Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Bachelor of Engineering

in

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE

For Affiliated Colleges

Semester – V to VI

W.E.F. 2026 – 27

Syllabus Structure for Third Year Engineering (Semester – V, Level – 5.5) (Artificial Intelligence & Data Science) (w.e.f. 2026 – 27)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-501	Introduction to Generative AI	PCC	3			3	40	60			100	3
AIDS-502	Introduction to Generative AI Lab	PCC			2	2			25	25 (PR)	50	1
AIDS-503	Introduction to Data Science	PCC	3			3	40	60			100	3
AIDS-504	Introduction to Data Science Lab	PCC			2	2			25	25 (PR)	50	1
AIDS-505	Data Visualization using R Programming Lab	PCC	3		4	7			50	25 (PR)	75	5
AIDS-506	Program Elective Course – I	PEC	3			3	40	60			100	3
AIDS-507	Program Elective Course – I-Lab	PEC			2	2			25		25	1
AIDS-508	Industry 4.0*	MD M	2			2	40	60	25		125	2
OE -509	Open Elective – III	OE	2			2			25		25	2
			16		**10**	**26**	**160**	**240**	**175**	**75**	**650**	**21**

* Syllabus common with T.E. (Computer)

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

CA: College Assessment UA: University Assessment

Program Elective Course – I		
Course Code		**Name of the Subject / Course**
AIDS-506	A	Business Economics and Financial Analysis
AIDS-506	B	Software Engineering and Automation Testing*
AIDS-506	C	Quantum Computing*

Syllabus Structure for Third Year Engineering (Semester – VI, Level – 5.5) (Artificial Intelligence & Data Science) (w.e.f. 2026 – 27)

(As per NEP 2020 Guidelines)

SEMESTER – WISE SYLLABUS STRUCTURE OF T. E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE For KBC NMU Affiliated Colleges, Semester – V to VI, W.E.F. 2026 – 27

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-601	Big Data Analytics	PCC	3			3	40	60			100	3
AIDS-602	Big Data Analytics Lab	PCC			2	2			25	25 (PR)	50	1
AIDS-603	Computer Network *	PCC	3			3	40	60			100	3
AIDS-604	Computer Network Lab *	PCC			2	2			25	25 (PR)	50	1
AIDS-605	Program Elective Course – II Lab *	PEC	3		4	7			50	25 (PR)	75	5
AIDS-606	Program Elective Course – III *	PEC	3			3	40	60			100	3
AIDS-607	Program Elective Course – III Lab*	PEC			2	2			25		25	1
AIDS-608	Industrial Automation *	MD M	2			2	40	60	25		125	2
AIDS-609	Introduction to Network Management and Virtualization *	VSEC	1		2	3			25		25	2
			15		**12**	**27**	**160**	**240**	**175**	**75**	**650**	**21**

* Syllabus common with T.E. (Computer)

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
CA: College Assessment UA: University Assessment

Program Elective Course – II Lab			Program Elective Course – III		
Course Code		Name of the Subject / Course	Course Code		Name of the Subject / Course
AIDS-605	A	Web Technology Lab *	AIDS-606	A	Block Chain Security and Performance *
AIDS-605	B	User Interface and User Experience Design Lab *	AIDS-606	B	Deep Learning and Neural Network *
AIDS-605	C	Internet of Things Lab *	AIDS-606	C	Database Security and Access Control *

EXIT COURSE FOR U. G. B. VOCATIONAL in ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (DURATION 8 WEEKS)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -610	Internship / Apprenticeship	OJT							125			4
AIDS -611	Mini Project	Project							25			4
									150			8

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Bachelor of Engineering

in

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – V

W.E.F. 2026 – 27

INTRODUCTION TO GENERATIVE AI (PCC)					
COURSE OUTLINE					
Course Title:	**Program Core Course (PCC) INTRODUCTION TO GENERATIVE AI**	**Short Title:**	**IGAI**	**Course Code:**	**AIDS-501**
Course description:					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Understand the fundamental concepts and evolution of Generative AI.
2. Analyze the working mechanisms of Large Language Models (LLMs).
3. To understand key Generative AI models and their architectures.
4. Apply prompt engineering techniques and programming frameworks for LLM-based systems.
5. Evaluate enterprise, ethical, and future implications of Generative AI.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain core concepts and types of Generative AI systems.
2. Describes how Large Language Models function internally.
3. Analyze and compare Generative AI models
4. Design effective prompts and build basic LLM applications.
5. Assess enterprise use cases, ethical concerns, and future trends in Generative AI.

COURSE CONTENT

INTRODUCTION TO GENERATIVE AI		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 9 Hours**	**Marks: 12**

Fundamentals of Generative AI

Introduction to Generative AI, Definition and scope of Generative AI, Overview of generative models and their applications, Generative AI vs Discriminative AI, Types of Generative AI outputs: Text, Images, Video, Music, Code, Voice, Importance of Generative AI in various domains, Real-world use cases: Banking, Healthcare, Manufacturing, Retail,

Unit–II:	**No. of Lectures: 9 Hours**	**Marks: 12**

Generative AI Models – Landscape and Types

Overview of popular Generative AI models, Types of Generative AI models: Text-based Generative Models, Image Generative Models, Code Generative Models, Closed-source vs Open-source models, Introduction to Generative AI Models: Generative Adversarial Networks (GANs), Variational Auto encoders (VAEs), Transformers, Attention Mechanism in detail, Long Short-Term

Memory Networks (LSTMs), Comparison of Generative AI models.

