IT49	Project-1 (Synopsis)	Theory	3	50	-	50	100
		Total	**18**				
Course credits completed during the previous inter-semester break will appear in this semester's marksheet							
IT48	Industry Internship	Practical	5	75	-	75	150

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

*Selection based on the subset of OE 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-4 Courses (ITXX)

Specialization Track Name#	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing @40% of total marks)
	Code	Name			ISA	MSE	ESE	
Artificial Intelligence and Machine Learning (AIML)	IT33T	Data Analytics & Visualization	Theory	2	15	20	40	075
	IT33P	Data Analytics & Visualization Lab	Practical	1	25	-	25	050
Data Science (DS)	IT34T	Big Data Analytics	Theory	2	15	20	40	075
	IT34P	Big Data Analytics Lab	Practical	1	25	-	25	050
Internet of Things (IoT)	IT35T	Internet of Things and Edge Computing	Theory	2	15	20	40	075
	IT35P	Internet of Things and Edge Computing Lab	Practical	1	25	-	25	050
Cyber Security (CSec)	IT36T	Mobile and Wireless Security	Theory	2	15	20	40	075
	IT36P	Mobile and Wireless Security Lab	Practical	1	25	-	25	050

#For details of Specialization Certificate, refer Appendix-A

Professional Elective-5 Courses (ITXX)

Specialization Track Name[#]	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Artificial Intelligence and Machine Learning (AIML)	IT37T	Deep Learning	Theory	2	15	20	40	075
	IT37P	Deep Learning Lab	Practical	1	25	-	25	050
Data Science (DS)	IT38T	Recommendation System	Theory	2	15	20	40	075
	IT38P	Recommendation System Lab	Practical	1	25	-	25	050
Internet of Things (IoT)	IT39T	Internet of Things Security and Trust	Theory	2	15	20	40	075
	IT39P	Internet of Things Security and Trust Lab	Practical	1	25	-	25	050
Cyber Security (CSec)	IT40T	Malware Analysis	Theory	2	15	20	40	075
	IT40P	Malware Analysis Lab	Practical	1	25	-	25	050

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

Professional Elective-6 Courses (ITXX)

Specialization Track Name[#]	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Artificial Intelligence and Machine Learning (AIML)	IT41T	Natural Language Processing	Theory	2	15	20	40	075
	IT41P	Natural Language Processing Lab	Practical	1	25	-	25	050
Data Science (DS)	IT42T	Text, Web & Social Media Analytics	Theory	2	15	20	40	075
	IT42P	Text, Web & Social Media Analytics Lab	Practical	1	25	-	25	050
Internet of Things (IoT)	IT43T	Industrial IoT	Theory	2	15	20	40	075
	IT43P	Industrial IoT Lab	Practical	1	25	-	25	050
Cyber Security (CSec)	IT44T	Web Application Security	Theory	2	15	20	40	075
	IT44P	Web Application Security Lab	Practical	1	25	-	25	050

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

Final Year B. Tech. Information Technology **Semester: VIII**

Course Structure and Assessment guidelines

Course		Head of Learning	Credits	Assessment guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
OEXX*	Any three from the offered Open Elective courses	Theory	3	20	30	50	100
OEXX*		Theory	3	20	30	50	100
OEXX*		Theory	3	20	30	50	100
IT50	Project-2 (Final)	Theory & Practical	4	75	-	50	125
		Total	**13**				

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

*Selection based on the subset of OE 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.

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 Science (DS)
3. Cyber Security (CSec)
4. Internet of Things (IoT)

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 specializations.

AIML Track: Courses to be chosen for specialization in Artificial Intelligence and Data Science

Semester	Course Code	Course Name
V	IT21T	Artificial Intelligence
	IT21P	Artificial Intelligence Lab
VI	IT25T	Soft Computing
	IT25P	Soft Computing Lab
VI	IT29T	Probabilistic Graphical Model
	IT29P	Probabilistic Graphical Model Lab
VII	IT33T	Data Analytics & Visualization
	IT33P	Data Analytics & Visualization Lab
VII	IT37T	Deep Learning
	IT37P	Deep Learning Lab
VII	IT41T	Natural Language Processing
	IT41P	Natural Language Processing Lab

Data Science Track: Courses to be chosen for specialization in Data Science

Semester	Course Code	Course Name
V	IT22T	Advanced Database Management System
	IT22P	Advanced Database Management System Lab
VI	IT26T	Data and Feature Engineering
	IT26P	Data and Feature Engineering
VI	IT29T	Probabilistic Graphical Model
	IT29P	Probabilistic Graphical Model Lab
VII	IT34T	Big Data Analytics
	IT34P	Big Data Analytics Lab
VII	IT38T	Recommendation System
	IT38P	Recommendation System Lab
VII	IT42T	Text, Web & Social Media Analytics
	IT42P	Text, Web & Social Media Analytics Lab

IoT Track: Courses to be chosen for specialization in IoT

Semester	Course Code	Course Name
V	IT23T	Modern Sensors for IoT
	IT23P	Modern Sensors for IoT Lab
VI	IT27T	Principles of IoT
	IT27P	Principles of IoT Lab
VI	IT31T	Embedded System Design with Tiny OS
	IT31P	Embedded System Design with Tiny OS Lab
VII	IT35T	IoT Network & Protocols & Edge Computing
	IT35P	IoT Network & Protocols & Edge Computing Lab
VII	IT39T	IoT Security & Trust
	IT39P	IoT Security & Trust Lab
VII	IT43T	Industrial IoT
	IT43P	Industrial IoT Lab

CSec Track: Courses to be chosen for specialization in Cyber Security

Semester	Course Code	Course Name
V	IT24T	Computer & Network Security
	IT24P	Computer & Network Security Lab
VI	IT28T	System Security & Ethical Hacking
	IT28P	System Security & Ethical Hacking Lab
VI	IT32T	Digital Forensic
	IT32P	Digital Forensic Lab
VII	IT36T	Mobile and Wireless Security
	IT36P	Mobile and Wireless Security Lab
VII	IT40T	Malware Analysis
	IT40P	Malware Analysis Lab
VII	IT44T	Web Application Security
	IT44P	Web Application Security Lab

Open Elective Courses for Final Year

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

Advanced Honors:

Semester	Course Code	Course Name	Track
Sem 7 Honors	IT55T	Scalable ML and BDA	AIML Track
	IT55P	Scalable ML and BDA Lab	
Sem 8 Honors	IT59T	Generative model and GenAI.	
	IT59P	Generative model and GenAI Lab	

Semester	Course Code	Course Name	Track
Sem 7 Honors	IT56T	Time Series and Forecasting	Advanced DA track
	IT56P	Time Series and Forecasting Lab	
Sem 8 Honors	IT60T	Data Ethics and Privacy	
	IT60P	Data Ethics and Privacy Lab	

Semester	Course Code	Course Name	Track
Sem 7 Honors	IT58T	Advanced Threat Intelligence and Penetration testing	Advanced Cyber Security
	IT58P	Advanced Threat Intelligence and Penetration testing Lab	
Sem 8 Honors	IT62T	Detection & Mitigation of Cyber Threats	
	IT62P	Detection & Mitigation of Cyber Threats Lab	

Semester	Course Code	Course Name	Track
Sem 7 Honors	IT68T	UX Design, Evaluation and ARVR	UI/UX
	IT68P	UX Design, Evaluation and ARVR Lab	
Sem -8 Honors	IT69T	Use cases in UI/UX	
	IT69P	Use cases in UI/UX Lab	

Course Name: Data Analytics and Visualization

Course Code: IT33T & IT33P

Vertical/ Sub-Vertical: Professional Elective (PE)

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Data And feature Engineering (Sem VI)

Pre-requisite for: NA Recommended

Semester: 7 Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT33T	2	-	2	-
IT33P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT33T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT33P)	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:

This course introduces students to the core concepts of data analytics and visualization, emphasizing analytical thinking and insight generation. It explores the complete data lifecycle—from collection and preparation to interpretation and storytelling. Students will develop the ability to extract meaningful patterns and present data-driven narratives effectively. The course lays a strong theoretical foundation for real-world data-driven decision-making in IT contexts.

Course Objectives:

- To provide a thorough understanding of the data analytics lifecycle and its role in decision-making.
- To develop the ability to preprocess, clean, and structure data for meaningful analysis.
- To enable students to perform exploratory data analysis and interpret statistical patterns.

- To impart knowledge of visualization principles for effective communication of insights.
- To cultivate analytical and critical thinking skills for solving real-world IT problems using data.

Course Outcomes:

Learner will be able to:

Course Outcome	**Course Outcome Statement**	**Bloom's Level**
CO1	Understand and apply types of analytics within the data lifecycle to solve business problems.	Applying
CO2	Classify data types and address quality issues for effective analysis.	Analysing
CO3	Clean, transform, and engineer features to prepare reliable analytical datasets.	Applying
CO4	Conduct exploratory and inferential analysis to identify patterns and validate hypotheses.	Analysing
CO5	Create and interpret ethical, effective visualizations for analytical storytelling.	Creating
CO6	Build decision models and communicate insights for informed action.	Evaluating

Detailed Syllabus:

Module No.	**Module Name**	**Content**	**No of Hours**
1	Foundations of Data Analytics and Analytical Thinking	The analytics mindset: data as a strategic asset, Key terms: data, information, knowledge, wisdom, Types of analytics: descriptive, diagnostic, predictive, prescriptive, Data analytics lifecycle: Business Understanding to Deployment, Stages of the analytics process: question formulation to insight generation, Analytical thinking vs. operational thinking, Hypothesis formulation and decision-making under uncertainty, Ethical aspects: data privacy, consent, and responsible analytics, Ethical reasoning and responsible analytics	5

2	Data Classification and Analytical Structures	Classification of data: structured, semi-structured, unstructured, Scales of measurement: nominal, ordinal, interval, ratio, Data quality issues: accuracy, completeness, consistency, timeliness Data domains: categorical, numerical, temporal, spatial, text, Levels of measurement and implications for analysis, Structured thinking: dimensional modeling (facts, dimensions), Data segmentation and cohort analysis, Identifying variables: dependent, independent, control, Analytical implications of data quality issue.	5
3	Data Cleaning, Transformation, and Feature Logic	Significance of data cleaning and transformation, Analytical importance of clean and reliable data, Handling missing data, noise, and outliers, Logic-based approaches to missing value imputation, Outlier analysis and its role in data sensitivity, Data normalization, standardization, and transformation techniques, Feature engineering: encoding, discretization, binning, Feature construction: derived variables, transformations, ratios, Causal reasoning and variable selection, Dimensionality reduction, Dimensionality vs. interpretability trade-offs, Sampling methods: random, stratified, systematic	5
4	Inferential and Exploratory Data Analysis	Role of EDA in hypothesis formation and pattern recognition, Statistical measures: central tendency, dispersion, skewness, kurtosis, Relationship analysis: correlation and covariance, Identifying patterns, anomalies, and trends in data, Data profiling and summary techniques, EDA in the context of problem-solving in IT and software systems Descriptive vs. inferential statistics in analytical workflows, Distribution analysis: normality, skewness, kurtosis, Correlation analysis, confounding variables, and spurious relationships, Cross-tabulation and association measures, Pattern recognition and anomaly detection, EDA as a tool for hypothesis refinement and validation	5
5	Analytical Visualization Techniques and Interpretation	Analytical purpose of visualization: exploration, confirmation, explanation, Visual encoding: cognitive effectiveness and data-to-ink ratio, Visual models for comparisons, trends, distributions, relationships, Interpretation of multi-dimensional and multivariate plots, Visual bias, distortion, and ethical implications, Narrative visualization: designing visual argumentation and insight flow.	5
6	Decision Modeling and Insight Communication	Decision trees and rule-based inference (theory-level), Scenario modelling and sensitivity analysis, KPI identification and metric interpretation, Synthesizing findings from data: from insight to action, framing business and IT problems as analytical questions, Constructing and presenting evidence-based arguments, Capstone analytical case studies from industry domains	5

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Simulating the Analytics Lifecycle to Address a Business Problem
2.	Build an Interactive Dashboard to Support Business Decisions using Power BI
3.	Classify the data into structured, semi-structured, and unstructured types & identify scales of measurement. Assess Data Quality dimensions (accuracy, completeness, consistency, timeliness) in a Real-World Dataset using python.
4.	Build a Dimensional Model and Perform Cohort Analysis using Power BI
5.	Enhance Model Accuracy by Cleaning and Transforming Raw Data using python
6.	Sampling and Dimensionality Reduction for Efficient Analysis using Python/Power BI
7.	Uncovering Customer Behavior Patterns through EDA using python and Power BI
8.	Hypothesis Testing and Anomaly Detection in IT System Logs
9.	Designing Effective Visualizations for Business Insights by developing Visual Dashboards to Explore and Explain Sales Performance using Power BI and tableau
10.	Create a Storytelling Report from Multivariate Data to Support Strategic Decisions
11.	Predict Customer Churn Using Decision Trees and Identify Key Influencing Factors using python
12.	KPI-Based Scenario Modeling for Business Performance Optimization using Power BI

Course Name: Big Data Analytics

Course Code: IT34T & IT34P

Vertical/ Sub-Vertical: PE

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT26T (Data & Feature Engineering), IT15T (Machine Learning)

Pre-requisite for: NIL

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT34T	2	--	2	--
IT34P	--	2	--	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT34T)	15	20	40	75
Practical (IT34P)	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.

Preamble:

This course introduces students to the foundational concepts, tools, and frameworks used in processing and analyzing big data, such as Hadoop, Spark, and NoSQL systems. Emphasis is placed on hands-on implementation and understanding of distributed computing paradigms, data storage models, data preprocessing techniques, and machine learning at scale. By integrating theory with real-world applications, the course prepares learners to design and deploy big data solutions that are efficient, robust, and impactful across domains such as finance, healthcare, social networks, and cybersecurity.

Course Objectives:

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs
5. Provide hands on Hodoop Eco System
6. Apply analytics on Structured, Unstructured Data.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Explain the motivation for big data systems and identify major sources and characteristics of Big Data in real-world domains.	Understanding
CO2	Demonstrate the use of Hadoop, NoSQL, and related tools to store, retrieve, and query large-scale data effectively.	Applying
CO3	Implement data processing tasks using the MapReduce programming model for handling large datasets.	Applying
CO4	Apply various algorithms for stream processing, clustering, classification, and frequent pattern mining in Big Data.	Applying
CO5	Analyze and design algorithms to extract insights from web graphs, social media, and sensor data streams.	Analyzing/Creating
CO6	Design and evaluate recommendation systems using collaborative filtering, content-based methods, and hybrid approaches.	Creating

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction to Big Data	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	2
2	Introduction to Big Data Frameworks: Hadoop, NOSQL	What is Hadoop? Hadoop Components; Hadoop Ecosystem **Overview of** Apache Spark, Pig, Hive, Hbase, Sqoop **What is NoSQL?** NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, **Mongo DB:** Creation and Deletion of database, insertion, deletion and updating operation	6
3	MapReduce Paradigm	**MapReduce:** The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution. **Algorithms Using MapReduce:** Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step	6
4	Mining Big Data Streams	**The Stream Data Model:** A Data- Stream-Management System, Stream Queries, Issues in Stream Processing. **Filtering Streams:** The Bloom Filter **Counting Distinct Elements in a stream**: The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements.	6

		Counting Ones in a Window: Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm.	
5	Big Data Mining Algorithms	**Frequent Pattern Mining**: Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. **Clustering Algorithms:** CURE Algorithm **Classification Algorithms:** Parallel Decision trees, Overview SVM classifiers, SVM, K-Nearest Neighbor classifications for Big Data	4
6	Big Data Applications	**Link Analysis**: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient Computation of Page Rank: PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. **Recommendation Engine**s: A Model for Recommendation Systems, Types of recommendation, Content-Based Recommendations, Collaborative Filtering	6
Total			**30**

Suggested List of Practicals:

Sr. No.	List of experiments
1	Find suitable dataset and perform data visualization using Python/Tableau/PowerBI.
2	To study Hadoop commands.
3	To implement MapReduce task for word count application
4	To study Hadoop Ecosystem
5	To perform CRUD operations in MongoDB
6	Simulate a stream of sensor data and perform basic stream queries.
7	Estimate count of distinct elements using Flajolet-Martin Algorithm
8	To study and implement classification algorithms on big data
9	To implement PageRank algorithm
10	To design and implement any one type of recommendation system

Course Name: IoT Network & Protocols & Edge Computing

Course Code: IT35T

Category: Professional elective - 4 (IoT Track)

Preamble:

This course explores the convergence of Internet of Things (IoT) and Edge Computing, delving into the technologies and applications that are transforming our world. This course delves into the rapidly evolving landscape where everyday objects are becoming intelligent and interconnected. Students will explore how sensors, actuators, and embedded systems are weaving a web of data, transforming how we live, work, and interact with the environment.