Unit–III:	No. of Lectures: 9 Hours	Marks: 12

Large Language Models, GPT and BERT

Language models overview, What are Large Language Models (LLMs)?, Foundational models, Pre-training of LLMs, Fine-tuning of LLMs, Reinforcement Learning from Human Feedback (RLHF), Autoregressive text generation, Inference and token-based generation, Limitations and hallucinations in LLMs, Applications of LLMs in engineering domains, GPT (Generative Pretrained Transformer): Pre-training and fine-tuning processes, Architecture and working of GPT models, Overview of GPT variants, ChatGPT, ChatGPT architecture (conceptual), Capabilities of ChatGPT, Strengths and limitations of ChatGPT, Understanding BERT architecture and pre-training objectives. Fine-tuning BERT for downstream NLP tasks,

Unit–IV:	No. of Lectures: 9Hours	Marks: 12

Prompt Engineering and Generative AI Programming

Introduction to prompt engineering**,** Prompt components and structure**,** Zero-shot and few-shot prompting**,** Prompt design strategies**,** Common prompt patterns**,** Programming LLM-based applications**,** Introduction to Retrieval Augmented Generation (RAG)**,** Use cases of RAG systems

Unit–V:	No. of Lectures:9 Hours	Marks: 12

Agents, Enterprise Applications and Responsible AI

Introduction to Autonomous Agents**,** Agent-based Generative AI systems**,** Business and economic impact of Generative AI**,** Enterprise adoption of Generative AI**,** Challenges in enterprise GenAI deployment**,** Responsible AI principles: Ethics**,** Bias**,** Safety and Transparency**,** Governance and compliance**,** Future trends in Generative AI

Text Books:

1. “Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology". Altaf Rehmani.
2. "Introduction to Generative AI”, Numa Dhamani, Kindle Edition, 2024.

Reference Books:

1. "Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, Tensor Flow, and Keras" by Josh Kalin.
2. “Generative AIin Software Development: Beyond the Limitations of Traditional Coding” Jesse Sprinter, 2024.

NPTEL Links:

1.Introduction to Language Models https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-language-models/?v=c86ee0d9d7ed

INTRODUCTION TO GENERATIVE AI LAB (PCC)					
LAB COURSE OUTLINE					
Course Title:	**Program Core Course (PCC) INTRODUCTION TO GENERATIVE AI**	**Short Title:**	**IGAIL**	**Course Code:**	**AIDS-502**
Course description:					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	**02**	**15**	**30**	**01**

Prerequisite course(s):

LAB COURSE CONTENT

INTRODUCTION TO GENERATIVE AI LAB	**Semester:**	**V**
Teaching Scheme:	**Examination scheme**	
Practical: **2 hours/week**	**End Semester Examination (ESE) UA: PR**	**25 marks**
	Internal Sessional Exam (ISE) CA:	**25 marks**

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. Write Python scripts to implement basic operations and TensorFlow 2 tensors.
2. Preprocess and clean datasets for Generative AI applications using Python libraries such as Pandas and NumPy. Handle missing data, normalize features, and encode categorical variables.
3. Use Matplotlib or Seaborn to visualize data distributions and patterns in Generative AI datasets. Plot histograms, scatter plots, and heatmaps to analyze data characteristics.
4. Implement a Generative Adversarial Network (GAN) architecture using TensorFlow 2. Train the GAN model on a dataset such as MNIST or CIFAR-10 for image generation tasks.
5. Train a GAN model on a custom dataset for image generation. Experiment with hyperparameters, loss functions, and optimization techniques to optimize GAN training.
6. Develop applications for image and video generation using trained Generative AI models. Use the models to generate art, create deep fakes, or synthesize video content.
7. Explore pre-trained word vectors. Explore word relationships using vector arithmetic. Perform arithmetic operations and analyze results.
8. Train a custom Word2Vec model on a small dataset. Train embedding s on a domain-specific corpus (e.g., legal, medical) and analyze how embedding s capture domain-specific semantics.
9. Use word embeddings to improve prompts for Generative AI model. Retrieve similar words using word embeddings. Use the similar words to enrich a Gen AI prompt. Use the AI model to generate responses for the original and enriched prompts. Compare the outputs in terms of detail and relevance.
10. Use word embeddings to create meaningful sentences for creative tasks. Retrieve similar words for a seed word. Create a sentence or story using these words as a starting point. Write a program that: Takes a seed word. Generates similar words. Constructs a short paragraph using these words.

Text Books:

1. "Responsible AI: Implementing Ethical and Unbiased Algorithms", by Shashin Mishra and Sray Agarwal
2. "Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4", by Valentina Alto, Packt Publishing Ltd, 2023.

Reference Books:

1. “Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models”, Joseph Babcock and Raghav Bali.
2. "Generative Adversarial Networks: An Overview" by Vinod Nair and Geoffrey E. Hinton.
3. "Hands-On Generative Adversarial Networks with PyTorch 1.x" by Stefano Bosisio and Vijayabhaskar J.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

INTRODUCTION TO DATA SCIENCE (PCC)					
COURSE OUTLINE					
Course Title:	**Program Core Course (PCC) INTRODUCTION TO DATA SCIENCE**	**Short Title:**	**IDS**	**Course Code:**	**AIDS-503**

Course description:

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3 Hours / Week**	**15**	**45**	**3**

Prerequisite course(s):

1. Basic Mathematics.
2. Fundamentals of Programming.

Course objectives:

The objective of this course is to:

1. Understand the evolution, scope, and foundational concepts of Data Science.
2. Explain key technologies and tools (e.g., Big Data platforms like Hadoop) used in real-world data processing.
3. Describe data management techniques including cleaning, modeling and handling unstructured data.
4. Apply basic predictive analysis and visualization techniques to interpret data insights.
5. Appreciate the role of creativity, intuition, and professional development pathways in Data Science.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain core concepts and the Data Science workflow.
2. Analyze the need for Big Data technologies in engineering problems.
3. Apply data cleaning and modeling strategies to real datasets.
4. Use basic predictive analysis and visualization to draw insights.
5. Recognize career development paths and emerging roles in Data Science.