The course will equip students with a foundational understanding of IoT, its core technologies, and communication protocols. Students will delve into the power of Edge Computing, a paradigm shift that brings processing capabilities closer to the data source, enabling real-time analytics, faster decision-making, and improved efficiency.

Pre-requisites:

- C Programming
- Microprocessor and Microcontroller
- IoT Sensor Technology

Course Objectives:

- To understand the core concepts of the Internet of Things (IoT) and its key components & Levels.
- Analyze the role of Edge Computing in distributed processing and data analysis within the IoT ecosystem**.**
- Evaluate the security challenges and potential vulnerabilities within IoT deployments.
- Understand the fundamental concepts of IoT, CPS, and their convergence.

Course Outcomes:

Student will be able to:
CO1: Understand the interaction between IoT devices, cloud platforms, and physical systems in CPS.
CO2: Apply principles of Edge Computing to analyze data at the network edge.
CO3: Analyze the role of Edge Computing in distributed processing and data analysis within the IoT ecosystem.
CO4: Identify and discuss security best practices for secure IoT deployments.
CO5: Analyze the role of cloud computing in managing and processing data from IoT device
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 IoT and CPS	1.1 Introduction to Cyber-Physical Systems (CPS) 1.2 Characteristics and applications of CPS 1.3 Convergence of IoT and CPS: creating intelligent systems	5
2	Introduction to Edge Computing	2.1 What is Edge Computing? 2.2 Benefits of Edge Computing in the IoT ecosystem (e.g., reduced latency, improved efficiency) 2.3 Edge Computing architectures (e.g., edge nodes, fog computing) Resource constraints and limitations of edge devices	5
3	Edge Computing Applications and Programming	3.1 Case studies of Edge Computing applications in IoT (e.g., predictive maintenance, autonomous vehicles) 3.2 Introduction to Edge Computing development tools and frameworks 3.3 Programming for edge devices (e.g., embedded systems programming)	5
4	Security Considerations in IoT	4.1 Security vulnerabilities in IoT deployments 4.2 Authentication and authorization mechanisms 4.3 Data encryption and privacy concerns 4.4 Secure coding practices for IoT devices	5
5	Cloud Computing for IoT	5.1 Cloud service models for IoT (IaaS, PaaS, SaaS) 5.2 Benefits of cloud computing in managing and processing IoT data (scalability, security, etc.) 5.3 Cloud platforms for IoT (e.g., AWS IoT, Azure IoT)	5

		5.4 Data pipelines for transferring and processing sensor data in the cloud	
6	Future Trends in IoT CPS and Edge Computing	6.1 Emerging technologies (e.g., Artificial Intelligence, Block chain) in IoT 6.2 Impact of 5G on IoT and Edge Computing 6.3 Ethical considerations and responsible development of CPS solutions	5
Total			**30**

Text Books:

1. "Cyber-Physical Systems: Design and Analysis" by Lee E. Miller (2013)
2. "Cloud Computing for Cyber Physical Systems: Enabling Technologies and Applications" by Vijayakumar Gayathri, et al. (2019)
3. "Hands-On Internet of Things with Arduino and Raspberry Pi: Building Practical Applications" by Dr. Srinivas Upputuri (2020)
4. "Building IoT Projects with ESP8266 and ESP32" by Pradeeka Kumar (2020)
5. "Edge Computing for the Internet of Things: Secure and Scalable Distributed Intelligence" by Michael Dieterich (2020)
6. "Cyber-Physical Systems Prototyping with Lego Mindstorms" by Wesley Plugge et al. (2014)

Reference Books:

1. "Designing the Internet of Things" by Adrian McEwen and Hakim Cassimally (2014)
2. "Edge Computing: Networking and Security for the Internet of Things" by Yuhui Xu, et al. (2018)
3. "Fog Computing: Theory, Practice, and Applications" by Tom Pfeifer and Dominic Grulich (2019)

Course Name: IoT Network & Protocols & Edge Computing Laboratory

Course Code: IT35P

Category: Professional elective - 4 (IoT track)

Preamble:

This laboratory course delves into the practical applications of the Internet of Things (IoT), Edge Computing, Cloud Computing, and Cyber-Physical Systems (CPS). Students will gain hands-on experience by working with real-world scenarios and exploring the interaction between these technologies
The lab will equip students with the skills to:

- Design and implement basic IoT systems
- Utilize Edge Computing platforms for data processing closer to the source
- Leverage cloud services for data storage, analysis, and visualization
- Integrate IoT devices with Cyber-Physical Systems for real-world applications

Pre-requisites:

- C Programming
- Microprocessor and Microcontroller
- IoT Sensor Technology

Course Objectives:

- Gain practical experience in setting up and configuring IoT devices.
- Understand and implement data collection and processing techniques on edge devices.
- Analyze and visualize data generated by IoT devices using cloud platforms.
- Design and implement basic Cyber-Physical Systems using IoT and cloud integration.
- Apply security best practices in developing and deploying IoT solutions.

Course Outcomes:

Student will be able to:
CO1: Successfully configure and program various IoT devices (sensors, actuators).
CO2: Utilize Edge Computing platforms for data processing tasks on edge nodes.
CO3: Develop data pipelines to transfer data from IoT devices to the cloud.
CO4: Analyze and visualize sensor data using cloud-based tools and services.
CO5: Design and prototype a basic Cyber-Physical System with IoT and cloud integration.
CO6: Implement secure communication protocols for data transmission in an IoT system.

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.

List of Practical's:

Experiment 1: Setting Up an IoT Development Environment

- Familiarize with development boards (e.g., Arduino, Raspberry Pi)
- Install necessary software and libraries

Experiment 2: Sensor Interfacing and Data Acquisition

- Interface various sensors (e.g., temperature, humidity) with the development board
- Write code to collect and record sensor data

Experiment 3: Communication Protocols for IoT

- Experiment with different communication protocols (e.g., Wi-Fi, Bluetooth)
- Develop code to send and receive data between devices

Experiment 4: Introduction to Edge Computing Platforms

- Explore popular Edge Computing platforms (e.g., AWS Greengrass, Azure IoT Edge)
- Deploy simple applications for data processing on edge devices

Experiment 5: Cloud Integration for IoT Data

- Connect IoT devices to a cloud platform (e.g., AWS IoT, Azure IoT Hub)
- Develop code to send sensor data to the cloud

Experiment 6: Data Visualization with Cloud Services

- Utilize cloud platform tools to visualize sensor data in real-time (e.g., dashboards, charts)

Experiment 7: Introduction to Cyber-Physical Systems (CPS)

- Simulate a basic CPS scenario (e.g., smart home, industrial automation)
- Integrate IoT devices with actuators to control physical processes

Experiment 8: Security Considerations in IoT Systems

- Implement secure communication protocols (e.g., encryption)
- Understand best practices for securing data transmission and storage in IoT

Mini Projects / Case Study:-

Design and develop a complete IoT-based system with Edge Computing and Cloud integration

Text Books:

1. "Cyber-Physical Systems: Design and Analysis" by Lee E. Miller (2013)
2. "Cloud Computing for Cyber Physical Systems: Enabling Technologies and Applications" by Vijayakumar Gayathri, et al. (2019)
3. "Hands-On Internet of Things with Arduino and Raspberry Pi: Building Practical Applications" by Dr. Srinivas Upputuri (2020)
4. "Building IoT Projects with ESP8266 and ESP32" by Pradeeka Kumar (2020)
5. "Edge Computing for the Internet of Things: Secure and Scalable Distributed Intelligence" by Michael Dieterich (2020)
6. "Cyber-Physical Systems Prototyping with Lego Mindstorms" by Wesley Plugge et al. (2014)

Reference Books:

1. "Designing the Internet of Things" by Adrian McEwen and Hakim Cassimally (2014)
2. "Edge Computing: Networking and Security for the Internet of Things" by Yuhui Xu, et al. (2018)
3. "Fog Computing: Theory, Practice, and Applications" by Tom Pfeifer and Dominic Grulich (2019)

Course Name: Mobile & Wireless Security

Course Code: IT36T and IT36P

Vertical/ Sub-Vertical: PE

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT21T (Computer Network & Security)

Pre-requisite for: IT62T (Detection & Mitigation of Cyber Threats)

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT36T	2	-	2	-
IT36P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (CE01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (CE01P)	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 rapid proliferation of mobile devices and wireless networks has introduced unique security challenges. This course focuses on understanding threats, vulnerabilities, and defenses specific to mobile platforms and wireless communication. Students will learn about attack vectors, security protocols, and mitigation strategies, with an emphasis on practical tools for securing mobile and wireless systems.

Course Objectives:

1. Understand the architecture and security challenges of mobile and wireless systems.
2. Explore vulnerabilities and attack methods in mobile devices and wireless networks.
3. Familiarize students with tools used for penetration testing and securing mobile and wireless platforms.
4. Study security protocols and frameworks used in wireless communications.
5. Develop strategies to protect against malware, phishing, and other mobile-based attacks.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Analyze and identify threats in mobile and wireless systems	Remembering
CO2	Perform security assessments using industry-standard tools.	Understanding
CO3	Understand and implement wireless security protocols.	Applying
CO4	Mitigate risks associated with mobile applications and platforms	Understanding
CO5	Demonstrate knowledge of securing IoT devices and wireless communications	Applying

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Mobile & Wireless Security	Overview of mobile and wireless security landscape. Threats and vulnerabilities in mobile platforms. Introduction to mobile and wireless attack surfaces. *Self-Learning Topics*: *Evolution Of mobile communication technologies (2G to 5G), Mobile operating systems (Android, iOS) security features, Wireless communication standards and protocols (Wi-Fi, Bluetooth, LTE)*	4
2	Mobile Device Security	analysis, permissions, and data storage. Threats: Rooting/jailbreaking, malware, phishing. Tools Covered: MobSF (Mobile Security Framework): For mobile app security assessment. Frida: For runtime analysis of mobile applications. *Self-Learning Topics*: *Android and iOS app security models , Best practices for secure mobile app development, Overview of OWASP Mobile Top 10 vulnerabilities, Static and dynamic mobile app analysis techniques, Case studies on real-world mobile security breaches, Introduction to mobile threat defense (MTD) solutions.*	6

3	Wireless Network Security	Wireless protocols: Wi-Fi, Bluetooth, NFC, and Zigbee. WPA, WPA2, WPA3: Strengths and weaknesses. Common attacks: Eavesdropping, MITM, rogue access points, replay attacks. Wireless intrusion detection and prevention systems. Aircrack-ng: For Wi-Fi penetration testing. Wireshark: For traffic capture and network analysis. *Self Learning topics: Differences between personal and enterprise wireless security configurations, IEEE 802.11 standards and security extensions, Real-world case studies of wireless network breaches.*	6
4	Mobile Application Security	To understand the principles of secure mobile application development, perform static and dynamic analysis, and identify vulnerabilities using industry-standard tools and frameworks. ***Self-Learning Topics***: *Mobile app development lifecycle and security checkpoints, Android app components and security implications (Activities, Services, Broadcast Receivers), Secure data storage and transmission practices in mobile apps*	4
5	IoT and Wearable Device Security	Security challenges in IoT and wearable devices. Protocols used in IoT communication (MQTT, CoAP). Securing IoT devices and gateways. Case studies: IoT attacks and their mitigation. Tools Covered: Shodan: For IoT device discovery and analysis. IoT Inspector: For IoT traffic analysis. ***Self-Learning Topics***: *Security implications of constrained devices and networks, Device authentication and firmware security in IoT, Threat modeling for IoT systems.*	6
6	Mobile and Wireless Incident Handling	Steps in mobile and wireless incident response. Analyzing and preserving evidence from mobile and wireless systems. Case studies: Mobile malware and wireless network breaches. Tools Covered: Cellebrite UFED: For mobile device forensic investigation. Kali Linux Wireless Tools: For wireless incident analysis. ***Self-Learning Topics***: Legal and ethical aspects of digital forensics, Chain of custody and evidence handling procedures, Mobile device acquisition techniques (logical, physical, and file system extraction)	4

Total	30

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Setting Up a Mobile and Wireless Security Lab
2.	Mobile Application Security Testing
3.	Reverse Engineering Android Applications
4.	Wireless Network Penetration Testing
5.	Rogue Access Point and Evil Twin Attack Simulation
6.	IoT Device Security Analysis
7.	Bluetooth Security Testing

Course Name: Deep Learning & Deep Learning Lab

Course Code: IT37T & IT37P

Vertical/ Sub-Vertical: Professional Elective

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT15 (Machine Learning), IT25 (Soft Computing)

Pre-requisite for: IT41 (Natural Language Processing)

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT37T	2	-	2	-
IT37P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT37T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (IT37P)	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:

Deep Learning explores the design, principles, and theoretical foundations of multi-layered neural networks used to model complex patterns in data. This course covers core architectures such as feedforward networks, CNNs, RNNs, and generative models, along with essential concepts like optimization, regularization, and representation learning. By the end, students will gain a strong conceptual understanding of deep learning and be prepared to analyze, design, and interpret deep models across a range of AI applications.

Course Objectives:

- To introduce the mathematical and algorithmic foundations of deep learning.
- To understand various neural network architectures and their internal mechanisms.
- To analyze and compare deep learning models in terms of complexity and performance.

- To explore key concepts like optimization, regularization, and representation learning.
- To appreciate the role of deep learning in modern AI applications.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall and describe fundamental concepts of deep learning such as perceptrons, MLPs, gradient descent, and backpropagation.	Remembering
CO2	Explain the role of autoencoders, regularization techniques, and architectural improvements in deep learning.	Understanding
CO3	Apply training techniques (e.g., backpropagation, dropout, batch normalization) to build effective neural networks.	Applying
CO4	Analyze various deep neural network architectures including CNNs, RNNs, GRUs, and LSTMs for different tasks.	Analysing
CO5	Evaluate and compare generative models such as VAEs, PixelRNNs, WaveNet, and GPT in terms of performance and applicability.	Evaluating
CO6	Design and implement deep learning solutions using encoder-decoder models and attention mechanisms for real-world problems.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Deep Learning	History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons	2
2	Neural Network Training Fundamentals	Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, FeedForward Neural Networks, Backpropagation	4
3	Autoencoders & Regularization	Autoencoders and relation to PCA, Regularization in autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout	6
4	Advanced Architectures & Representations	Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization, Learning Vectorial Representations Of Words, Encoder Decoder	6

		Models, Attention Mechanism, Attention over image	
5	Advancement of CNNs and RNNs	Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs	6
6	Generative Deep Learning	Variational Autoencoders (VAEs): Latent space, reparameterization trick, Applications in image generation, Transformer-based Gen Models: GPT architecture (decoder-only), Self-attention for text generation, Autoregressive Models: PixelRNN, WaveNet, Token-based generation (e.g., char-RNNs)	6
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Train a single-layer perceptron to perform binary classification (e.g., AND/OR gates) using Python and NumPy.
2.	Develop an MLP using PyTorch/TensorFlow to classify handwritten digits (MNIST dataset).
3.	Plot the loss landscape for a simple model and compare convergence rates of SGD, Momentum, and Adam optimizers.
4.	Experiment with dropout, L2 regularization, and early stopping to improve model generalization on a noisy dataset.
5.	Design a CNN (e.g., LeNet or custom architecture) to classify images from the CIFAR-10 dataset.
6.	Fine-tune a pre-trained CNN (e.g., ResNet, VGG) on a custom dataset using PyTorch/TensorFlow.
7.	Train an LSTM/GRU model to predict stock prices or perform sentiment analysis on text data.
8.	Build and train a denoising autoencoder to reconstruct corrupted images (e.g., noisy MNIST digits).
9.	Train a DCGAN to generate synthetic images (e.g., faces or handwritten digits) and evaluate output quality.
10.	Implement a transformer-based model (e.g., simplified GPT or seq2seq with attention) for language translation tasks.

Textbooks:

1. Deep Learning, Goodfellow, Ian, author, Cambridge, Massachusetts: The MIT Press
2. Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal, Springer
3. Pattern Recognition and Machine Learning, Christopher Bishop, Springer

Reference books:

1. Artificial Intelligence: A Modern Approach, Russell & Norvig, 4th Edition, Pearson
2. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press
3. Speech and Language Processing, Jurafsky & Martin, Pearson

Course Name: Recommendation System

Course Code: IT38T & IT38P

Vertical/ Sub-Vertical:

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT21T (Artificial Intelligence)

IT15T (Machine Learning)

Pre-requisite for: NIL Recommended

Semester: 7 Course Scheme:

Course Code	**Contact Hours**		**Credits Assigned**	
	Theory	Practical	Theory	Practical
IT38T	2	--	2	--
IT38P	--	2	--	1

Assessment guidelines:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Theory (IT38T)	15	20	40	75
Practical (IT38P)	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.

Preamble:

Recommendation systems have emerged as essential tools to deliver personalized suggestions, enhancing user experience and decision-making. By analyzing user behavior, preferences, and contextual data, these systems intelligently filter and present relevant options. This project focuses on developing an effective Recommendation System that adapts to user needs, improves engagement, and supports smarter, data-driven decisions.

Course Objectives:

1. To provide a foundation of recommender systems concepts

2. To expose to a variety of recommender systems algorithms

3. To provide a knowledge on the different evaluation methods of Recommender Systems

4. To build up the capability to develop a recommender system solution

Course Outcomes:

Learner will be able to:

Course Outcome	**Course Outcome Statement**	**Bloom's Level**
CO1	Familiarize with recommender systems and their applications	Remembering
CO2	Understand various issues related to Recommender System development.	Understanding
CO3	Relate data collected from a Recommender System to understand user preferences and/or behaviour.	Understanding
CO4	Compare different types of Recommender Systems.	Analysing
CO5	Evaluate the effectiveness of recommender system	Evaluating
CO6	Design a recommender system for a given problem	Creating

Detailed Syllabus:

Module No.	**Module name**	**Content**	**No. of Hours**
1	Introduction to Recommender Systems	What is Recommendation engine?, Need for recommender systems, Framework of recommendation systems, Personalized vs. Non-Personalized, Semi/Segment - Personalized, Privacy, users data and trustworthiness.	2`
2	Collaborative filtering-based Recommender System	Understanding ratings and rating data, User-based nearest-neighbor recommendation: Similarity Function, User-Based Algorithms Item-based nearest neighbor recommendation: Similarity Function, Item-Based Algorithms, Further model-based and preprocessing-based approaches, Comparing User-Based and Item-Based recommendations, data drift and concept drift.	6

3	Content-based Recommender System	Architecture of Content-based Systems, Advantages and Drawbacks of Content-based Filtering, Content representation and content similarity, Item profiles, discovering features of data, obtaining item features from tags, representing item profiles, Learning User Profiles and Filtering, Similarity-based retrieval, Classification algorithms, Knowledge base recommendation: Knowledge representation and reasoning, constraint-based recommenders, Case based recommenders.	6
4	Neighborhood - based Recommendation Methods	Advantages of Neighborhood Approaches, Neighborhood-based Recommendation, User-based Rating Prediction, User-based Classification Regression Vs Classification, Item-based Recommendation, User-based Vs Item based Recommendation, Rating Normalization, Similarity Weight Computation, Neighborhood Selection	4
5	Context-Aware Recommender Systems	Trust Context in Recommender Systems, Modeling Contextual Information in Recommender Systems. Paradigms for Incorporating Context in Recommender Systems: Contextual Pre-Filtering, Contextual Post-Filtering, Contextual Modeling, Combining Multiple Approaches, Additional Issues in Context-Aware Recommender Systems.	4
6	Evaluating Recommender system	Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Case Study of the Netflix Prize Data Set, Segmenting the Ratings for Training and Testing, Hold-Out, Cross-Validation Accuracy Metrics Evaluation: RMSE versus MAE, Impact of the Long Tail, Evaluating Ranking via Correlation, Evaluating Ranking via Utility, Evaluating Ranking via Receiver Operating Characteristic	6
Total			**30**

Sr. No.	List of experiments
1	Build a Recommendation Engine with Item-Based Collaborative Filtering.
2	Build Content-based recommendation engine on different datasets.
3	Build Recommender System using association rule mining.
4	Implement Recommendation System using K-Nearest Neighbors
5	Build Context-Aware Recommender Systems.
6	Build Constraint-based Recommenders.
7	Implement knowledge-based recommender system.
8	Evaluate the recommendation system with evaluation matrix.
9	Compare the performance of different recommender systems

Course Name: Internet of Things Security and Trust

Course Code: IT39T

Category: Professional elective - 5 (IoT Track)

Preamble:

The modern world is becoming increasingly interconnected through a technology called Internet of Things (IoT). IoT is rapidly evolving field that is transforming the way we live, work, and interact with the real world. This course is useful for learning security aspects of IoT applications. Security is a major requirement for IoT applications since variety of devices and networks are involved in IoT application. This course teaches fundamental aspects of security and different techniques for providing security to IoT application.

Pre-requisites:

C Programming
Object Oriented Programming
Microprocessor and Microcontroller

Course Objectives:

- To understand the core concepts of the IoT security.
- To explore different types of vulnerabilities and threats.
- To gain a foundational knowledge of testing.
- To gain foundation knowledge of tools and framework.
- To get understanding of firmware security aspects.
- To gain knowledge of common attack vectors.

Course Outcomes:

Student will be able to:
CO1: Understand the concepts of security in IoT system.
CO2: Implement mechanism to handle IoT Vulnerabilities and Threats.
CO3: Perform testing of IoT systems.
CO4: Use monitoring tools for providing IoT security.
CO5: Use techniques for efficient firmware design of IoT application.
CO6: Identify different attacks.

Course Scheme:

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

Assessment Guidelines:

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

The assessment 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	Overview of industrial control systems (ICS), ICS operation & components, Perdue model, SCADA systems, Cyber-physical systems (CPS) & IoT	4
2	IoT Vulnerabilities and Threats	STRIDE methodology, OWASP Iot vulnerabilities, Privacy & trust, Insufficient authentication/authorization, Insufficient access control, Attacks on IoT data, Attacks on IoT layered architecture, Security concerns in IoT applications, Security concerns in SCADA	6
3	IoT Pen Testing	Active vulnerability analysis tools, Port scanning, Operating system fingerprinting and version scanning, Penetration testing, Attack surface mapping	6
4	Monitoring Tools	Exploitation using I2C & SPI, JTAG debugging and exploitation, Boundary scan, Test access ports	6
5	Firmware Implementation	Understanding firmware, Extracting firmware, Manual firmware extraction, Automated file system extraction, Firmware internals, Backdooring a firmware, Static & dynamic analysis	4
6	Attack Surfaces	Software defined radio, Exploiting ZIGBEE & BLE, Power analysis attack, Invasive attack, Perturbation -attacks, Electromagnetic side channel attack, fault injection attack, timing attack, covert channel attacks	4
Total			30

Text Books:

1. "Securing the Internet of Things", Shancang Li, Li Da Xu, Syngress, Elsevier, 2017.
2. "Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations", Edited by Fei Hu, CRC Press, 2016.
3. "IoT Security Guide", DSCI, August 2022.

Reference Book:

1. "Practical Internet of Things Security", Brian Russell Drew Van Duren, Packt Publishing, 2016

Course Name: Internet of Things (IoT) Security and Trust Laboratory

Course Code: IT39P

Category: Professional Elective- 5 (IoT Track)

Preamble:

The modern world is becoming increasingly interconnected through a technology called Internet of Things (IoT). IoT is rapidly evolving field that is transforming the way we live, work, and interact with the real world. This course is useful for learning security aspects of IoT applications. Security is a major requirement for IoT applications since variety of devices and networks are involved in IoT application. This course teaches implementation of different security techniques for IoT application. It also enables learner to use standard tools and frameworks for developing efficient security solutions.

Pre-requisites:

- C Programming
- Object Oriented Programming
- Microprocessor and microcontroller

Course Objectives:

- To understand the core concepts of the IoT security.
- To explore different types of vulnerabilities and threats.
- To gain a foundational knowledge of testing.
- To gain foundation knowledge of tools and framework.
- To get understanding of firmware security aspects.
- To gain knowledge of common attack vectors.

Course Outcomes:

Student will be able to:
CO1: Identify metrics for providing security in IoT system.
CO2: Implement techniques for handling IoT Vulnerabilities and Threats.
CO3: Perform testing of IoT systems.
CO4: Use tools and frameworks for providing security to IoT applications.
CO5: Design efficient secure firmware for IoT applications.
CO6: Implement mechanism to handle different types of attacks in IoT application.

Course Scheme:

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

Assessment Scheme:

Head	ISA	MSA	ESA	Total
Practical	25	-	25	25

Suggested List of Practical:

All practical will be project based with focus on following concepts

1. Identification and implementation of standard metrics for providing security.
2. Handle different types of threats and vulnerabilities in IoT application.
3. Perform security testing of IoT application.
4. Identify and explore different tools for monitoring and providing security to IoT applications.
5. Design secure firmware for IoT application.
6. Handle different types of attacks in IoT application.

Text Books:

1. "Securing the Internet of Things", Shancang Li, Li Da Xu, Syngress, Elsevier, 2017.
2. "Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations", Edited by Fei Hu, CRC Press, 2016.
3. "IoT Security Guide", DSCI, August 2022.

Reference Books:

1. "Practical Internet of Things Security", Brian Russell Drew Van Duren, Packt Publishing, 2016

Assessment: In-Semester-Assessment (25 Marks)

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

Course Name: Malware Analysis

Course Code: IT40T & IT40P

Vertical/ Sub-Vertical: PE

K-S-A *Mapping:*

Pre-requisite required: IT28T (SSEH) & IT32T (DF)

Pre-requisite for: IT60T & IT62T (Decentralised and Blockchain Technologies)

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT40T	2	-	2	-
IT40P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT40T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (IT40P)	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 course "Malware Analysis" is designed to equip students with the theoretical knowledge and practical skills required to detect, analyze, and respond to malicious software threats. With the increasing complexity and frequency of cyberattacks, understanding the techniques used by attackers and reverse engineering malware is crucial for cyber defense professionals.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge related to:

- Introduce the fundamentals of malware and its impact on computing systems.
- Enable students to perform static and dynamic analysis of malware.
- Equip students with the knowledge to use forensic and reverse engineering tools.
- Familiarize students with malware detection, classification, and reporting techniques.
- Develop hands-on skills to safely analyze malware in controlled environments.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Describe various types of malware, their behavior, and infection mechanisms.	L1–L2 (Remember–Understand)
CO2	Apply static and dynamic malware analysis techniques to extract and interpret behavior and artifacts.	L3-L4 (Apply- Analyze)
CO3	Use tools for reverse engineering and demonstrate understanding of anti-analysis techniques.	L3–L5 (Apply –Evaluate)
CO4	Utilize automated analysis tools and synthesize malware analysis reports including IOCs.	L3–L6 (Apply – Create)
CO5	Analyze and evaluate real-world malware samples using forensic approaches and document the findings.	L4–L5 (Analyze – Evaluate)

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Malware	Definition, types, history, and trends of malware Malware lifecycle and delivery mechanisms Real-world case studies	5
2	Malware Behavior and Infection Vectors	Persistence mechanisms, privilege escalation Fileless malware, macro malware, polymorphism Indicators of Compromise (IOCs)	6
3	Static Malware Analysis	PE file structure, hashing, strings extraction Disassembly using IDA Free/Ghidra Assembly code basics	6
4	Dynamic Malware Analysis	Sandboxing, system call monitoring Behavioral analysis using Process Monitor, ProcMon Network behavior using Wireshark	6
5	Reverse Engineering & Anti-Analysis Techniques	Anti-debugging and anti-VM techniques Unpacking and decryption Debugging with x64dbg/OllyDbg	5
6	Automated Malware Analysis & Reporting	Cuckoo Sandbox and Any.Run usage Classification and signature creation Threat Intelligence Platforms Malware reporting and IOCs	2
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Perform string analysis and examine PE file headers.
2.	Observe malware behavior using system monitoring tools.
3.	Monitor and analyze malware's network behavior.
4.	Analyze malware using an automated sandbox environment.
5.	Disassemble malware and interpret logic.
6.	Final Project: Perform end-to-end malware analysis and documentation.
7.	Study and present a real-world case study where blockchain is used with cognitive applications.

Text Books:

1. *Practical Malware Analysis* by Michael Sikorski and Andrew Honig
2. *The IDA Pro Book* by Chris Eagle
3. *Malware Analyst's Cookbook and DVD* by Ligh et al.

Reference Books:

1. *The Art of Memory Forensics* by Ligh, Case, Levy, Walters
2. *Rootkits: Subverting the Windows Kernel* by Greg Hoglund
3. Online Resources: VirusTotal, Hybrid Analysis, Any.Run, Cuckoo Sandbox Documentation

Course Name: Natural Language Processing

Course Code: IT41T & IT41P

Vertical/ Sub-Vertical: Professional Elective

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT15 (Machine Learning),

Pre-requisite for: Nil Recommended

Semester: 7 Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT41T	2	-	2	-
IT41P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT41T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (IT41P)	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:

Natural Language Processing (NLP) is a foundational field at the intersection of Artificial Intelligence and Linguistics, concerned with the design and development of algorithms that enable computers to understand, interpret, and generate human language. With the increasing demand for intelligent systems that can process text and speech, NLP has become an essential area in computer science and data science. This course introduces the theoretical and practical aspects of NLP, covering linguistic fundamentals, core text analysis techniques, parsing, semantics, discourse processing, and real-world applications. Emphasis is also placed on the challenges of processing Indian languages and the development of interpretable NLP systems.

Course Objectives:

- Understand the foundational concepts of Natural Language Processing, including language structure, ambiguity, and key processing stages.
- Learn core text processing techniques such as tokenization, stemming, lemmatization, morphological parsing, and language modeling using N-grams.
- Develop a thorough understanding of syntactic and semantic analysis, including parsing algorithms and meaning representation using lexical resources.
- Explore discourse-level phenomena like anaphora and reference resolution to understand the coherence and context of texts.
- Evaluate and compare different NLP techniques for language modeling, parsing, and disambiguation using appropriate metrics.
- Apply NLP techniques to build real-world applications, such as machine translation, information retrieval, and sentiment analysis, with a focus on Indian regional languages.

Course Outcomes:

Learner will be able to:

Course Outcome	**Course Outcome Statement**	**Bloom's Level**
CO1	Recall fundamental concepts of NLP such as stages of NLP, grammar, ambiguities, and basic text processing techniques.	Remembering
CO2	Explain morphological, syntactic, and semantic structures in natural language and describe common NLP tools and techniques.	Understanding
CO3	Apply parsing algorithms, N-gram models, and stemming/lemmatization to analyze linguistic data.	Applying
CO4	Analyze the structure of language using semantic representations, word sense disambiguation techniques, and discourse analysis algorithms.	Analysing
CO5	Evaluate the performance of NLP models such as parsers, N-gram models, and disambiguation systems using appropriate metrics.	Evaluating
CO6	Design and implement NLP applications such as machine translation, sentiment analysis, and information retrieval using appropriate models and techniques.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Foundations of NLP and Language Modelling	Language, Knowledge and Grammar in language processing; Stages in NLP; Ambiguities and its types in English and Indian Regional Languages; Challenges of NLP; Applications of NLP. Basic Terms: Tokenization, Stemming, Lemmatization; Survey of English Morphology, Inflectional Morphology, Derivational Morphology; Morphological Models: Dictionary lookup, finite state morphology; Lexicon free FST Porter Stemmer algorithm; Grams and its variation: Bigram, Trigram; Simple (Unsmoothed) N-grams; N-gram Sensitivity to the Training Corpus; Unknown Words: Open versus closed vocabulary tasks; Evaluating N-grams: Perplexity; Smoothing: Laplace Smoothing, Good-Turing Discounting. ***Self-Learning Topics***: *Variety types of tools for regional languages pre-processing and other functionalities, Noisy channel models, various edit distance, Advance Issues in Language Modelling.*	6
2	Parsing Techniques and Syntax Modelling	Parsers: Top down and bottom up; Modelling constituency; Bottom-Up Parser: CYK, PCFG (Probabilistic Context Free Grammar), Shift Reduce Parser; TopDown Parser: Early Parser, Predictive Parser. ***Self-Learning Topics***: *Evaluating parsers, Parsers based language modelling, Regional languages POS tree banks*	5
3	Semantics, and Discourse	Introduction, meaning representation; Lexical Semantics; Corpus study; Knowledge Graphs & Ontologies; Study of Various language dictionaries like WorldNet, Babelnet; Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy; Semantic Ambiguity; Word Sense Disambiguation (WSD); Semantic Similarity and Relatedness. Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence; Anaphora Resolution using Hobbs Algorithm ***Self-Learning Topics***: *Dictionaries for regional languages, Topic Models, Discourse segmentation, Conference resolution*	5
4	Word Representations and Embedding Models	Word2Vec, CBOW and Skip-Gram Models, One word learning architecture, Forward pass for Word2Vec, Matrix Operations, Word Representation: Word2Vec & fastText, Word Representation: GloVe, Tokenization Strategies	6
5	Neural Language Models and Sequence Learning	Neural Language Models - CNN, RNN, RNN - Based Language Model, LSTM, GRU, Sequence-to-Sequence Models, Greedy Decoding, Beam search, Other Decoding	5

		Strategies: Nucleus Sampling, Temperature Sampling, Top-k Sampling, Attention in Sequence-to-Sequence Models	
6	Applications of NLP in Real-World Scenarios	Case studies on (preferable in regional language): Machine translation; Text Summarization; Sentiment analysis; Information retrieval; Question Answering system ***Self-Learning Topics***: *Applications based on Deep Neural Network with NLP such as LSTM network, Recurrent Neural network etc.*	3

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Build a Tokenizer and Stemmer for English and a selected Indian regional language (e.g., Hindi or Tamil).
2.	Implement a language model to predict the next word using Trigram with Laplace smoothing.
3.	Linguistic Analysis using POS Tagging and Named Entity Recognition
4.	Feature Extraction: TF-IDF, N-grams, and Word Embeddings
5.	Build a Word Sense Disambiguation (WSD) tool using dictionary-based and machine learning approaches.
6.	Develop an Anaphora Resolver using Hobbs' Algorithm for English narratives.
7.	Train Word2Vec (CBOW and Skip-Gram) models on a regional language corpus.
8.	Build and train an RNN-based language model to generate simple sentences from a dataset.
9.	Create a Seq2Seq translation model with attention for English to regional language (e.g., English to Hindi).
10.	Design a sentiment analysis system for product reviews in a regional language using LSTM.