COURSE CONTENT

Introduction to Data Science		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 9 Hours**	**Marks: 12**

Introduction & Core Concepts : Data Science Summarized, What is Big Data - Definitions of Data Science & Big Data, Significance in engineering contexts, Examples of data-driven decisions, **Hadoop (Overview) -** Distributed storage & processing, Hadoop ecosystem — high-level concepts

Unit–II:	**No. of Lectures: 09**	**Marks: 12**

Data Management and Cleaning : Data Management -Data collection, Storage strategies, **Data Cleaning-** Importance of data quality, Common issues and cleaning techniques, **Data Modeling for Unstructured Data -** Representing unstructured information, Challenges & considerations.

Unit–III:	**No. of Lectures: 09**	**Marks: 12**
Predictive Analysis: Predictive Analysis - Basic idea of making predictions from data, Role of algorithms in engineering applications, **Creativity and Intuition -** Framing right questions, Combining domain expertise with data insights		
Unit–IV:	**No. of Lectures: 09**	**Marks: 12**
Data Visualization: Data Visualization (or Telling the Story) - Visualization principles, Interpreting results, Engineering use-cases, **Cassandra (Conceptual) -** NoSQL data stores overview.		
Unit–V:	**No. of Lectures: 9**	**Marks: 12**
: Professional Development & Emerging Areas : Academic Programs - Career directions in Data Science, Skills profiles (technical vs domain), **Review of All Topics -** Use cases in engineering fields, Emerging trends.		

Text Books:

1. Lars Nielsen & Noreen Burlingame — *A Simple Introduction to DATA SCIENCE* New Street Communications, LLC (2012).

Reference Books:

NPTEL Links:

These courses supplement the syllabus (programming tools, analytics, visualization):

1. **NPTEL – Introduction to Data Science**
   https://onlinecourses.nptel.ac.in (search “Data Science”)
2. **NPTEL – Machine Learning for Data Science**
   https://nptel.ac.in (search “machine learning”)
3. **NPTEL – Big Data Analytics**
   https://nptel.ac.in (search “big data analytics”)
4. **SWAYAM – Data Visualization courses**
   https://onlinecourses.swayam2.ac.in (search “data visualization”)
5. **NPTEL – Database Management Systems**

INTRODUCTION TO DATA SCIENCE-LAB (PCC)					
LAB COURSE OUTLINE					
Course Title:	**Program Core Course (PCC) INTRODUCTION TO DATA SCIENCE-**	**Short Title:**	**IDSL**	**Course Code:**	**AIDS-504**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**2 Hours / Week**	**15 Weeks**	**30 hours**	**1**

Prerequisite course(s):

COURSE CONTENT

Introduction to Data Science-Lab		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Continuous Assessment (ICA):CA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. To get familiar with the Data Science environment and workflow.
2. To understand different types of data and sources of data.
3. To understand the need for Big Data technologies.
4. To load real-world data and perform basic exploration.
5. To clean and prepare data for analysis.
6. To apply data transformation techniques.
7. To understand basics of unstructured text data.
8. To visualize data using basic graphs.
9. To create meaningful visual insights.
10. To understand the basics of prediction using data.
11. To perform basic classification.
12. To evaluate predictive models.
13. To apply complete Data Science lifecycle on a dataset.
14. To explore how creativity and intuition help in data analysis.
15. To understand professional pathways in Data Science.

Text Books:

1. Lars Nielsen & Noreen Burlingame — *A Simple Introduction to DATA SCIENCE* New Street Communications, LLC (2012).

Reference Books:

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the

DATA VISUALIZATION USING R PROGRAMMING LAB (PCC)					
LAB COURSE OUTLINE					
Course Title:	**Program Core Course (PCC) Data Visualization using R Programming**	**Short Title:**	**DVURPL**	**Course Code:**	**AIDS-505**

Course description:				
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3 Hours / Week**	**15 Weeks**	**45 hours**	**5**
Practical	**4 Hours / Week**	**15 Weeks**	**60 hours**	

Prerequisite course(s):			
COURSE CONTENT			
Data Visualization using R		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**	**End Semester Examination (ESE) UA: PR**	**25 marks**
		Internal Continuous Assessment (ICA):CA	**50 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. **Introduction to R and R Studio** – Exploring R environment, basic commands, and data structures.
2. **Data Import and Preparation** – Importing datasets (CSV/Excel), data cleaning, and handling missing values.
3. **Basic Graphs using Base R** – Creating bar charts, pie charts, histograms, and line graphs.
4. **Scatter and Box Plots in Base R** – Visualizing relationships and distributions with customization.
5. **Introduction to ggplot2** – Understanding Grammar of Graphics and creating basic plots.
6. **Advanced ggplot2 Visualizations** – Using layers, themes, labels, and aesthetic mappings.
7. **Visualization of Categorical Data** – Stacked bar charts and count plots.
8. **Time Series Visualization** – Line charts for time-based data and trend visualization.
9. **Distribution Visualization** – Density plots, violin plots, and boxplot comparisons.
10. **Correlation and Heatmaps** – Creating correlation matrices and heatmap visualizations.
11. **Multi-Plot Layouts** – Combining multiple plots using grid or facet techniques.
12. **Interactive Visualizations using Plotly** – Converting static plots to interactive charts.
13. **Geospatial Data Visualization** – Creating maps and location-based visualizations in R.
14. **Dashboard Basics using Shiny** – Designing a simple interactive dashboard.
15. **Mini Project: End-to-End Data Visualization** – Data selection, preprocessing, visualization, and insight presentation.