Textbooks:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing", 3e, Pearson Education, 2018
2. Christopher D.Manning and Hinrich Schutze, — Foundations of Statistical Natural Language Processing —, MIT Press, 1999.
3. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.
4. Daniel and James H. Martin "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Second Edition, Prentice Hall of India, 2008.

Reference Books:

1. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
2. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) — The Handbook of Computational Linguistics and Natural Language Processing
3. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012

Course Name: Text, Web & Social Media Analytics & Text, Web & Social Media Analytics Lab

Course Code: IT42T & IT42P

Vertical/ Sub-Vertical:

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Basic Programming, Data Structures and Algorithms, Statistics and Probability

Pre-requisite for: Basic Programming, Data Structures and Algorithms, Statistics and Probability

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT42T	2	-	2	-
IT42P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT42T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT42P)	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:

This course on Text, Web & Social Media Analytics introduces the fundamental techniques and tools for analyzing unstructured textual data from web and social media sources. Students will learn methods in text mining, natural language processing, sentiment analysis, and web analytics, combined with practical applications using real-world datasets. The course aims to develop skills necessary for extracting actionable insights and making data-driven decisions in diverse fields.

Course Objectives:

- To introduce the foundational concepts and techniques of text mining, including information extraction, text representation, clustering, and classification.
- To develop analytical skills for mining structured and unstructured data from web and social media platforms, focusing on user behavior, influence, and recommendation systems.
- To enable students to perform sentiment analysis and opinion mining using supervised and unsupervised learning methods, and to detect and handle opinion spam effectively.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand the core concepts, terminologies, and real-world applications of text mining, web mining, and social media analytics.	Understand
CO2	Apply text preprocessing and representation techniques (e.g., tokenization, vectorization, N-grams) to prepare unstructured data for analysis.	Apply
CO3	Implement appropriate clustering, classification, and modeling algorithms (e.g., K-means, Decision Trees, CRFs) for extracting patterns from text and web data.	Apply/Analyze
CO4	Analyze web usage data to identify user behavior patterns using data modeling, clustering, and session analysis techniques.	Analyze
CO5	Evaluate social network structures, user influence, and recommendation strategies by mining and interpreting social media data.	Evaluate
CO 6	Develop opinion and sentiment mining systems using supervised and unsupervised learning methods, and detect spam and abnormal behaviors in online content.	Create/Evaluate

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Databases and Data Models	Introduction to Text Mining: Introduction, Algorithms for Text Mining: Topic Modelling, Sentiment analysis, Future Directions Information Extraction from Text: Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction Text Representation: tokenization, stemming & Lemmatization, stop words, NER, N- gram modelling, Vectorization *Self-Learning Topics*: *NA*	2
2	Clustering and Classification	Text Clustering: Feature Selection and Transformation Methods, distance-based Clustering Algorithms, Word and Phrase based Clustering, Probabilistic document Clustering Text Classification: Feature Selection, Decision tree Classifiers, Rule- based Classifiers, Probabilistic based Classifiers, Proximity based Classifiers. Text Modelling: Bayesian Networks, Hidden Markovian Models, Markov random Fields, Conditional Random Fields	5

3	Web-Minning	Introduction to Web-Mining : Web Structure mining, web content mining and web usage mining, Inverted indices and Compression, Latent Semantic Indexing, Web Search Meta Search: Search Engine and types of search engine, Using Similarity Scores, Rank Positions Web Spamming : Content Spamming, Link Spamming, hiding Techniques, and Combating Spam	5
4	Web Usage Mining	Data Collection and Pre-processing, Sources and types of Data, Data Modelling, Session and Visitor Analysis, Cluster Analysis and Visitor segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigational Patterns, Classification and Prediction based on Web User Transactions.	6
5	Social Media Mining	Introduction, Challenges, Types of social Network Graphs Mining Social Media: Influence and Homophily, Behaviour Analytics, Recommendation in Social Media: Challenges, Classical recommendation Algorithms, Recommendation using Social Context, Evaluating recommendations.	5
6		The problem of opinion mining, Document Sentiment Classification: Supervised, Unsupervised, Opinion Lexicon Expansion: Dictionary based, Corpus based , Opinion Spam Detection: Supervised Learning, Abnormal Behaviours, Group Spam Detection.	2
Total			30

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Text Preprocessing and Representation
2.	Named Entity Recognition and Topic Modelling
3.	News Article Categorization using Text Classification
4.	Clustering Customer Feedback for Service Improvement
5.	Implement a Mini Search Engine with Ranking and Similarity Scoring
6.	Detecting Web Spam in Search Results
7.	Session and Visitor Behavior Analysis for an E-Commerce Website
8.	Predicting Purchase Intent Based on Web Usage Patterns
9.	Analyzing Influence and Homophily in a Twitter Network
10.	Building a Social Media Recommendation System
11.	Sentiment Classification of Product Reviews
12.	Opinion Spam Detection in Online Reviews

Course Name: Industrial Internet of Things (IIoT)

Course Code: IT43T

Category: Professional elective – 6 (IoT Track)

Preamble:

This course introduces students to IIoT complexity on a scale previously unseen in the software industry. Software architecture must accommodate these heterogeneous domains and competencies and handle the increasing levels of complexity. The IIoT generates large amounts of data that is subsequently stored, analysed, archived and eventually fed back into the product life cycle.

Pre-requisites:

- Modern Sensor Technology for IoT
- Principles of IoT

Course Objectives:

- To understand the concepts of Industry 4.0 and IIoT.
- To learn the reference architecture of IIoT
- To learn industrial data acquisition and transmission
- To learn the IIoT key technologies.
- To learn securities in IIoT.
- To learn application areas in IIoT.

Course Outcomes:

Student will be able to:
CO1: Understand the fundamentals of Industry 4.0 and IIoT.
CO2: Understand different types of architectures required in the IIoT applications.
CO3: Apply knowledge of data acquisition and transmission techniques required in IIoT.
CO4: Understand Key technologies required in the implementation of IIoT model.
CO5: Create a security system for IIoT application.
CO6: Design prototype model of IIoT system.

Course Scheme:

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

Assessment Guidelines:

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

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	Overview of Industry 4.0 and Industrial Internet of Things, Industrial Internet, Design requirements of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of Industries, Smart Business Perspective, Basics, IIOT and Industry 4.0, Industrial Internet Systems, Industrial Sensing, Industrial Processes, IIOT Challenges – Identifying Things within the internet, Discovering Things and the Data they possess, Managing massive amount of data, Navigating Connectivity Outages, IIOT Edge – Leveraging the Power of Cloud Computing, Communicating with Devices on the Edge, Determining a Request/Response Model	4
2	IIOT Reference Architecture	The IIC Industrial Internet Reference Architecture - Industrial Internet Architecture Framework (IIAF), Industrial Internet Viewpoints. The Three-Tier Topology, Key Functional Characteristics of Connectivity. Software Architectural Style for the Industrial Internet of Things. Challenges of Software Engineering in IIoT, Principles for Software Architecture design in IIoT, The Principled Decomposition, and The Architectural Style.	5
3	IIoT data acquisition and transmission	Introduction, Features and Components of - Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Batibus, DigitalSTROM, Controller Area Network, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and LoRaWAN) NB-IoT, IEEE 802.11AH, Distributed Control System, PLC, SCADA	6
4	Key Technologies in IIoT	Off-Site Technologies: Cloud Computing in IIOT Fog Computing: Principles, Architectures, and Applications. On-Site Technologies: Big Data and Advanced Analytics	5
5	IIoT securities	Securing the Industrial Internet- Security in Manufacturing, PLCs and DCS, Securing the OT (Operation Technology), Network, System Level: Potential Security Issues, Identity Access Management. Internet of Things (IoT) Cyber security Improvement Act of 2017, Other governmental bodies, IoT security best practices, Holistic security. The IoT Security Lifecycle	6
6	IIoT Applications	Develop New Business Models : Adopt Smart Architectures and Technologies, Sensor-Driven Computing, Industrial Analytics, Intelligent Machine Applications, Transform the Workforce. Inventory Management and Quality Control: Introduction, Inventory Management and IIOT, Quality Control	4

		Case Studies: Manufacturing Industry, Automotive Industry and Mining Industry, Healthcare Applications in Industries, Challenges associated with Healthcare	
Total			**30**

Textbooks:

1. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
2. "Introduction to Industrial Internet of Things and Industry 4.0",by Sudip Misra, Chandana Roy And Anandarup Mukherjee, CRC Press (Taylor & Francis Group)
3. "Internet of Things Principles and Paradigms", by Rajkumar Buyya, Amir Vahid Dastjerdi, ELSEVIER Inc.
4. Internet of things For Architects, Perry Lea Packt Publication,2018

Reference Books:

1. "Practical Internet of Things Security", by Brian Russell, Drew Van Duren (Packt Publishing)
2. "Industrial Internet of Things and Communications at the Edge", by Tony Paine, CEO, Kepware Technologies
3. "Architectural Design Principles For Industrial Internet of Things", Hasan Derhamy, Luleå University of Technology, Graphic Production

Course Name: Industrial Internet of Things (IIoT) Laboratory

Course Code: IT43P

Category: Professional elective – 6 (IoT Track)

Preamble:

The IIoT Lab is a hands-on learning environment where you will gain practical experience in designing, developing, and deploying IIoT solutions. By the end of this lab, students will have a strong foundation in IIoT concepts and be prepared to apply your knowledge to real-world industrial applications.

Pre-requisites:

- Modern Sensor Technology for IoT
- Principles of IoT

Course Objectives:

- Familiarize students with the fundamentals of Industrial IoT (IIoT)
- Understand the core concepts of IIoT, including sensors, actuators, communication protocols, and data analytics
- Gain insights into the applications of IIoT in various industries
- Develop the skills necessary to design and implement IIoT solutions

Course Outcomes:

Student will be able to:

CO1: Learn IIoT and its key components

CO2: Study and interface the different types of sensors and actuators used in IIoT applications

CO3: Analyze the various communication protocols used in IIoT

CO4: Analyze and interpret data collected from IIoT devices

CO5: Design and implement simple IIoT solutions

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:

1) **Familiarization with Development Boards:** This experiment will get students familiar with popular development boards like Arduino Uno or Raspberry Pi. Students will learn how to set up the board, install the necessary software, and write simple programs to control LEDs, read sensor data, and control actuators.
2) **Sensor Interfacing**: This experiment will introduce students to various sensors used in IIoT applications, such as temperature sensors, humidity sensors, light sensors, and pressure sensors. Students will learn how to interface these sensors with the development board and read the sensor data.
3) **Actuator Control:** This experiment will introduce students to actuators used in IIoT applications, such as relays, motors, and solenoids. Students will learn how to control these actuators using the development board based on sensor readings or user input.
4) **Data Visualization**: This experiment will teach students how to visualize the data collected from sensors. Students will use software tools to plot the data on graphs and charts, allowing for easier monitoring and analysis.
5) **Communication Protocols:** This experiment will cover various communication protocols used in IIoT, such as Modbus, Profibus, and MQTT. Students will learn how to configure these protocols for communication between devices and the cloud platform.
6) **Cloud Integration**: This experiment will introduce students to cloud platforms for IIoT applications. Students will learn how to connect their IIoT devices to the cloud platform, send sensor data to the cloud, and receive commands from the cloud.
7) **Remote Monitoring and Control:** This experiment will build on the previous experiments by creating a system where students can remotely monitor sensor data and control actuators over the internet.
8) **Data Analytics:** This experiment will introduce students to basic data analytics techniques used in IIoT applications. Students will learn how to analyze sensor data to identify trends, patterns, and anomalies.
9) Robotics arms and Industry 4.0 Setup

Textbooks:

1. **Industrial Automation with the Internet of Things** by Andreas Georgakopoulos and Peter Slyepen
2. **Designing the Industrial Internet of Things** by Adrian McEwen and Hakim El-Darwich

Reference Books:

1. Internet of Things (IoT) Prototyping with Arduino and Raspberry Piby Colin Wong
2. Hands-On Industrial Internet of Things by Richard Radoczki

Final Year Scheme & Syllabus (2022) for Bachelor of Technology (B.Tech)
Information Technology

Course Name: Web Application Security

Course Code: IT44T and IT44P

Vertical/ Sub-Vertical: PE

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: System Security & Ethical Hacking (IT28T)

Pre-requisite for: IT62T (Detection & Mitigation of Cyber Threats)

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT44T	2	-	2	-
IT44P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT44T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (IT44P)	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:

This course focuses on identifying, analysing, and mitigating vulnerabilities specific to web applications. It empowers students with practical skills using industry-standard tools and frameworks and promotes secure web development practices aligned with OWASP and modern threat landscapes.

Course Objectives:

- To reveal the underlying in web application.
- To identify and aid in fixing any security vulnerabilities during the web development process.
- To understand the security principles in developing a reliable web application.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Identify the vulnerabilities in the web applications	Understanding
CO2	Identify the various types of threats and mitigation measures of web applications.	Understanding
CO3	Apply the security principles in developing a reliable web application.	Applying
CO4	Use industry standard tools for web application security	Applying
CO5	Create detailed reports on findings, mitigations, and secure design	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Overview of Web Applications	Introduction history of web applications interface ad structure benefits and drawbacks of web applications Web application Vs Cloud application, Web architecture, HTTP/HTTPS, sessions, cookies, authentication, same-origin policy, common attack vectors. ***Self-Learning Topics***: Evolution of web apps, REST APIs basics, Cross-origin resource sharing (CORS), browser security models.	4
2	Web Application Security Fundamentals	Security Fundamentals: Input Validation - Attack Surface Reduction Rules of Thumb- Classi- fying and Prioritizing Threads , Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting and Cross-Site Request Forgery - Reflected XSS - HTML Injection.	7

		Self-Learning Topics: *Principle of least privilege, defense in depth, Same-site cookie attribute, CSP (Content Security Policy).*	
3	Web Application Vulnerabilities	Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie-based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. SSL vulnerabilities and testing - Proper encryption use in web application - Session vulnerabilities and testing - Cross-site request forgery, OWASP Top 10: SQLi, XSS, CSRF, IDOR, File Inclusion, SSRF, XXE. Understanding root causes and testing techniques. ***Self-Learning Topics:*** *Secure coding practices for input sanitization, TLS versions and vulnerabilities, session fixation.*	6
4	Tools for Security Testing	Burp Suite, ZAP Proxy, Nikto, WFuzz, HTTP interceptors, crawling, fuzzing, authentication testing ***Self-Learning Topics:*** *Comparison of open-source vs. commercial tools, Scripting automation in Burp/ZAP*	6
5	Secure Website Design	Secure website design : Architecture and Design Issues for Web Applications, Deployment Considerations Input Validation, Authentication, Authorization, Configuration Management ,Sensitive Data, Session Management, Cryptography, Parameter Manipulation, Exception Management, Auditing and Logging, Design Guidelines, Forms and validity, Technical implementation ***Self-Learning Topics: :*** *Secure audit logging techniques, error handling best practices*	4
6	Case Studies and Emerging Trends	Recent high-profile web application breaches, evolving attack trends (e.g., API abuse, supply chain), real-world secure architecture examples ***Self-Learning Topics:*** *Verizon DBIR (Data Breach Investigation Report), Threat feeds (e.g., OTX, MISP), API security checklist.*	3
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Web application reconnaissance and spidering using ZAP/Burp Suite
2.	Exploit SQL Injection on a vulnerable application (DVWA or Juice Shop)
3.	Detect and exploit Cross-Site Scripting (XSS)
4.	Perform vulnerability scans using Nikto or ZAP
5.	Analyse secure HTTP headers and apply security configurations (CSP, HSTS, etc.)
6.	Build and Deploy a Secure Login Module ***(Design login with input sanitization, secure cookies, and rate-limiting.)***
7.	Prepare a Security Assessment Report

Detailed Syllabus of Advance Learning Courses
(Open Electives)

Course Name: Cyber Law

Course Code: OE21

Category: Open Elective

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

Pre-requisites: Nil

Course Objectives:

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

Course Outcomes:

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

Course Scheme:

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

Assessment Guidelines:

Head	**ISA**	**MSA**	**ESA**	**Total**

Theory	20	30	50	100

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

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Introduction to Cyber Law and IT Act	Evolution and necessity of ITA 2000 Overview of ITA 2000 and ITAA 2008: Key provisions, authorities, and penalties Amendments to Indian Penal Code, Evidence Act, and other laws Case studies on jurisdiction under cyber law	6
2	Cyber Security Framework	Definition and importance of cybersecurity Overview of threats: hacking, malware, phishing, and cyberterrorism Basic security mechanisms: firewalls, encryption, PKI, and digital signatures Role of CERT-IN and other agencies in India	7
3	Cyber Crimes and Investigation	Types of cybercrimes: data theft, identity theft, cyberstalking, cyberbullying, and online fraud Investigation procedures for cybercrimes Seizure of digital evidence and forensic procedures Digital forensics: tools and anti-forensics measures	8
4	E-Commerce, E-Governance, and Cyber Law	E-commerce regulations under ITA 2000 and ITAA 2008 Validity of electronic signatures and contracts in Indian law E-Governance and issues in e-taxation, Cyber Tribunal and appellate processes	8
5	Privacy, Data Protection, and Emerging Trends	Sensitive Personal Data or Information (SPDI) under Indian law International perspectives on data protection and privacy (GDPR, HIPAA) Impact of cloud computing and data localization Case studies on privacy violations and legal recourse	8
6	International Cyber Law and Legal Framework	UNCITRAL model law and international conventions on cybercrime Intellectual property rights in cyberspace: trademarks, patents, and copyright Cyber warfare, digital sovereignty, and human rights Cyber law practices in other jurisdictions (US, EU, China)	8
Total			**45**

Textbooks:

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

Reference Books:

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

Course Name: Nanotechnology

Course Code: OE31

Category: Open elective

Preamble:

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

Pre-requisites:

Nil

Course Objectives:

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

Course Outcomes:

Learner will be able to:
CO1: Understand nanotechnology fundamentals.
CO2: Analyze nanoscale phenomena
CO3: Understand and apply key nanofabrication methods for creating nanoscale structures and devices.
CO4: Understand the principles behind various characterization techniques for nanoscale materials.
CO5: Explore engineering applications of nanotechnology. CO6: Evaluate ethical, environmental, and societal Impacts.

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1.	Introduction to Nanotechnology	Definition, scope, and multidisciplinary nature of nanotechnology. Historical development of nanotechnology and key breakthroughs. Types of nanomaterials: nanoparticles, nanotubes, nanowires, quantum dots, and nanocomposites. Nanoscale dimensions: importance of size, surface area, and quantum effects. Exploration of nanotechnology's role in various industries (electronics, medicine, energy, etc.).	9
2.	Properties of Nanomaterials	In-depth study of the physical, chemical, electrical, optical, and mechanical properties of nanomaterials. Surface energy, surface-to-volume ratio, and its impact on material properties.	9

		etailed study of quantum confinement and its influence on electrical and optical properties. oxicity and environmental concerns of nanomaterials: impact on living organisms and ecosystems.	
3.	Nanofabrication Techniques	Comprehensive overview of top-down and bottom-up nanofabrication methods. In-depth study of lithographic techniques: photolithography, electron-beam lithography. Advanced deposition techniques: Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), Physical Vapor Deposition (PVD). Molecular self-assembly, nanoimprint lithography, and soft lithography techniqus.	9
4.	Characterization of Nanomaterials	Detailed study of key characterization tools: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM). Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), X-ray diffraction (XRD). Optical spectroscopy and Raman spectroscopy techniques. Importance of precision and resolution in nanomaterial characterization.	6
5.	Applications of Nanotechnology in Engineering	Nanotechnology in Electronics: nanoscale transistors, quantum dots, and nanomaterials for next-gen electronics. Energy Applications: nanomaterials for solar cells, energy storage, supercapacitors, and batteries. Biomedical Applications: drug delivery, diagnostic tools, nanomedicine, and tissue engineering. Environmental Applications: nanotechnology in water purification, air filtration, and pollution control. Mechanical and Civil Engineering: nanocomposites, self-cleaning surfaces, and smart materials.	8
.	Societal, Ethical, and	Ethical issues related to nanotechnology: privacy concerns, nanotoxicology, and regulation.	4

	Environmental Implications	Environmental impacts of nanomaterials: nanowaste management and recycling. Public perception of nanotechnology and its societal impacts. Responsible innovation and future directions for ethical development of nanotechnology. Regulatory frameworks for nanomaterials in India and worldwide.	
		Total	**45**

Suggested list of Assignments:

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

Suggested List of Value-Added Home Assignments:

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

Suggested Online Courses:

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

Reference Books:

- Marc Madou, "Fundamentals of Microfabrication", CRC Press, 1997.
- Charles P. Poole and Frank J. Owens, "Introduction to Nanotechnology", Wiley-Interscience, 2003.

- Sulabha Kulkarni, "Nanotechnology: Principles and Practices", Springer, 2015.
- R.S. Tiwari and A. Gosh, "Nanomaterials and Nanotechnology", S. Chand & Company, 2017.
- Patricia I. Dolez, "Nanoengineering: Global Approaches to Health and Safety Issues", Elsevier,
- 2015.

Course Name: Product Life Cycle Management

Course Code: OE23

Category: Open Elective

Preamble:

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

Pre-requisites:

Course Objectives:

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

Course Outcomes:

Students will be able to:

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

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
	-	3	-

Assessment guidelines:

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

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

Detailed Syllabus:

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

	Life Cycle Assessment and Life Cycle Cost Analysis	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	06
Otal			45

Textbooks:

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

Reference Books:

- SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
- Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course: Renewable Energy Management

Category: Open Elective

Course Code: OE28

Preamble:

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

Pre-requisites:

Nil

Course Outcomes:

CO1: Understand the principles and technologies of various renewable energy sources.
CO2: Analyse the economic, environmental, and social impacts of renewable energy projects.
CO3: Evaluate and design renewable energy systems for specific applications.
CO4: Develop strategies for the integration and management of renewable energy in the energy mix.
CO5: Understand the policies, regulations, and incentives related to renewable energy.
CO6: Gain practical skills in renewable energy project planning, implementation, and management.

Course Scheme:

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

Assessment Guidelines:

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

Detailed Syllabus:

Mod No.	Module Name	Content	No. of hrs.
1	Introduction to Renewable Energy	Overview of global and national energy scenarios Importance and benefits of renewable energy Types of renewable energy sources: solar, wind, biomass, hydro, and geothermal Comparison between renewable and non-renewable energy Current trends and future prospects in renewable energy	7
2	Solar Thermal Energy	Principles of solar thermal energy conversion Solar collectors: flat plate, evacuated tube, and concentrating collectors Solar thermal applications: water heating, space heating, and industrial processes Solar thermal power plants: parabolic troughs, solar towers, and dish Stirling systems Economic and environmental aspects of solar thermal energy	6
3	Solar Photovoltaics	Principles of photovoltaic energy conversion Types of photovoltaic cells: monocrystalline, polycrystalline, and thin film	6

		Design and components of photovoltaic systems: modules, inverters, and batteries Performance analysis of PV systems: efficiency, shading, and temperature effects Grid integration and energy storage for PV systems	
4	Wind Energy	Fundamentals of wind energy conversion Wind turbine types, components, and operation Wind farm design and site selection Environmental and social impacts of wind energy projects Economic analysis and policy considerations for wind energy	6
5	Biomass, Hydro and Geothermal Energy	Biomass & Bio Energy Biomass resources and conversion technologies Bioenergy production: biogas, biofuels, and biomass power generation Waste-to-energy systems Environmental and economic aspects of bioenergy Policies and incentives for bioenergy development Hydro Energy Principles of hydro power generation Small-scale and large-scale hydro power plants Geothermal Energy Geothermal energy resources and extraction methods Applications and challenges of geothermal energy Environmental and economic considerations for hydro and geothermal energy	9
6	Renewable Energy and Management Policy	Energy management principles and practices Renewable energy project planning and management Integration of renewable energy into the grid Policies, regulations, and incentives for renewable energy Case studies of successful renewable energy projects	12

Textbooks:

- "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
- "Renewable Energy Systems: The Earthscan Expert Guide to Renewable Energy Technologies for Home and Business" by David Thorpe
- "Energy Management Handbook" by Wayne C. Turner and Steve Doty
- Reference Books:
- "Solar Engineering of Thermal Processes" by John A. Duffie and William A. Beckman
- "Wind Energy Explained: Theory, Design and Application" by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers
- "Biomass to Renewable Energy Processes" by Jay Cheng
- "Hydropower: Renewable Energy for a Sustainable Future" by Dirk Aschenbach
- "Geothermal Energy: Renewable Energy and the Environment" by William E. Glassley
- "Renewable Energy Policy and Politics: A Handbook for Decision-Making" by Volker M. Quaschning

Evaluation Scheme for Renewable Energy Management

1. Internal Assessment (ISA) - 25 Marks

Internal Assessment evaluates students through assignments, quizzes, and practical work throughout the semester.

Assignments/Quizzes (15 marks)

11 Assignments/Quizzes: Each assignment or quiz will be graded out of 10 marks. The average of the 11 best assignment/quiz scores will contribute to the final 15 marks.

Assignment 1: Global and national renewable energy scenarios

Assignment 2: Principles and applications of solar thermal energy

Assignment 3: Photovoltaic system design

Assignment 4: Wind turbine technology and wind farm design
Assignment 5: Biomass energy systems and waste-to-energy technologies
Assignment 6: Hydro energy principles and applications
Assignment 7: Geothermal energy systems
Assignment 8: Economic analysis of renewable energy projects
Assignment 9: Renewable energy policies and regulations
Assignment 10: Feasibility analysis of renewable energy integration into the grid
Assignment 11: Case study on a successful renewable energy project (student's choice)

Lab Work/Simulations (10 marks)

Hands-on lab work and simulations using software tools (e.g., PVsyst, WindPRO, TRNSYS).
Students will be evaluated based on their performance in lab experiments, system designs, and report submissions.

2. Mid-Semester Examination (MSE) - 25 Marks

The mid-semester theory exam will cover Modules 1, 2, and 3 for MSE-1 and Modules 4,5, & 6 for MSE-2.

Exam Format:

Part A (5 marks): Objective questions (multiple choice, true/false, short answers).
Part B (20 marks): Descriptive questions covering Solar Thermal Energy, Photovoltaics, and fundamental renewable energy concepts.
Note: Average of MSE-1 & 2 will be considered for above mentioned exam head.

3. End-Semester Examination (ESE) - 50 Marks

The final theory exam will cover the entire syllabus, assessing students' understanding of all modules.
Exam Format:
Part A (10 marks): Objective questions (multiple choice, true/false, short answers).
Part B (40 marks): Descriptive questions, where students answer 5 out of 7 questions. Each question carries 8 marks and covers different modules.

Summary of Marks Distribution:

Component	Marks
Internal Assessment (ISA)	25
Mid-Semester Examination (MSE)	25
End-Semester Examination (ESE)	50
Total	100

Recommended Pedagogy:

Module 1:
Lectures: Overview of renewable energy sources and their role in global energy scenarios.
Interactive Sessions: Discussions on the importance and benefits of renewable energy.
Case Studies: Analysis of renewable energy adoption in different countries.
Videos: Visual presentations of renewable energy systems in operation.
Module 2:
Lectures: Explanation of solar thermal energy principles and technologies.
Hands-on Workshops: Demonstrations of solar collectors and thermal systems.
Simulation Software: Use of tools like TRNSYS to model solar thermal systems.
Field Visit: Tour of a solar thermal power plant, if possible.
Module 3:
Lectures: Fundamentals of PV systems and their components.
Lab Work: Experiments with different types of photovoltaic cells.
Design Projects: Students design a PV system for a specific application.
Software Tools: Use of PVsyst or similar software for PV system design and simulation.
Module 4:
Lectures: Comprehensive coverage of wind energy principles and technology.
Group Discussions: Debates on the environmental and social impacts of wind energy.
Case Studies: Analysis of successful wind energy projects.
Software Tools: Use of WindPRO or similar software for wind farm design.

Module 5:
Lectures: In-depth explanation of biomass, hydro, and geothermal energy principles.
Workshops: Hands-on demonstrations of biomass conversion technologies.
Field Visits: If possible, tours of hydro or geothermal power plants.
Case Studies: Real-world examples of biomass, hydro, and geothermal energy projects.
Module 6:
Lectures: Coverage of energy management principles and renewable energy policies.
Group Projects: Students plan and present a renewable energy project.
Guest Lectures: Industry experts discuss current trends and challenges in renewable energy management.
Case Studies: Detailed analysis of successful renewable energy projects, with a focus on management and policy aspects.

Course Name: IPR and Patenting

Course Code: OE26

Category: Preamble:

Course Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as international treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Course Outcomes:

Learner will be able to…

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

Course Scheme:

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

Assessment guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Intellectual Property Rights (IPR):	Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	6
2	Enforcement of Intellectual Property Rights:	Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, international agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	8
3	Emerging Issues in IPR:	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc	6
4	Basics of Patents:	Definition of Patents, Conditions of patentability, Patentable and nonpatentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	8
5	Patent Rules:	Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	9
6	Procedure for Filing a Patent (National and International):	Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	8
Total			45

REFERENCE BOOKS:

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

Course Name: Research Methodology

Course Code: OE27
Category: OE

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

Course Objectives:

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

Course Outcomes:

Students will be able to:

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

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3		3	

Assessment guidelines:

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

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction and Basic Research Concepts	Introduction and Basic Research Concepts 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology 1.2 Need of Research in Business and Social Sciences 1.3 Objectives of Research 1.4 Issues and Problems in Research 1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	9
2	Types of Research	Types of Research 2.1. Basic Research 2.2. Applied Research 2.3. Descriptive Research 2.4. Analytical Research 2.5. Empirical Research 2.6 Qualitative and Quantitative Approaches	7
3	Research Design and Sample Design	Research Design and Sample Design 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	7
4	Research Methodology	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	8
5	Ethics in Research	Ethics in Research - Plagiarism - Definition, different forms, consequences, unintentional plagiarism, copyright infringement, collaborative work. Qualities of good Researcher.	4
6	ICT Tools for Research	ICT Tools for Research: Role of computers in research, maintenance of data using software such as Mendeley, Endnote, Tabulation and graphical presentation of research data and software tools. Web search : Introduction to Internet, use of Internet and www, using search engines and advanced search tools.	4
Total			39

Text Books:

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

Reference books

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

Course Code	Course Name	Credits Assigned				
		Theory	Practical	Theory	Practical	Total
OE22	Project Management	03	--	03	--	03

Evaluation Scheme:

	ISE	MSE (Mid Semester)	ES (End Semester)	Total
TH	20	30	50	100

Objectives:

To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.

To appraise the students with the project management life cycle and make them knowledgeableabout the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process.Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM,GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	Planning Projects:	6

	Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and riskregister. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
05	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engagingwith all stakeholders of the projects. Team management, communication and project meetings. Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Usingmilestones for measurement; change requests and scope creep. Project audit. Project Contracting Project procurement management, contracting and outsourcing,	8
06	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6
Total		9

REFERENCES:

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

Course Name: Sustainability Management

Course Code: OE24

Category: Open Elective

Preamble:

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

Pre-requisites:

NIL

Course Objectives:

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

Course Outcomes:

Learner will be able to:

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

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

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

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

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

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

Course Scheme:

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

Assessment guidelines:

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

Theory	20	30	50	100

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

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Sustainability	Overview of Sustainability: Definition, history, and importance. Sustainable Development Goals (SDGs): UN's 2030 Agenda and its impact on global development. Three Pillars of Sustainability: Environmental, social, and economic dimensions. Current Challenges: Climate change, resource depletion, inequality, and global initiatives.	5
2	Environmental Sustainability	Understanding Environmental Impact: Carbon footprint, waste management, and biodiversity. Energy Management: Renewable energy sources, energy efficiency, and innovations in energy systems. Circular Economy: Concepts, examples, and transitioning to closed-loop systems. Sustainable Resource Management: Water, minerals, and sustainable agriculture.	8
3	Social Sustainability	Social Equity and Inclusion: Addressing diversity, equity, and inclusion in organizations. Community Engagement: Building partnerships and contributing to societal development. Labor Practices: Ethical employment practices, health, and safety. Corporate Social Responsibility (CSR): Importance, frameworks, and success stories.	7
4	Economic Sustainability	Sustainable Business Practices: Triple bottom line approach. Green Finance: ESG investing, green bonds, and carbon pricing. Sustainable Innovation: Developing products and services that align with sustainability goals. Regulatory Frameworks: Policies and standards for sustainable business operations.	5
5	Sustainability Strategy & Implementation	Developing a Sustainability Strategy: Key steps and tools. Stakeholder Engagement: Identifying and collaborating with key stakeholders. Sustainability Reporting: Standards (GRI, SASB), metrics, and case studies.	8

		Measuring Impact: Life cycle assessment (LCA), carbon accounting, and sustainability indicators.	
6	Technology and Innovation for Sustainability	Digital Transformation: Role of AI, IoT, and big data in achieving sustainability. Green Technologies: Innovations in clean energy, transportation, and waste management. Smart Cities: Integration of sustainable technologies in urban planning. Role of Blockchain: Transparency and traceability in sustainability practices.	6
7	Leadership and Change Management in Sustainability	Sustainability Leadership: Characteristics and examples of successful leaders. Driving Organizational Change: Overcoming resistance and fostering a sustainability culture. Ethical Decision Making: Frameworks for responsible leadership. Global Case Studies: Examining successful implementations of sustainability initiatives.	6
Total			**45**

Textbooks:

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

Reference Books:

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

Advanced Honors/Minors

Course Name: Scalable ML and Big Data Analytics

Course Code: IT55T

Category: Honors/Minors

Preamble:

This course introduces students to scalable techniques in Machine Learning and Big Data Analytics, focusing on processing large-scale datasets using distributed frameworks like Apache Spark and Hadoop. It emphasizes the design, implementation, and optimization of machine learning and deep learning models in scalable environments.