Text Books:

1. Hadley Wickham – ggplot2: Elegant Graphics for Data Analysis, Springer
2. Kieran Healy – Data Visualization: A Practical Introduction, Princeton University Press

Reference Books:

1. Winston Chang – R Graphics Cookbook, O'Reilly

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS (PEC-I)					
COURSE OUTLINE					
Course Title:	**Program Elective Course-I BUSINESS ECONOMICS AND FINANCIAL ANALYSIS (PEC)**	**Short Title:**	**BEFA**	**Course Code:**	**AIDS-506A**

Course description:

Business Economics and Financial Analysis is a vital subject that bridges the gap between economic theory and practical business decision-making. In today's competitive environment, managers and entrepreneurs must understand how markets function, how resources are allocated, and how financial performance is measured. This course is designed to provide a clear understanding of the principles of microeconomics and macroeconomics as they apply to business, along with essential tools of financial analysis. Students will learn how demand and supply influence pricing, how cost structures affect profitability, and how economic policies shape business strategies. In addition, the course introduces techniques of financial statement analysis, ratio analysis, and investment appraisal, enabling learners to evaluate the financial health of organizations and make informed decisions. By the end of the course, students will be equipped with both economic insight and analytical skills to interpret business environments and contribute effectively to organizational growth

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	**15**	**45**	**3**

Pre requisite course(s):

Principles of Economics, Fundamentals of Accounting, and Business Mathematics or a program or courses of similar content.

Course objectives:

1. To understand the fundamental concepts of microeconomics and macroeconomics relevant to business decision-making.
2. To analyze demand, supply, and cost structures and their impact on pricing and profitability.
3. To study the role of market structures, competition, and government policies in shaping business strategies.
4. To learn techniques of financial statement analysis, including ratio analysis and cash flow evaluation.
5. To apply investment appraisal methods and financial tools for assessing business performance and sustainability.

Course outcomes:

After successful completion of this course the student will be able to:

1. Summarize fundamental concepts of microeconomics and macroeconomics and illustrate their application in business decision-making.
2. Analyze demand, supply, and cost relationships to evaluate pricing and production strategies.
3. Examine the impact of market structures, competition, and government policies on business performance.
4. Apply techniques of financial statement analysis, including ratio analysis and cash flow evaluation, to assess organizational health.

COURSE CONTENT

Business Economics and Financial Analysis	**Semester:**	**V**
Teaching Scheme:	**Examination scheme:**	

Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Introduction to Business Economics

Meaning, nature & scope of business economics, Business environment & types of business entities, Microeconomic concepts relevant to business decision making, Business cycles and role of economics in firm decisions

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Demand & Supply Analysis

Law of Demand & Supply, Elasticity of demand: price, income & cross elasticity, Methods of demand forecasting, Supply function and determinants of supply

Unit–III:	**No. of Lectures:09 Hours**	**Marks:12**

Production, Cost & Market Structure

Production function & law of variable proportions, Cost concepts: fixed, variable, short-run vs long-run, Market forms: Perfect competition, Monopoly, Oligopoly, Monopolistic competition, Pricing methods & pricing strategies

Unit– IV:	**No. of Lectures:09 Hours**	**Marks:12**

Financial Accounting Fundamentals

Accounting concepts & conventions, Double-entry system & financial statements, Trading, Profit & Loss A/c & Balance Sheet preparation, Basics of financial reporting

Unit– V:	**No. of Lectures:09 Hours**	**Marks:12**

Financial Analysis through Ratios

Meaning & objectives of financial analysis, Ratio analysis: liquidity, solvency, profitability, efficiency, Interpretations of financial performance, Simple analytical problems

Text Books:

1. Aryasri, A. R., *Business Economics and Financial Analysis*, McGraw Hill India, 2020.

Reference Books:

1. Salvatore, D., *Managerial Economics*, Oxford University Press.
2. Dwivedi, D. N., *Managerial Economics*, Vikas Publishing.
3. Pandey, I. M., *Financial Management*, Vikas Publishing.

NPTEL Link- 1. (Economic Analysis for Management)By Prof. Vinay Ramani | IIT Kanpur
https://onlinecourses.nptel.ac.in/noc26_mg04/preview

BUSINESS ECONOMICS AND FINANCIAL ANALYSIS LAB(PEC-I)					
LAB COURSE OUTLINE					
Course Title:	**BUSINESS ECONOMICS AND FINANCIAL ANALYSIS LAB(PEC-I)**	**Short Title:**	**BEFAL**	**Course Code:**	**AIDS-507A**

Course description:				
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	**2**	**15**	**30**	**1**

Prerequisite course(s): Principles of Economics, Business Mathematics, Fundamentals of Accounting, Basic Computer Skills

COURSE CONTENT

Business Economics and Financial Analysis Lab		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**Internal continues assessment (ICA):CA**	**25 Marks**

List of Experiments

Concern faculty member should suitably frame at least **THREE** laboratory assignments from the Group A and **THREE** experiments from the Group B from the following list.

(Group A)

Experiment 1 Demand Schedule and Demand Curve

Experiment 2 Elasticity of Demand Calculation

Experiment 3 Demand Forecasting using Trend Metho

Experiment 4 Production Function Analysis

Experiment 5 Cost Analysis (Fixed, Variable, Total Cost)

(Group B)

Experiment 1 Break Even Analysis

Experiment 2 Preparation of Trading Account

Experiment 3 Preparation of Profit & Loss Account

Experiment 4 Preparation of Balance Sheet

Experiment 5 Ratio Analysis

Text Books:

1. Aryasri, A. R., *Business Economics and Financial Analysis*, McGraw Hill India, 2020.

Reference Books:

1. Salvatore, D., Managerial Economics, Oxford University Press.
2. Dwivedi, D. N., Managerial Economics, Vikas Publishing.
3. Pandey, I. M., Financial Management, Vikas Publishing.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

SOFTWARE ENGINEERING AND AUTOMATION TESTING (PEC-I)					
COURSE OUTLINE					
Course Title:	**Program Elective Course-I SOFTWARE ENGINEERING AND AUTOMATION TESTING**	**Short Title:**	**SEAT**	**Course Code:**	**AIDS-506B**

Course description: The course is aimed to provide students with different aspects of Software Engineering including requirements engineering, software design and testing.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3 Hours / Week**	**15**	**45**	**3**

Prerequisite course(s):

1. Basic Knowledge of Software Development
2. Fundamentals of Programming
3. Data Structures

Course objectives:

The objective of this course is to:

1. Understand principles, phases, and models of Software Engineering.
2. Learn software requirement analysis and system modeling techniques.
3. Apply software design concepts and architectural styles.
4. Understand software testing principles with emphasis on automation.
5. Familiarize with modern tools and practices used in software quality assurance.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain fundamental concepts and processes of software engineering.
2. Analyze and document software requirements using standard techniques.
3. Design software systems using appropriate design models and patterns.
4. Apply various software testing strategies and automation concepts.
5. 5.Use testing tools to improve software quality and reliability.