Pre-requisites:

Data Structure & Analysis - IT01T
Machine Learning - IT15T

Course Objectives:

- Understand the fundamentals of big data, its architecture, and the need for scalable machine learning systems.
- Explore and implement scalable machine learning algorithms using distributed computing frameworks like Apache Spark and Hadoop.
- Apply deep learning techniques in distributed environments and analyze their performance on large-scale datasets.
- Design and evaluate end-to-end big data analytics pipelines, integrating real-time data processing and model deployment.

Course Outcomes:

Learner will be able to:
CO1: Explain the architecture and components of big data and scalable ML systems.
CO2: Use big data tools such as Hadoop, Spark, and Kafka for distributed data processing.
CO3: Implement and evaluate scalable ML algorithms using Spark MLlib or equivalent libraries.
CO4: Train and fine-tune deep learning models on large datasets using distributed training approaches.
CO5: Build and deploy real-time data analytics pipelines for practical applications.
CO6: Analyze and interpret the performance and limitations of scalable ML models using appropriate metrics and techniques.

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 Big Data and Scalable Machine Learning	Overview of Big Data: Characteristics, sources, and challenges (Volume, Variety, Velocity, Veracity, Value) Traditional vs. Big Data approaches Introduction to Scalable ML: Need for scalability, distributed computing, ML pipeline in the context of big data Tools and frameworks overview: Hadoop, Spark, Flink, etc.	4
2	Big Data Storage and Processing Frameworks	Distributed File Systems: HDFS architecture, data replication, block storage Introduction to Hadoop Ecosystem: MapReduce paradigm Apache Spark: RDDs, DataFrames, DAGs In-memory computing and performance benefits Streaming and batch processing frameworks (Spark Streaming, Flink, Kafka basics)	6
3	Scalable Machine Learning Algorithms	Introduction to scalable ML libraries: MLlib, H2O.ai, TensorFlow on Spark Scalable versions of ML algorithms: Linear/Logistic Regression, Decision Trees and Random Forest, K-Means Clustering, Gradient Boosted Trees	6
4	Feature Engineering and Model Optimization at Scale	Handling high-dimensional data Feature selection, dimensionality reduction (e.g., PCA, t-SNE) Data preprocessing at scale (Spark DataFrames, pipelines) Hyperparameter tuning at scale (Grid Search, Random Search using MLlib/Hyperopt) Model evaluation and cross-validation in distributed environments	6
5	Deep Learning with Big Data	Introduction to Deep Learning at scale Distributed training techniques (data parallelism, parameter servers) Using TensorFlow, PyTorch with Spark and BigDL Case study: Image/Text classification using distributed DL frameworks Use of GPU clusters and cloud-based training (Google Colab, AWS SageMaker basics)	4
6	Applications, Case Studies & Emerging Trends	Real-world applications: Fraud detection, recommender systems, IoT analytics Case studies: Netflix, Uber, Amazon, etc.	4

		Ethical issues in large-scale data analysis (bias, privacy, fairness) Edge computing and federated learning overview Trends: AutoML, MLOps, Large Language Models at scale	
Total			**30**

Textbooks:

1. Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, "Advanced Analytics with Spark: Patterns for Learning from Data at Scale", O'Reilly Media
2. Nick Pentreath,""Machine Learning with Spark", Packt Publishing
3. Jure Leskovec, Anand Rajaraman, Jeff Ullman,"Mining of Massive Datasets", Cambridge University Press

Reference Books:

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi,"Big Data: Principles and Paradigms", Morgan Kaufmann
2. Vijay Kotu, "Data Science for Engineers", Elsevier
3. Tomasz Drabas, Denny Lee, "Deep Learning with PyTorch and Spark", O'Reilly Media

Course Name: Scalable ML and Big Data Analytics Lab

Course Code: IT55P

Category: Honors/Minors

Preamble:

This course introduces students to scalable techniques in Machine Learning and Big Data Analytics, focusing on processing large-scale datasets using distributed frameworks like Apache Spark and Hadoop. It emphasizes the design, implementation, and optimization of machine learning and deep learning models in scalable environments.

Pre-requisites:

Data Structure & Analysis Lab - IT01P
Machine Learning Lab- IT15P

Course Objectives:

- Understand the fundamentals of big data, its architecture, and the need for scalable machine learning systems.
- Explore and implement scalable machine learning algorithms using distributed computing frameworks like Apache Spark and Hadoop.
- Apply deep learning techniques in distributed environments and analyze their performance on large-scale datasets.
- Design and evaluate end-to-end big data analytics pipelines, integrating real-time data processing and model deployment.

Course Outcomes:

Learner will be able to:
CO1: Explain the architecture and components of big data and scalable ML systems.
CO2: Use big data tools such as Hadoop, Spark, and Kafka for distributed data processing.
CO3: Implement and evaluate scalable ML algorithms using Spark MLlib or equivalent libraries.
CO4: Train and fine-tune deep learning models on large datasets using distributed training approaches.
CO5: Build and deploy real-time data analytics pipelines for practical applications.
CO6: Analyze and interpret the performance and limitations of scalable ML models using appropriate metrics and techniques.

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	Perform file operations on HDFS – uploading, reading, and deleting files.
2	Write a MapReduce program to count word frequency in a large text file.
3	Use Spark RDDs and DataFrames to perform transformations and actions on a large dataset
4	Apply Logistic Regression and Decision Trees using Spark MLlib on a classification dataset.
5	Cluster high-dimensional data using K-Means in Spark, visualize clusters using t-SNE/PCA.
6	Compare the performance of Random Forest and Gradient Boosting using large datasets.
7	Implement feature selection and normalization pipelines using Spark ML.
8	Build a simple deep learning model (e.g., MNIST classifier) using TensorFlow or PyTorch.
9	Integrate a deep learning model with Spark for inference on streaming or batch data.
10	Mini Project

Textbooks:

1. Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, "Advanced Analytics with Spark: Patterns for Learning from Data at Scale", O'Reilly Media
2. Nick Pentreath,""Machine Learning with Spark", Packt Publishing
3. Jure Leskovec, Anand Rajaraman, Jeff Ullman,"Mining of Massive Datasets", Cambridge University Press

Reference Books:

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi,"Big Data: Principles and Paradigms", Morgan Kaufmann
2. Vijay Kotu, "Data Science for Engineers", Elsevier
3. Tomasz Drabas, Denny Lee, "Deep Learning with PyTorch and Spark", O'Reilly Media

Course Name: Time Series and Forecasting & Time Series and Forecasting Lab

Course Code: IT56T & IT56P

Vertical/ Sub-Vertical:

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Probability and Statistics, Linear Algebra, Calculus

Pre-requisite for: Advanced Forecasting Techniques, Financial Analytics / Quantitative Finance, Machine Learning for Sequential Data

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT56T	2	-	2	-
IT56P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT56T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (IT56P)	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 course Time Series and Forecasting introduces students to the analysis of time-dependent data, focusing on identifying patterns, modeling trends and seasonality, and forecasting future values. It combines statistical techniques with practical implementation using tools like Python/R, preparing students for real-world applications in finance, economics, environmental science, and engineering.

Course Objectives:

- To develop a strong foundation in time series concepts, including trend, seasonality, stationarity, and autocorrelation, along with their significance in real-world data analysis.
- To equip students with practical skills to apply statistical and machine learning-based forecasting techniques using tools like Python or R.
- To enable critical thinking and problem-solving by analyzing time-dependent data and designing effective forecasting models for domains such as finance, healthcare, environment, and operations.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	To recall fundamental concepts and terminology related to time series data and forecasting methods.	Remembering
CO2	To explain the components of time series data and the theoretical foundations of various forecasting models.	Understanding
CO3	To apply classical and modern forecasting models (e.g., ARIMA, exponential smoothing) to real-world time series datasets.	Applying
CO4	To analyze time series data using decomposition, autocorrelation, and diagnostic tools to identify suitable forecasting techniques.	Analysing
CO5	To evaluate the accuracy and performance of different forecasting models using standard metrics and validation methods.	Evaluating
CO 6	To design and implement complete forecasting solutions for practical problems using programming tools and domain-specific data.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Time Series Analysis	Definition and examples of time series Components: trend, seasonality, cyclicity, noise Types: univariate vs. multivariate, discrete vs. continuous Time series visualization Applications across domains (finance, healthcare, environment) • **Self-Learning Topics:** o Exploring open time series datasets o Domain-wise application studies	2

Module No.	Module Name	Content	No of Hours
2	Time Series Decomposition and Smoothing	Additive vs. multiplicative models Moving average, weighted moving average Exponential smoothing: SES, DES (Holt), TES (Holt-Winters) STL decomposition (Seasonal-Trend decomposition) **Self-Learning Topics:** • Visualization and implementation using Python/R/Excel • Hands-on experimentation with smoothing methods	5
3	Stationarity and ARIMA Modeling	Stationarity: concept, importance, visual detection Differencing and transformations ACF and PACF Unit root tests: ADF, KPSS AR, MA, ARMA, ARIMA models Model selection: AIC, BIC **Self-Learning Topics:** • ACF/PACF analysis on sample datasets • Using Python (statsmodels) for ARIMA	5
4	Advanced Time Series Models	Seasonal ARIMA (SARIMA), SARIMAX Vector Autoregression (VAR) Granger causality Cointegration Introduction to state space models and Kalman filters **Self-Learning Topics:** o Application of VAR and SARIMAX in real-world datasets o Financial time series examples	6
5	Machine Learning for Time Series Forecasting		**5**

		Time-based feature engineering (lags, rolling windows) Train-test split for time series Regression models: Decision Tree, Random Forest Basics of deep learning: RNN, LSTM Evaluation metrics: RMSE, MAE, MAPE **Self-Learning Topics:** • Hands-on with ML models using Python (scikit-learn, Keras) • Walk-forward validation techniques	
6	Applications, Case Studies & Project Work	Case studies: stock market, weather prediction, demand forecasting Forecasting dashboard basics (e.g., Streamlit/Flask for Python) Ethics in forecasting Mini-project: problem selection, modeling, evaluation, and presentation **Self-Learning Topics:** • Deployment tools for model sharing • Business storytelling with data	**2**
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Time Series Visualization and Component Analysi
2.	Smoothing Techniques: MA, WMA, and Exponential Smoothing
3.	Stationarity Testing using ADF and KPSS Tests
4.	ARIMA Model Building and Forecasting
5.	Seasonal ARIMA (SARIMA) Model for Periodic Data
6.	Vector Autoregression (VAR) for Multivariate Time Series
7.	*Feature Engineering for ML-based Time Series Forecasting*
8.	Forecasting using Decision Tree and Random Forest
9.	LSTM Model for Sequence Forecasting (Deep Learning)
10.	Mini-Project: End-to-End Forecasting Pipeline

Course Name: Advanced Threat Intelligence and Penetration Testing

Course Code: IT58T and IT58P

Vertical/ Sub-Vertical: PE

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Computer Networks (IT06T)

Pre-requisite for: IT62T (Detection & Mitigation of Cyber Threats)

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT40T	2	-	2	-
IT40P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT40T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (IT40P)	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:

This course explores the landscape of cyber threats and countermeasures. It introduces students to advanced threat intelligence concepts, attack simulation techniques, and penetration testing methodologies. Students gain hands-on experience in discovering, analysing, and mitigating real-world security vulnerabilities.

Course Objectives:

- Understand the advanced concepts in cyber threat intelligence and actor profiling.
- Perform vulnerability assessments and penetration testing on networked environments.
- Use industry-standard tools to collect, process, and report threat intelligence.
- Apply ethical and legal considerations in offensive security practices.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Describe the principles of threat intelligence and penetration testing	Remembering
CO2	Identify and classify threat actors, TTPs, and attack vectors using threat models	Understanding
CO3	Conduct penetration tests using tools and techniques across various attack surfaces	Applying
CO4	Analyse threat data and penetration test results to assess organizational risks	Applying
CO5	Design threat reports and penetration test documentation with actionable recommendations	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Threat Intelligence	Definitions and types of threat intelligence (Strategic, Tactical, Operational, Technical), Threat intelligence lifecycle, Threat actors and motivations ***Self-Learning Topics***: *Cyber kill chain, Threat hunting basics*	4
2	Threat Intelligence Tools and Techniques	STIX/TAXII standards, MITRE ATT&CK framework, MISP, OpenCTI, OSINT tools, IOCs and TTPs. ***Self-Learning Topics:*** *YARA rules, Passive DNS, WHOIS lookups*	6

3	Introduction to Penetration Testing	Phases of penetration testing; ethics and legal considerations; vulnerability scanning tools (Nessus, OpenVAS); CVEs and CVSS; Metasploit basics. ***Self-Learning Topics:*** *SAST vs. DAST, manual code reviews, OSCP/CEH overview*	6
4	Network and Web Application Testing	Network scanning (Nmap), Web application testing (Burp Suite, Nikto); OWASP Top 10 (SQLi, XSS, LFI); exploitation walkthroughs. ***Self-Learning Topics:*** *Gobuster, Hydra, ZAP Proxy*	6
5	Threat Reporting and Risk Mitigation	Types of reports (technical, executive); report structure; TTP documentation; risk ratings and mitigation strategy formulation. ***Self-Learning Topics:*** *NIST Framework, ISO/IEC 27001*	4
6	Case Studies and Emerging Threat Trends	Case studies (APT29, Lazarus, SolarWinds); current threat landscapes; dark web intelligence; threat hunting practices. ***Self-Learning Topics:*** *Threat feeds (VirusTotal, OTX), annual threat reports (Mandiant, DBIR)*	4
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Configure MISP and integrate a threat feed
2.	Map attacker techniques using MITRE ATT&CK Navigator
3.	Perform active and passive OSINT collection (e.g., Shodan, WHOIS, Google Dorks)
4.	Scan a network using Nmap and interpret port/service results
5.	Perform vulnerability assessment using Nessus or OpenVAS
6.	Exploit a system using Metasploit (e.g., SMB exploit)
7.	Conduct a web application attack using Burp Suite (e.g., SQLi or XSS on DVWA)
8.	Prepare a structured technical + executive report of test findings and recommendations

Course Name: UX Design, Evaluation and AR-VR

Course Code: IT68T

Category: Honour – Minor (UI/UX)

Preamble:

Usability engineering is a framework for evaluating digital products or services that focuses on the optimization of usability. It incorporates theories from both psychology and computer science. It involves an iterative approach to design by considering the needs, abilities, or even limitations of the intended users. UX designers focus on the interactions that people have with products like websites, mobile apps, and physical objects. UX designers make those everyday interactions usable.

Pre-requisites:

- Foundations of UI /UX
- Web Technologies
- Basic knowledge of designing tools and languages like HTML,

Course Objectives:

- Stress the importance of User Interface and User Experience.
- Evaluate designs based on usability and accessibility metrics.
- Eplore the fundamentals of AR and VR technologies.
- Apply UX principles to create immersive AR/VR applications.
- Analyze real-world case studies to bridge theory with practice.

Course Outcomes:

Learner will be able to

CO1 : Understand UX Design and learn UX process . CO2: Apply UX Evaluation and Testing

CO3 : Understand the fundamentals of AR and VR technologies. CO4 : Learn Design principles of AR-VR

CO5 : Create AR/VR system components and their applications. CO6 : Understand Ethics and Trends in UX and AR-VR

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.

Sr. No.	Module	Detailed Content	Hrs	CO Mapping
1	**Introduction to UX Design**	• Principles of UX Design: Usability, Accessibility, and Interaction Design. • UX vs. UI: Differences and overlaps. • Design Thinking Process: Empathize, Define, Ideate, Prototype, and Test. • Tools for UX Design: Figma, Adobe XD, Sketch.	05	CO1
2	**UX Evaluation and Testing**	• Importance of Usability Testing: Metrics and Methods. • Heuristic Evaluation and Cognitive Walkthroughs. • User Testing Techniques: A/B Testing, Surveys, Focus Groups. • Data Analysis in UX: Using heatmaps, analytics, and feedback.	05	CO2

		• Hands-on: Conduct usability testing for a simple app prototype.		
3	**Fundamentals of AR and VR**	• Overview of Augmented Reality and Virtual Reality. • Key Components: Hardware (e.g., headsets, controllers), Software, and Sensors. • Differences Between AR and VR: Use cases and applications. • Introduction to AR SDKs (e.g., ARKit, ARCore) and VR platforms (e.g., Oculus, Unity).	05	CO3
4	**AR and VR Design Principles**	• UX for Immersive Technologies: Interaction design in 3D spaces. • Storyboarding and Prototyping for AR/VR. • Challenges: Motion sickness, haptics, and real-time performance. • Hands-on: Build a basic AR app using ARCore/ARKit.	05	CO4
5	**Applications and Case Studies in AR/VR**	• Applications in Engineering: Training simulations, product design, and prototyping. • Healthcare: Surgical simulations and patient education. • Education and Gaming: AR/VR for immersive learning. • Case Studies: Real-world success stories of AR/VR implementation.	05	CO5
6	**Ethics and Future Trends in UX and AR/VR**	• Ethical Design: Privacy, inclusivity, and psychological impacts. • Evaluating AR/VR for accessibility.	05	CO6

		• Future Directions: Mixed Reality, AI- driven AR/VR experiences. • Final Project: Design and present an AR/VR application prototype.		

Online resources

- https://nptel.ac.in/courses/107/103/107103083/
- https://www.uxbeginner.com/ux-courses/
- Google UX Design Certificate
- Coursera AR/VR Development

Books and References:

A. Books:

1. The Design of Everyday Things by Don Norman.
2. UX for XR: User Experience Design and Strategies for Immersive Technologies by Cornel Hillmann.
3. The UX Book by Rex Hartson and Pardha Pyla
4. Smashing UX Design by Jesmond Allen and James Chudley
5. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden
6. Don't Make Me Think, Revisited by Steve Krug
7. The User Experience Team of One by Leah Buley
8. The Elements of User Experience by Jesse James Garrett
9. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

B. References:

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler
2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
4. Human Computer Interaction by Alan Dix

C. Tools:

1. Figma, Adobe XD, Sketch for UX.
2. Unity3D, Unreal Engine, ARKit, ARCore for AR/VR.

Course Name: UX Design, Evaluation and AR-VR Lab

Course Code: IT68P

Category: Honour – Minor (UI/UX)

Preamble:

Usability engineering is a framework for evaluating digital products or services that focuses on the optimization of usability. It incorporates theories from both psychology and computer science. It involves an iterative approach to design by considering the needs, abilities, or even limitations of the intended users. UX designers focus on the interactions that people have with products like websites, mobile apps, and physical objects. UX designers make those everyday interactions usable.

Pre-requisites:

- Foundations of UI /UX ,
- Web Technologies
- Basic knowledge of designing tools and languages like HTML

Lab Objectives:

- Understand and Apply Design Thinking and UX Process
- Develop Skills in UX Evaluation and Testing
- Introduce Fundamentals of AR and VR Development
- Develop skills to design user-friendly and accessible AR/VR systems.
- Explore Ethical and Emerging Trends in UX and AR/VR

Lab Outcomes:

Learner will be able to

LO1 : Apply the design thinking methodology and UX process.
LO2 : Perform heuristic evaluations and usability testing for an existing application, documenting usability issues and proposing solutions.
LO3: Create a basic AR application or VR simulation using tools like Unity or ARKit, demonstrating understanding of fundamental technologies.
LO4 : Build an interactive AR/VR experience
LO5 : Present a research-based analysis on the ethical challenges and emerging trends in UX and AR/VR technologies

Course Scheme:

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

Assessment guidelines:

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

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 Experiments

Experiment 1: Design Thinking Process

Objective: Apply the Design Thinking methodology to solve a real-world problem.

Tasks:

Identify a user problem (e.g., app for booking study rooms). Develop personas and empathy maps.
Create low-fidelity prototypes using tools like Figma or paper sketches.

Experiment 2: Heuristic Evaluation

Objective: Conduct heuristic evaluation for an existing website or app.

Tasks:

Evaluate based on Jakob Nielsen's 10 Usability Heuristics. Document usability issues and severity ratings.
Suggest design improvements.

Experiment 3: Usability Testing

Objective: Test the usability of a simple app prototype.

Tasks:

Define test tasks (e.g., logging in, completing a purchase). Recruit participants and record observations.
Analyze results using usability metrics (e.g., task success rate).

Experiment 4: Accessibility Testing

Objective: Evaluate a web application for accessibility compliance.

Tasks:

Use tools like Axe or Lighthouse for automated testing.
Manually inspect for color contrast, keyboard navigation, and screen reader compatibility.
Propose fixes for identified issues.

Experiment 5: A/B Testing

Objective: Perform A/B testing for UI variants.

Tasks:

Create two design variants of a landing page.
Simulate user interaction data using tools like Optimizely.
Compare performance metrics (e.g., click-through rate, conversion rate).

Experiment 6: Building a Basic AR Application

Objective: Develop an AR app for visualizing 3D models.

Tasks:

Use ARCore or ARKit to create an app.
Load and display a 3D object (e.g., furniture or car model) in a real-world environment.
Test on a mobile device.

Experiment 7: Developing a VR Environment Objective: Create an

interactive VR environment.

Tasks:

Use Unity3D or Unreal Engine to design a virtual space.
Add basic interaction, like picking up objects or moving in the environment.
Test using a VR headset (e.g., Oculus or HTC Vive).

Experiment 8: Marker-Based AR

Objective: Implement marker-based AR for object recognition.

Tasks:

Use Vuforia or a similar SDK to detect markers (e.g., QR codes). Overlay relevant 3D models or information on detected markers. Optimize for accuracy and performance.

Experiment 9: Gesture-Based Interaction in VR

Objective: Implement gesture recognition for VR navigation.

Tasks:

Use Leap Motion or a similar device for tracking hand movements.
Map gestures to interactions (e.g., swipe to open menus, pinch to zoom). Test the usability of the gesture system.

Experiment 10: Simulating Real-World Scenarios in VR Objective:

Create a VR simulation for a real-world task.

Tasks:

Develop a training module (e.g., assembling machinery). Include step-by-step guidance and feedback.
Assess user learning outcomes based on interactions.

Online resources

- **https://nptel.ac.in/courses/107/103/107103083/**
- **https://www.uxbeginner.com/ux-courses/**
- **Google UX Design Certificate**
- **Coursera AR/VR Development**

Books and References:

B. Books:

1. The Design of Everyday Things by Don Norman.
2. UX for XR: User Experience Design and Strategies for Immersive Technologies by Cornel Hillmann.
3. The UX Book by Rex Hartson and Pardha Pyla
4. Smashing UX Design by Jesmond Allen and James Chudley
5. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden
6. Don't Make Me Think, Revisited by Steve Krug

7. The User Experience Team of One by Leah Buley
8. The Elements of User Experience by Jesse James Garrett
9. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

B. References:

5. A Project Guide to UX Design by Russ Unger and Carolyn Chandler
6. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
7. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
8. Human Computer Interaction by Alan Dix

C. Tools:

3. Figma, Adobe XD, Sketch for UX.
4. Unity3D, Unreal Engine, ARKit, ARCore for AR/VR.

Course Name: Generative Model and GenAI & Generative Model and GenAI Lab

Course Code: IT59T & IT59P

Vertical/ Sub-Vertical:

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT21T (Artificial Intelligence)

IT15T (Machine Learning)

Pre-requisite for: NIL

Recommended Semester: 8

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT59T	2	--	2	--
IT59P	--	2	--	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT59T)	15	20	40	75
Practical (IT59P)	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.

Preamble:

Generative AI represents a dynamic field at the forefront of technological advancement, where algorithms are imbued with the capacity to imagine, create, and innovate. In this course, we aim to provide you with a comprehensive understanding of the principles, techniques, and applications of Generative AI, while offering you the opportunity to delve into specialized topics and hands-on projects tailored to your

interests.

Course Objectives:

- Understand the mathematical foundations of generative models.
- Learn popular deep generative architectures such as GANs and VAEs.
- Explore real-world applications of generative AI.
- Develop and evaluate generative models using Python and deep learning libraries.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand the fundamental concepts of generative models and distinguish between discriminative and generative approaches	Understanding
CO2	Apply probabilistic concepts and latent variable models to interpret and construct generative frameworks like VAEs and GANs.	Applying
CO3	Develop and train Variational Autoencoders and analyze their effectiveness in generating high dimensional data.	Applying
CO4	Implement Generative Adversarial Networks and explore advanced architectures like DCGAN, cGAN, and StyleGAN.	Applying
CO5	Experiment with and evaluate transformer-based and diffusion-based generative models for tasks such as text generation and image synthesis.	Applying
CO6	Demonstrate practical skills in using industry tools (like Hugging Face, OpenAI API, Stable Diffusion) and create a mini-project applying generative AI to real-world problems.	Applying

Detailed Syllabus:

Module No.	Module name	Content	No. of Hours
1	Introduction to Generative Models and Gen AI	What are Generative Models? Discriminative vs Generative Approaches	5

		History and Evolution of Generative AI Key Applications: • Image generation (DALL·E, Midjourney) • Text generation (ChatGPT, GPT-4) • Code generation (Copilot, CodeGen) • Music, Art, and Video synthesis Introduction to ethical and social concerns • Deepfakes, hallucination, biases Overview of major models: GANs, VAEs, Diffusion Models, Transformers	
2	Probability & Mathematical Foundations	Random Variables, Probability Distributions (Gaussian, Bernoulli, etc.) Maximum Likelihood Estimation (MLE) KL Divergence and Cross-Entropy Jensen's Inequality, Bayesian Inference: Priors, Posteriors Latent Variable Models	4
		Review of Autoencoders: Encoder, Decoder, Reconstruction	
		Concept of Latent Space	

3	Variational Autoencoders (VAEs)	Probabilistic Encoder/Decoder Reparameterization Trick Loss Function: Reconstruction + KL Divergence Sampling from Latent Space Applications in image denoising, style transfer	5
4	Generative Adversarial Networks (GANs)	GAN Architecture: Generator vs Discriminator Adversarial Loss and Training Procedure Instabilities and Training Tricks • Label smoothing, BatchNorm, Learning rates GAN Variants: • DCGAN (Deep Convolutional GAN) • Conditional GAN (cGAN) • CycleGAN, StyleGAN Evaluation Metrics: FID, Inception Score	6

	Diffusion Models & Transformer- based Gen AI	Overview of Diffusion Models • Forward and Reverse Process • Sampling and Noise Scheduling • Models: DDPM, Stable Diffusion Transformer Architectures: • Encoder-Decoder, Self-Attention • GPT-style Autoregressive Models Training Large Language Models (LLMs) Prompt Engineering Basics	5
5			
	Tools, Projects, and Applications	**Contents:** Using Gen AI tools: Hugging Face, OpenAI, RunwayML, Replicate Design Thinking for GenAI projects Capstone Mini-Project Options: • Story generator • Chatbot • AI artist or designer	5

		Educational tutor	
6		• Deployment basics (Streamlit/Gradio) Ethics and the Future of Generative AI	
• **Total**			**30**

Sr. No.	List of experiments
1	Visualizing Probability Distributions: Plot Gaussian, Bernoulli, and Multinomial distributions.
2	Build a Simple Autoencoder
3	Train a VAE on Fashion-MNIST
4	Train a DCGAN on MNIST or CIFAR-10
5	Conditional GAN for Digit Generation
6	Text-to-Image Generation with Stable Diffusion
7	Generate Text using GPT-2 or GPT-Neo
8	Build an AI Art Generator or Chatbot
9	Face Aging or Style Transfer using GANs

Course Name: Data Ethics and Privacy & Data Ethics and Privacy Lab

Course Code: IT60T & IT60P

Vertical/ Sub-Vertical:

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Computer Networks, Introduction to Artificial Intelligence, Database Management Systems

Pre-requisite for: -

Recommended Semester: 8

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT60T	2	-	2	-
IT60P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT60T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (IT60P)	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 the era of data-driven decision making, ensuring ethical handling and privacy of data is paramount. This course equips students with the foundational principles of data ethics, privacy laws, and responsible data usage. It explores the ethical dilemmas, legal frameworks, and technical measures needed to protect individual rights and societal values in the digital age. The subject prepares students to develop and deploy data-centric solutions with accountability, transparency, and fairness.

Course Objectives:

- Understand fundamental principles of data ethics and privacy, including key concepts, challenges, and societal implications.
- Analyze legal and regulatory frameworks governing data protection and privacy in different jurisdictions.

- Apply ethical decision-making and privacy-preserving techniques to design responsible data-driven systems.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall fundamental concepts of data ethics, privacy, and related terminologies.	Remembering
CO2	Explain the importance of data privacy and ethical considerations in data usage and management.	Understanding
CO3	Apply relevant data protection laws and ethical guidelines to real-world data handling scenarios.	Applying
CO4	Analyze ethical dilemmas and privacy challenges in data-driven applications and technologies..	Analysing
CO5	Evaluate different privacy-preserving techniques and ethical frameworks for compliance and effectiveness.	Evaluating
CO 6	Design data-driven systems and policies that integrate ethical principles and privacy safeguards.	Creating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Data Ethics and Privacy	• Definition and history of data ethics • Importance of ethics in data handling • Key concepts: data privacy, confidentiality, consent, ownership • Overview of ethical challenges in data science and AI • Privacy principles and ethical frameworks **Self-Learning Topics:** • Case studies of ethical breaches in data use • Research on ethical codes (ACM, IEEE)	2

Module No.	Module Name	Content	No of Hours
2	Ethical Theories and Frameworks in Data	• Overview of normative ethical theories: utilitarianism, deontology, virtue ethics • Ethical decision-making models • Principles of fairness, accountability, transparency (FAT) • Stakeholders and their responsibilities in data ecosystems **Self-Learning Topics:** • Compare different ethical theories with real-world examples • Analyze a data ethics dilemma using multiple frameworks	5
3	Legal and Regulatory Landscape for Data Privacy	• Overview of GDPR, HIPAA, CCPA, and other major regulations • Data subject rights and data controller responsibilities • Consent and data breach notification requirements • Cross-border data flow and compliance challenges **Self-Learning Topics:** • Study a selected privacy law in detail • Research recent legal cases involving data privacy violations	5

Module No.	Module Name	Content	No of Hours
4	Privacy-Preserving Technologies and Techniques	• Data anonymization and pseudonymization • Differential privacy and its applications • Encryption and secure data storage • Access control and identity management • Emerging techniques: federated learning, homomorphic encryption **Self-Learning Topics:** • Hands-on with open-source privacy tools • Review recent research on privacy-enhancing technologies	6
5	Ethical Issues in AI and Data-Driven Systems	• Algorithmic bias and fairness • Transparency and explainability of AI models • Accountability in automated systems • Social impact and unintended consequences of AI • Case studies of ethical dilemmas in AI deployments **Self-Learning Topics:** • Explore datasets for bias and fairness analysis • Review prominent AI ethics guidelines	5

Module No.	Module Name	Content	No of Hours
6	Designing Responsible Data Systems and Policies	• Privacy by design and default principles • Ethical data governance frameworks • Risk assessment and mitigation strategies • Developing data usage policies and user consent mechanisms • Role of audits and compliance monitoring **Self-Learning Topics:** • Draft a data privacy policy for a hypothetical organization • Conduct a risk assessment for a data system	2
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Case Study Analysis of Data Ethics BreacheS
2.	Applying Ethical Frameworks to Data Dilemmas
3.	Comparative Study of Data Privacy Laws
4.	Implementing Data Anonymization Techniques
5.	Bias Detection in AI Models Le
6.	Designing a Data Privacy Policy for an Organization

Course Name: USECASE in UI/UX

Course Code: IT69T

Category: Honour – Minor (UI/UX)

Pre-requisites:

- Foundations of UI /UX
- Design and evaluation with AR/VR applications and web sites
- Basic knowledge of designing tools and languages like HTML

Course Objectives:

- Identify problem statement.
- Create project document.
- Plan and conduct user research
- Design wireframes.
- Develop prototypes.
- Perform testing and evaluation.

Course Outcomes:

Learner will be able to

CO1 : Identify problem statement from any domain. CO2 : Create and Complete project document.
CO3 : Understand the process of user research and apply. CO4 : Design wireframes
CO5 : Develop low fidelity and high fidelity prototypes CO6 : Evaluate and Test USECASE.

Course Scheme:

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

Assessment guidelines:

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

Theory	50	-	-	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall 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.