COURSE CONTENT

Software Engineering and Automation Testing		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End Semester Examination (ESE)**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Software Engineering:

Software Engineering: Definition and need, Software crisis and evolution, Software characteristics and applications, Software Development Life Cycle (SDLC), Software process models: Waterfall, Incremental, Spiral, Agile.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Software Requirements Engineering:

Requirement engineering process, Functional and non-functional requirements, Requirement elicitation techniques, Software Requirement Specification (SRS), Requirement validation and management

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Software Design and Architecture: Software design concepts and principles, Architectural design styles, UML Modeling: Use case, Sequence, Class, Component and Deployment diagrams, Component-level and data design

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Software Testing Fundamentals : Software testing principles, Levels of testing: Unit, Integration, System, Acceptance , Black-box and White-box testing techniques, Test planning and test case design

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Automation Testing: Introduction to automation testing, Automation testing life cycle, Selenium overview and architecture, Automation frameworks, Continuous Integration and testing.

Text Books:

1. Software Engineering: A Practioner's Approach by Roger S. Pressman, McGraw Hill, 7th
a. Edition, 2010
2. Ian Sommerville, Software Engineering, Pearson Education

Reference Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Springer.
2. Alan C. Gillies, Software Quality ,Theory and Management, Chapman & Hall.

NPTEL Links: 1. NOC: Software Engineering, IIT Kharagpur Prof. Rajib Mall
https://nptel.ac.in/courses/106105182
NPTEL Links: 2. Software Engineering, IIT Bombay Prof. Rushikesh K Joshi, Prof Umesh Bellur
https://nptel.ac.in/courses/106101061

SOFTWARE ENGINEERING AND AUTOMATION TESTING LAB (PEC-I)					
LAB COURSE OUTLINE					
Course Title:	**Program Elective Course – I SOFTWARE ENGINEERING AND AUTOMATION TESTING LAB**	**Short Title:**	**SEATL**	**Course Code:**	**AIDS-507B**

Course description: The laboratory provides students an ability to apply software engineering analysis, design and testing concepts for developing software.

	Hours/week	No. of weeks	Total hours	Semester credits
Practical	**2 Hours / Week**	**15 Weeks**	**30 hours**	**1**

Prerequisite course(s):

1. Basic Knowledge of Software Development
2. Fundamentals of Programming

COURSE CONTENT

SOFTWARE ENGINEERING AND AUTOMATION TESTING LAB (PEC-I)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**Internal Continuous Assessment**	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. Case study on SDLC models.
2. Preparation of Software Requirement Specification (SRS).
3. UML diagrams for a given system.
4. Manual test case design and execution.
5. Introduction to Selenium tool.
6. Automation of test cases using Selenium.
7. Testing of web application using automation framework.
8. Mini project integrating software engineering and testing concepts.

Text Books:

1. Software Engineering: A Practioner's Approach by Roger S. Pressman, McGraw Hill, 7th
   a. Edition, 2010
2. Ian Sommerville, Software Engineering, Pearson Education

Reference Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Springer.
2. Alan C. Gillies, Software Quality – Theory and Management, Chapman & Hall.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

QUANTUM COMPUTING (PEC-I)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – I QUANTUM COMPUTING**	**Short Title:**	**QC**	**Course Code:**	**AIDS-506 C**

Course description: This course introduces the fundamental principles of quantum mechanics applied to computation. It covers mathematical foundations, qubits, entanglement, quantum gates, circuits, quantum communication protocols, and major quantum algorithms. The course also explores real-world applications and future challenges in quantum computing.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Linear Algebra, Probability Theory, Discrete Mathematics

Course objectives:

The objective of this course is to:

1. Introduce the fundamental principles of quantum mechanics for computation.
2. Develop the mathematical foundations required for quantum computing.
3. Understand qubits, entanglement, and quantum communication protocols.
4. Design and analyze quantum gates, circuits, and algorithms.
5. Explore applications and future impact of quantum computing.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain fundamental quantum principles used in quantum computing.
2. Apply linear algebra concepts to represent quantum states and operations.
3. Analyze qubits, entanglement, and quantum measurements.
4. Design and evaluate quantum gates, circuits, and algorithms.
5. Assess applications and the impact of quantum computing.

COURSE CONTENT

QUANTUM COMPUTING		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE)**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Quantum Mechanics and Linear Algebra

Quantum systems, quantum clock, measurement theory, randomness, photons and polarization, spin, complex numbers, vectors, orthogonality, bra–ket notation, matrices, unitary and orthogonal matrices.

Unit–II:	**No. of Lectures: 09**	**Marks: 12**

Qubits and Quantum States

Probability, quantum spin mathematics, equivalent state vectors, qubits, probability amplitudes, quantum interference, BB84 quantum key distribution protocol.

Unit–III:	No. of Lectures: 09	Marks: 12
Quantum Entanglement and Bell's Inequality Tensor products, entangled and unentangled states, CNOT-based entanglement generation, Bell's inequality, EPR paradox, local realism, Ekert quantum key distribution protocol.		
Unit–IV:	**No. of Lectures: 09**	**Marks: 12**
Quantum Gates, Circuits and Communication Classical logic, reversible computation, quantum gates, CNOT gate, universal gates, no-cloning theorem, Bell circuit, superdense coding, quantum teleportation, quantum error correction.		
Unit–V:	**No. of Lectures: 09**	**Marks: 12**
Quantum Algorithms and Applications Complexity classes, Deutsch's algorithm, Deutsch–Jozsa algorithm, Simon's algorithm, Shor's algorithm, Grover's algorithm, quantum supremacy, cryptanalysis, chemistry simulation, hardware challenges.		
Text Books:		
1. Chris Bernhardt, Quantum Computing for Everyone, MIT Press.		
Reference Books: 1. Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge University Press. 2. Kaye, Laflamme & Mosca, An Introduction to Quantum Computing, Oxford University		
NPTEL Links: 1. Introduction to Quantum Computing: Quantum Algorithms and Qiskit, IBM and IITM Prof. Prabha Mandayam Prof. Anupama Ray Prof. Sheshashayee Raghunathan https://nptel.ac.in/courses/106106232		

QUANTUM COMPUTING LAB (PEC-I)					
COURSE OUTLINE					
Course Title:	**Program Elective Course- I QUANTUM COMPUTING LAB**	**Short Title:**	**QCL**	**Course Code:**	**AIDS-507 C**

Course description: This course introduces the fundamental principles of quantum mechanics applied to computation. It covers mathematical foundations, qubits, entanglement, quantum gates, circuits, quantum communication protocols, and major quantum algorithms. The course also explores real-world applications and future challenges in quantum computing.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	**2 Hours / Week**	**15 Weeks**	**30 hours**	**1**

COURSE CONTENT

QUANTUM COMPUTING		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**Internal Continuous assessments (ICA)**	**25 marks**

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Practical

1. **Assignment 1: Install and Setup Qiskit**
   Tasks: Install Qiskit in Google Colab. Import required libraries. Create an empty quantum circuit. Draw the circuit.
2. **Assignment 2: Create and Measure a Single Qubit**
   Tasks: Create 1-qubit circuit, Measure without applying any gate, Execute with 1000 shots. Display result histogram. Observation: Output should be mostly 0.
3. **Assignment 3: Apply Pauli-X Gate**
   Tasks: Initialize qubit in $|0\rangle$. Apply X gate. Measure result. Compare with classical NOT gate.
4. **Assignment 4: Create Superposition Using Hadamard Gate**
   Tasks: Apply H gate on $|0\rangle$. Measure with 1024 shots. Plot histogram.
   Explain why results are nearly 50%-50%.
5. **Assignment 5: Multiple Shots Analysis**
   Tasks: Run superposition experiment with: 10 shots,100 shots,1000 shots
   Compare distribution, Write conclusion.
6. **Assignment 6: Two-Qubit Circuit**
   Tasks: Create 2 qubits , Apply H on both, Measure, Analyze output probabilities.
7. **Assignment 7: Create Bell State (Basic Entanglement)**
   Tasks: Apply H on qubit 0. Apply CNOT. Measure both qubits.
   Show that outputs are correlated (00 and 11).
8. **Assignment 8: Compare Entangled vs Non-Entangled State**
   Tasks: Case 1: Apply H on both qubits (no CNOT).
   Case 2: Apply H + CNOT. Compare measurement results. Write difference.

NPTEL Links:

1. (Introduction to Quantum Computing: Quantum Algorithms and Qiskit, IBM and IITM)
   Prof. Prabha Mandayam Prof. Anupama Ray Prof. Sheshashayee Raghunathan
   https://nptel.ac.in/courses/106106232

INDUSTRY 4.0 (MD M)					
COURSE OUTLINE					
Course Title:	**INDUSTRY 4.0 (MD M)**	**Short Title:**	**I 4.0**	**Course Code:**	**CS-508**

Course description:

Industry 4.0 represents the fourth industrial revolution, where digital technologies, automation, and intelligent systems transform modern business operations. This course introduces key concepts such as cyber-physical systems, IoT, artificial intelligence, big data, cloud computing, blockchain, and smart manufacturing. Students will understand how digital technologies improve efficiency, enable real-time decision-making, and support secure and innovative business environments. By the end of the course, learners will gain the knowledge and analytical skills required to support digital transformation and enhance organizational competitiveness in the Industry 4.0 era.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	2	15	30	2

Pre requisite course(s):

Principles of Economics, Fundamentals of Accounting, and Business Mathematics or a program or courses of similar content.

Course objectives:

1. Understand the fundamental concepts, technologies, and frameworks driving Industry 4.0.
2. Explore the role of IoT, AI, robotics, and cyber-physical systems in modern industrial ecosystems.
3. Analyze how digital transformation impacts manufacturing, supply chains, and business models.
4. Develop awareness of challenges such as cybersecurity, data privacy, and workforce adaptation in Industry 4.0.
5. Apply Industry 4.0 principles to evaluate organizational readiness and design strategies for sustainable competitiveness.

Course outcomes:

After successful completion of this course the student will be able to:

1. Demonstrate knowledge of Industry 4.0 technologies and their integration into business processes.
2. Evaluate the impact of smart manufacturing and digital tools on productivity and efficiency.
3. Apply data-driven approaches (big data analytics, digital twins, AI) to solve industrial problems.
4. Assess organizational digital maturity and recommend strategies for Industry 4.0 adoption.
5. Contribute to innovation and transformation initiatives by aligning technological solutions with business goals.