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

Assessment guidelines:

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

Guidelines for USECASE Discussion

Sr. No.	**Module**	**Detailed Content**	**Hrs**	**CO Mapping**
1	**Problem Identification**	Select a real-world problem relevant to your chosen domain. a. UI/UX Example: Redesign a website or app for improved accessibility and usability. b. AR-VR Example: Develop a VR training module for assembly line workers or an AR-based educational app.	05	CO1

2	**Project Proposal**	Create a **proposal document** with the following components: 1. **Title**: A concise project title. 2. **Background**: Context of the problem and why it's significant. 3. **Objectives**: What the project aims to achieve. 4. **Scope**: Define the boundaries of the project. 5. **Methodology**: ▪ UI/UX: Design Thinking or Agile UX methodology. ▪ AR-VR: Software development lifecycle (SDLC) specific to AR/VR.	05	CO2
3	**Planning and Research**	Conduct user research: a. UI/UX: Surveys, interviews, usability tests. b. AR-VR: Use case analysis, technical feasibility study. Benchmark similar applications and identify gaps.	05	CO3

4	**Design and Prototyping**	**UI/UX Projects**: a. Use tools like **Figma**, **Adobe XD**, or **Sketch** for prototyping.	05	CO4

		b. Prepare: i. Wireframes (low-fidelity and high-fidelity). ii. User flows and interaction designs. c. Include accessibility considerations (e.g., color contrast, keyboard navigation).		
5	**Development**	**UI/UX**: a. Develop functional prototypes or implement designs in a working product (e.g., using HTML/CSS/JavaScript). b. Integrate usability testing during the development phase. **AR-VR**: c. Develop AR/VR applications using SDKs (e.g., Vuforia for AR, Oculus SDK for VR). d. Optimize for performance and interactivity.	05	CO5

6	**Testing and Evaluation**	**UI/UX**: a. Conduct usability tests: i. Recruit participants	05	CO6

		matching your target audience. ii. Use metrics like task success rate, error rate, and time-on-task. **AR-VR**: b. Evaluate: i. Immersion: How engaging is the experience? ii. Performance: Frame rates, responsiveness.		

Books and References:

C. Books:

10. The Design of Everyday Things by Don Norman.
11. UX for XR: User Experience Design and Strategies for Immersive Technologies by Cornel Hillmann.
12. The UX Book by Rex Hartson and Pardha Pyla
13. Smashing UX Design by Jesmond Allen and James Chudley
14. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden
15. Don't Make Me Think, Revisited by Steve Krug
16. The User Experience Team of One by Leah Buley
17. The Elements of User Experience by Jesse James Garrett
18. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

B. References:

9. A Project Guide to UX Design by Russ Unger and Carolyn Chandler

10. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
11. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
12. Human Computer Interaction by Alan Dix

C. Tools:

5. Figma, Adobe XD, Sketch for UX.
6. Unity3D, Unreal Engine, ARKit, ARCore for AR/VR.

Course Name: Detection & Mitigation of Cyber Threats

Course Code: IT26T

Category: Honour – Minor (Advanced Cyber security)

Pre-requisites:

- Computer Network Security
- System Security and Ethical Hacking
- Digital Forensics

Course Objectives:

- To understand the nature and evolution of cyber threats and attack vectors.
- To learn various threat detection methodologies used in cybersecurity.
- To explore mechanisms and tools for mitigating different types of cyber threats.
- To understand the role of security frameworks and standards in cyber threat defense.
- To analyze case studies involving cyberattacks and their mitigation techniques.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1: Identify and classify various types of cyber threats and vulnerabilities.
CO2: Explain the principles and techniques used in cyber threat detection.
CO3: Describe defense strategies including security technologies and policies.
CO4: Evaluate cybersecurity frameworks and their application in threat mitigation.
CO5: Analyze real-world cyber incidents to derive threat mitigation approaches.
CO6: Demonstrate awareness of current trends and tools in cyber threat intelligence.

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.

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

Assessment guidelines:

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

Sr. No.	Module	Detailed Content	Hrs	CO Mapping
1	**Introduction to Cyber Threats**	Types of threats: malware, phishing, ransomware, insider threats, DDoS, APTs. Threat actors and motives. Threat intelligence lifecycle. OWASP Top 10.	5	CO1
2	**Threat Detection Techniques**	Signature-based vs. anomaly-based detection. Host-based and network-based detection. Behavioral analysis. Indicators of compromise (IoCs).	5	CO2
3	**Cyber Threat Intelligence (CTI)**	Threat intelligence sources, feeds, and platforms. STIX, TAXII standards. Open-source intelligence (OSINT). Role of CTI in threat detection.	5	CO3
4	**Mitigation Techniques & Incident Response**	Mitigation strategies: patching, segmentation, access control, encryption. Incident response process (NIST model). Containment, eradication, and recovery steps.	5	CO4

5	**Security Technologies & Tools**	Firewalls, antivirus, IDS/IPS, endpoint detection & response (EDR), security information and event management (SIEM). Modern defense tools (EDR/XDR, SOAR).	5	CO5
6	**Cybersecurity Frameworks & Case Studies**	MITRE ATT&CK, NIST CSF, ISO/IEC 27001. Case studies: SolarWinds, WannaCry, Target breach. Lessons learned and best practices.	5	CO6
Total				30

Textbooks

1. William Stallings, Computer Security: Principles and Practice, 4th Edition, Pearson, 2023.
2. Eric Conrad, Seth Misenar, Joshua Feldman, CISSP Study Guide, Syngress, 4th Edition.

Reference Books

1. Michael Sikorski & Andrew Honig, Practical Malware Analysis, No Starch Press.
2. Chris Sanders, Applied Network Security Monitoring, Syngress.
3. Paul E. Proctor, The Practice of Network Security Monitoring, No Starch Press.
4. MITRE ATT&CK Framework – https://attack.mitre.org
5. NIST SP 800-61 Rev. 2 – Computer Security Incident Handling Guide

Course Name: USECASE in UI/UX Lab

Course Code: IT69P

Category: Honour – Minor (UI/UX)

Pre-requisites:

- Foundations of UI /UX
- Design and evaluation with AR/VR applications and web sites.
- Basic knowledge of designing tools and languages like HTML, Figma.

Lab Objectives:

- Identify problem statement.
- Create project document.
- Plan and conduct user research
- Design wireframes.
- Develop prototypes.
- Perform testing and evaluation.

Lab Outcomes:

Learner will be able to

LO1 : Identify problem statement from any domain. LO2 : Create and Complete project document.
LO3 : Understand the process of user research and apply. LO4 : Design wireframes
LO5 : Develop low fidelity and high-fidelity prototypes LO6 : Evaluate and Test USECASE.

Course Scheme:

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

Assessment guidelines:

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

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall 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.

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	50	-		50

Guidelines for USECASE Documentation and Presentation

A	**Documentation and Presentation**	Create a final **report** including: 1. Introduction and objectives. 2. Literature review. 3. Methodology. 4. Design and development process. 5. Testing and results. 6. Future scope and limitations. Prepare a **presentation**: • Showcase project workflow, results, and demonstrations. • Use visuals like videos or live demos for AR/VR projects.
B	**Suggested Project Topics**	**UI/UX Topics:** a. Redesign a government service portal for better usability. b. Build an accessible e-learning platform for visually impaired users.

		c. Create a mobile app for mental health tracking with gamification elements. **AR-VR Topics:** a. VR-based firefighter training simulator. b. AR app for interior design visualization. **c.** VR museum tour with interactive 3D exhibits

Resources

- **UI/UX Tools**: Figma, Adobe XD, Sketch, Axure.
- **AR-VR Tools**: Unity3D, Unreal Engine, ARKit, ARCore.
- **Hardware**: AR-capable phones, VR headsets (Oculus, HTC Vive).
- **Research Material**: Google UX Design Certificate, Unity Learn AR/VR tutorials

Evaluation Criteria

- **Relevance and Innovation** (10M): How well does the project address the problem?
- **Design Quality** (15M): Quality of design and adherence to usability/interaction principles.
- **Technical Implementation** (30M): Functionality and technical robustness.
- **Testing and Evaluation** (10M): Depth of testing and insights from results.
- **Presentation** (10M): Clarity and effectiveness of documentation and demonstration.

Course Name: Smart Contact and Crypto Currencies

Course Code: IT71T & IT71P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: IT70L (Blockchain Technology)

Pre-requisite for: IT72T (Decentralised and Blockchain Technologies)

Recommended Semester: 7

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IT71T	2	-	2	-
IT71P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IT71T)	15	20	40	75
Practical(IT71P)	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.

Preamble:

This subject provides a comprehensive understanding of the concepts, technologies, and real-world applications of Blockchain and Cryptocurrency. It introduces the foundations of smart contracts, Ethereum blockchain components, cryptocurrency protocols, and regulatory frameworks. Students will gain practical exposure through smart contract development and blockchain tool usage, and will develop the ability to analyze, evaluate, and design blockchain-based solutions in various domains.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge related to:

- Crypto currency, Bitcoin and Smart contracts.
- Study public blockchain platforms such as Ethereum.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall and explain th fundamental concepts of smart contracts and their role in blockchain systems.	L1–L2 (Remember–Understand)
CO2	Demonstrate the ability to use Ethereum blockchain tools and interpret the functioning of Ethereum clients, accounts, and smart contracts.	L3 (Apply)

CO3	Analyze and evaluate cryptocurrency protocols, mining strategies, vulnerabilities, and the evolution of Bitcoin-like systems.	L4–L5 (Analyze–Evaluate)
CO4	Examine the legal and regulatory frameworks of cryptocurrency and assess their implications on the global economy and technology adoption.	L4–L5 (Analyze–Evaluate)
CO5	Illustrate the working of Bitcoin technology, including digital signatures, key pairs, transactions, wallets, and APIs.	L2–L4 (Understand–Analyze)
CO6	Design and evaluate blockchain applications in AI and cognitive domains through real-world case studies.	L5–L6 (Evaluate–Create)

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Smart Contracts**	Introduction to Smart Contracts, Structure of Smart Contract, Smart Contract Interaction, Contracts, Patterns and Smart Contracts Examples. ***Self-Learning Topics*** Patterns and Smart Contracts Examples.	5
2	**Ethereum Blockchain Components**	Introduction to Ethereum Development Tools, Ethereum Clients, Ethereum Languages, Ethereum Wallets, Ethereum Accounts, Ethereum Key pairs, Ethereum Platform	6
3	**Crypto currency**	History Distributed Ledger, Bitcoin protocols - Mining strategy and rewards,, Smart Contract, GHOST, Vulnerability, Attacks, Side chain, Name coin.	7
4	**Crypto currency Regulation**	Stakeholders, Roots of Bitcoin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy, future of Blockchain for crypto currencies.	7
5	**Bitcoins**	Introduction to Bitcoins, Bitcoin : Digital Signature, Digital Keys, Private Keys, Public Keys, Bitcoins Addresses, Bitcoins Transactions, Bitcoins Network, Bitcoins Wallets, Bitcoins Payments, Bitcoins Clients and APIs, Bitcoins Limitation	5
6	**Case studies of Block Chain in Cognitive applications**	Blockchain in Health care Innovation, AI Marketplaces, Future of AI and Blockchain.	2
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Install Ethereum wallet (e.g., MetaMask), create accounts, and understand wallet functionalities.
2.	Install Ethereum wallet (e.g., MetaMask), create accounts, and understand wallet functionalities.
3.	Implement contracts with functions, conditions, modifiers, and storage variables.
4.	Install Ethereum wallet (e.g., MetaMask), create accounts, and understand wallet functionalities.
5.	Create two or more contracts and implement interactions between them.
6.	*Simulate a Bitcoin-like transaction using testnet wallets or APIs.*
7.	Study and present a real-world case study where blockchain is used with cognitive applications.

Course Name: Decentralize & Blockchain Technologies
Course Code: IT72T
Category: Honours /Minor
Preamble:
Pre-requisites:
Computer Networks
Cryptography & Network Security
Data Structures
Distributed Systems
Course Objectives: After completion of the course, students will have adequate background, conceptual clarity and knowledge related to:

1. To understand the foundations of decentralized systems and peer-to-peer networks.
2. To explore the architecture and mechanisms of blockchain technology.
3. To study consensus mechanisms and smart contract development.
4. To investigate blockchain use-cases across various industries.
5. To analyze the challenges, security issues, and future directions of decentralized technologies.

Course Outcomes:
Learner will be able to:
Students who complete this course successfully are expected to:
CO1: Explain the fundamentals of decentralized networks and blockchain architecture.
CO2: Analyze various consensus mechanisms and their applicability.
CO3: Describe and evaluate blockchain platforms and smart contracts.
CO4: Apply blockchain concepts to design use-case-driven solutions.
CO5: Understand regulatory, scalability, and security issues in blockchain.
CO6: Critically assess future trends and developments in decentralized technologies.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	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.

Module No.	Module Name	Content	No of Hours
1	Introduction to Decentralization & Blockchain	Centralized vs decentralized systems, peer-to-peer networks, history and evolution of blockchain, key components: blocks, nodes, ledgers, hash, nonce, Merkle trees	5
2	Blockchain Architecture & Mechanics	Blockchain structure, public vs private vs consortium blockchain, cryptographic primitives (SHA-256, digital signatures), distributed consensus	5
3	Consensus Mechanisms	Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, Practical Byzantine Fault Tolerance (PBFT), Proof of Authority (PoA), comparisons and use-cases	5
4	Smart Contracts & Platforms	Ethereum overview, smart contract architecture, Solidity basics, use of EVM, Hyperledger Fabric, blockchain as a service (BaaS)	5
5	Applications of Blockchain	Blockchain in finance, supply chain, healthcare, voting, identity management, NFTs and tokenization, enterprise use-cases	5
6	Challenges, Security & Future Directions	Scalability (sharding, Layer 2), security vulnerabilities (51% attack, reentrancy, Sybil), privacy-enhancing tech (ZKP, mixers), regulatory concerns, CBDCs, Web3	5
Total			**30**

Textbooks:

1. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
2. Andreas M. Antonopoulos, Mastering Bitcoin, O'Reilly Media, 2nd Edition, 2017.
3. Imran Bashir, Mastering Blockchain, Packt Publishing, 4th Edition, 2023.

Reference Books:

1. Arvind Narayanan et al., Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.
2. Joseph Bonneau et al., SoK: Research Perspectives and Challenges for Blockchain Technology, IEEE, 2015.
3. Ethereum White Paper: https://ethereum.org/en/whitepaper/
4. Hyperledger Fabric Documentation: https://hyperledger-fabric.readthedocs.io
5. MIT OpenCourseWare: Blockchain and Money – https://ocw.mit.edu

Course Name: Decentralized & Blockchain Technologies Lab

Course Code: IT72P

Category: Honour/Minor

Preamble:

The course aims to offer hands-on experience with decentralized systems and blockchain technologies, focusing on development and deployment of smart contracts, simulation of consensus protocols, and real-world blockchain applications. It equips students with essential technical skills to understand and implement blockchain-based solutions.

Pre-requisites:

- Computer Programming (Python/JavaScript)
- Computer Network
- Cryptography and Network Security
- Basic Web Development

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge related to:

- To provide practical experience with blockchain architecture and peer-to-peer networks.
- To develop and deploy smart contracts using blockchain platforms such as Ethereum.
- To simulate consensus algorithms and cryptographic techniques used in blockchain.
- To design and implement simple decentralized applications (dApps).

Course Outcomes:

Students who complete this course successfully are expected to:
CO 1: Demonstrate understanding of blockchain architecture and setup using Ethereum.
CO 2: Implement smart contracts using Solidity and deploy them on test networks.
CO 3: Simulate consensus algorithms and analyze their effectiveness.
CO 4: Apply blockchain concepts to develop dApps for 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

The assessment methodology may be adapted by faculty and approved at the institute level prior to semester commencement.

Suggested List of Experiments:

Sr. No.	**List of Experiments**
1	Set up Ethereum environment (MetaMask, Ganache, Truffle). Deploy and test simple transactions.
2	Create a basic blockchain using Python or JavaScript with block validation logic.
3	Write and deploy a basic smart contract using Solidity on Remix IDE.
4	Interact with smart contracts via Web3.js and testnet (e.g., Ropsten/Goerli).
5	Develop and simulate a simple voting dApp using smart contracts.
6	Design and deploy an ERC-20 token smart contract
7	Simulate Proof of Work consensus using Python (basic mining simulation).
8	Create a private blockchain using Ganache and simulate peer nodes and transactions.
9	Demonstrate hashing and digital signatures using Python/OpenSSL.
10	Mini Project: Blockchain-based use-case implementation (e.g., asset tracking, certificate issuance).

Textbooks:

1. *Mastering Blockchain*, Imran Bashir, Packt Publishing, 4th Edition, 2023.
2. *Mastering Ethereum*, Andreas M. Antonopoulos & Gavin Wood, O'Reilly Media, 2018.

Reference Books:

1. *Bitcoin and Cryptocurrency Technologies*, Arvind Narayanan et al., Princeton University Press, 2016.
2. Ethereum White Paper – https://ethereum.org/en/whitepaper
3. Hyperledger Fabric Documentation – https://hyperledger-fabric.readthedocs.io
4. Remix Solidity IDE – https://remix.ethereum.org