COURSE CONTENT

Industry 4.0		**Semester:**		
Teaching Scheme:		**Examination scheme:**		
Lectures:	**2 hours/week**	**End semester exam (ESE): UA TH**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exam (ISE):CA TH		**40 marks**
		Internal Continuous Assessment (ICA) PR		**25 marks**

Unit–I:	No. of Lectures: 06 Hours	Marks:12
Introduction to Industry 4.0 Evolution of Industrial Revolutions (1.0 to 4.0) ,Definition, scope, and significance of Industry 4.0,Historical background and emergence of the Fourth Industrial Revolution, Characteristics: speed, scale, and systemic impact, Convergence of physical, digital, and biological technologies		
Unit–II:	**No. of Lectures: 06 Hours**	**Marks:12**
Drivers and Enabling Technologies Megatrends driving Industry 4.0 ,Physical technologies: Autonomous vehicles, Advanced robotics, Additive manufacturing (3D printing),Smart and advanced materials, Digital technologies: Internet of Things (IoT),Big Data and analytics, Cloud computing, Blockchain ,Biological technologies: Biotechnology, Genetic engineering, Bio-manufacturing		
Unit–III:	**No. of Lectures: 06 Hours**	**Marks:12**
Smart Manufacturing and Intelligent Systems Smart factories and connected production systems ,Cyber-Physical Systems (CPS) ,Sensor-based monitoring and automation ,Machine-to-machine (M2M) communication ,Digital Twin concept Human–machine collaboration		
Unit– IV:	**No. of Lectures: 06 Hours**	**Marks:12**
Impact of Industry 4.0 on Engineering and Industry Impact on manufacturing systems ,Transformation of supply chains ,Productivity and efficiency improvements ,Industry 4.0 and engineering job roles ,Skill requirements and workforce transformation ,Data-driven products and services		
Unit– V:	**No. of Lectures: 06 Hours**	**Marks:12**
Challenges, Ethics, and Future Trends Cybersecurity and data privacy challenges, Ethical issues and social implications, Technological unemployment and inequality ,Regulatory and policy challenges ,Future trends and tipping points ,Introduction to Industry 5.0		
Text Books:		
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Springer.		
Reference Books		
1. Klaus Schwab, The Fourth Industrial Revolution, World Economic Forum, 2016. 2. Albrecht Enders & Ramge, Industry 4.0: Managing the Digital Transformation, Springer. 3. Ramjee Prasad, Cyber-Physical Systems and Industry 4.0, River Publishers.		
NPTEL Link- https://nptel.ac.in/courses/106105195		

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Bachelor of Engineering

in

(Common for all)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE FOR OPEN ELECTIVE - III

For Affiliated Colleges

Semester – V

W.E.F. 2026 – 27

Open Elective – III

A Student can opt for any one subject out of available institute wide subjects defined in the following list as Open Elective provided, he/she has not taken that particular subject in his/her Programme core, Programme elective, Multidisciplinary Minor, other Open elective and Vocational and Skill Enhancement courses etc. throughout his / her four years of UG Engineering Programme. The student must opt a subject that is compulsorily from faculty other than that of the Major discipline.

Course Code	Name of the Subject / Course	Faculty Offered by	Department Offered by
Open Elective - III (w.e.f. 2026 - 27 at Semester - V, Third Year Engineering)			
OE – 509 A	Legal Aspects of Business	Comm. & Mgmt.	Management
OE – 509 B	Modern Office Management	Comm. & Mgmt.	Commerce
OE – 509 C	Food Adulteration and Safety	Sci. & Tech.	Environment
OE – 509 D	Insurance Management	Comm. & Mgmt.	Commerce
OE – 509 E	Indian Social Problems	Humanities	Sociology
OE – 509 F	Disaster Management	Sci. & Tech.	Environment
OE – 509 G	Pharma Marketing Management	Sci. & Tech.	Pharmacy
OE – 509 H	Circular Economy	Humanities	Economics

LEGAL ASPECTS OF BUSINESS (Open Elective – III)

COURSE OUTLINE

Course Title:	**LEGAL ASPECTS OF BUSINESS**	**Short Title:**	LAB	**Course Code:**	OE – 509 A

Course description:

This course provides a concise overview of the legal framework governing business in India, covering contracts, sale of goods, negotiable instruments, intellectual property rights, company law, and cyber law. It equips students with basic legal knowledge and practical understanding required for lawful, ethical, and effective business decision-making in a digital environment.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	15	30	02

Prerequisite course(s):

Basics of Law, Legal Environment of Business, Mercantile Law

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To understand the basic concepts and rules of contracts as per the Indian Contract Act.
2. To learn the legal provisions related to sale of goods and negotiable instruments.
3. To know the importance and protection of intellectual property rights with reference to the Patents Act, Copyright Act, and Trade Marks Act.
4. To understand the basic structure and working of companies according to the Companies Act.

5. To understand digital laws, cybercrimes, and data protection as guided by the Information Technology Act.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the basic principles and essentials of contracts under the Indian Contract Act.
2. Apply provisions of Sale of Goods and Negotiable Instruments laws in business transactions.
3. Explain the importance and protection of Intellectual Property Rights in business.
4. Understand the formation and legal framework of companies under company law.
5. Identify cyber laws, digital transactions, and data protection under the Information Technology Act.

COURSE CONTENT

LEGAL ASPECTS OF BUSINESS		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**	

INDIAN CONTRACT ACT, 1872

Contract: Definition and meaning-Essentials of contract
Classification of Contracts, Offer and Acceptance
Consideration: Definition, Essentials of a Valid Consideration –Capacity to contract
Free Consent: Coercion, Undue influence, Fraud, Misrepresentation and Mistake

Unit–II:	**No. of Lectures: 06 Hours**	

SALES OF GOODS ACT, 1930 & Negotiable Instruments Act 1881

Sale of Goods Act 1930: Sale and agreement to sell, Conditions and warranties, Transfer of ownership, rights of unpaid seller.
Negotiable Instruments Act 1881: Meaning, type of negotiable instruments; promissory note, bill of exchange, cheque. Endorsement and negotiation, Dishonour and legal remedies

Unit–III:	**No. of Lectures: 06 Hours**	

INTELLECTUAL PROPERTY RIGHTS

Intellectual Property Rights-Meaning, Need and Importance of Intellectual Property
Patents Act, 1970 (2002): Definition, Objectives, Nature, and Types of Patents,
Transfer of Patent Rights, Rights of Patentee.
Copyright Act, 1957-Concept, Objectives, Nature, Criteria for protection, Ownership, Duration, and Copy Right in Computer Programmes.
Trademark Act 1999 (Amendment Act 2010)- Concept, Registration, rights of registered proprietor, infringement and defenses.

Unit–IV:	**No. of Lectures: 06 Hours**	

COMPANIES ACT, 1956 (Amended 2013)

Meaning, Definition and characteristics and kinds of company.
Memorandum of Association - Meaning, Purpose, Contents
Doctrine of Ultra-Vires
Articles of Association - Meaning Purpose, Content. Alternation, Constructive Notice

Unit–V:	No. of Lectures: 06 Hours	
The Information Technology Act, 2000 (Amended 2008)		
Introduction, Digital Signatures and Electronic records, Electronic governance Cyber-crimes: hacking, phishing, identity theft, cyber fraud and remedies Data protection, privacy and digital compliance Important Provision of Information Technology Act 2000		
Text Books:		
1. Legal Aspects of Business (8th ed.). McGraw Hill Education. - Akhileshwar Pathak		
Reference Books:		
1. Legal Aspects of Business – David Albuquerque 2. Business Law – N.D.Kapoor 3. Mercantile Law – M. C. Kuchhal and Vivek Kuchhal		
NPTEL Links: 1.NOC: (Advanced Contracts, Tendering and Public Procurement), NLSIUProf. Sairam Bhat https://nptel.ac.in/courses/129106006 2. (Fundamentals of Legal Aspects of Business) By Dr. Mamta Brahmbhatt|B .K. School of Professiona https://onlinecourses.swayam2.ac.in/e-learning/preview/cec21_mg02 3. 9Business Law for Managers) By Prof. S. Srinivasan, Prof. Kaushik Mukherjee IIT Kharagpur https://onlinecourses.nptel.ac.in/noc26_mg30/preview		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

\

MODERN OFFICE MANAGEMENT (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**MODERN OFFICE MANAGEMENT**	**Short Title:**	MOM	**Course Code:**	OE – 509 B

Course description:

This course introduces the concepts and practices of modern office management in a technology-driven environment. It covers office structure, layout, communication, documentation, and record management, along with digital office tools and automation. The course also focuses on office personnel management, professional behaviour, productivity skills, and emerging trends preparing students to manage contemporary offices effectively.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	02	15	30	02

Prerequisite course(s):

Fundamentals of Office Administration, Business Communication, Office Administration and Secretarial Practice

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To understand basics of modern office management and emerging office trends.
2. To learn office layout, systems, and workplace environment management.
3. To develop skills in office communication, documentation, and services.
4. To understand records management, meetings, and office automation.
5. To build competencies in personnel management and productivity skills.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain concepts and modern trends of office management.
2. Apply office layout, systems, and environmental principles.
3. Demonstrate office communication, documentation, and services.
4. Analyze records management, meetings, and office automation.
5. Evaluate personnel management, productivity, and emerging trends.

COURSE CONTENT

MODERN OFFICE MANAGEMENT		Semester:	V
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	No. of Lectures: 06 Hours	

Introduction to Modern Office Management

Modern Office: Meaning, Definition, Characteristics, Functions and Past–Present–Future

Office Management: Meaning, Elements and Office as Service & Information Centre

Office Organisation: Office Manager- Functions, Duties, Responsibilities

Modern Trends in Office: Paperless Office and Virtual Office

Unit–II:	No. of Lectures: 06 Hours	

Office Layout and Environment

Office Systems: Objectives, Flow of Work, Planning and Scheduling

Office Layout: Meaning, Objectives, Principles, Types

Office Infrastructure & Facilities Management

Office Environment: Meaning, Factors & Importance Office Safety & Remedies		
Unit–III:	**No. of Lectures: 06 Hours**	
Office Communication, Forms and Services		
Office Communication: Internal & External Communication, Digital Communication Business Documentation: Report Writing, Documentation and Office Correspondence Office Forms: Types, Control, Stationery- Standardisation and Issues Mail & Communication Services: Courier, Speed Post, Fax and E-mail Services		
Unit–IV:	**No. of Lectures: 6 Hours**	
Office Record Management		
Records Management: Meaning, Objectives and Organisation of Record Department Office Meetings - Meaning, Definition, Purpose, Types of meeting Filing & Retrieval Systems: Physical and Electronic Records, Retention and Disposal Digital Office & Automation: E-Office, Office Software Tools and Automation Systems		
Unit–V:	**No. of Lectures: 06 Hours**	
Office Personnel Management and Emerging Trends		
Office Personnel Management: Types, Qualities, Recruitment, and Training Professional Behaviour: Ethics, Discipline, Leadership and Team Coordination Productivity Skills: Time Management and Stress Management Emerging Trends in Office: Remote Work and Green Office Practices		
Text Books:		
Office Management & Control – G.R.Terry		
Reference Books:		
Office Organization and Management – S. P. Arora, Vikas Publishing House Pvt. Ltd., New Delhi. Office Organisation & Management – R.K. Chopada & Ankita Chopada, Himalaya Publishing House, Mumbai. Office Management – I. M. Sahai, Kitab Mahal, Allahabad. Office Management – P. K. Ghosh, Sultan Chand & Sons, New Delhi.		
NPTEL Links: 1.(Office Management and Secretarial Practices)By Prof.Subodh Kesharwani https://onlinecourses.swayam2.ac.in/e-learning/preview/nou23_mg05 2. (Fundamentals of Office Management and Methods) By Dr. Rupali Sheth https://onlinecourses.swayam2.ac.in/e-learning/preview/cec21_mg24 3. (Business Communication) By Prof. K Preetham https://onlinecourses.swayam2.ac.in/e-learning/preview/imb24_mg54		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

FOOD ADULTERATION AND SAFETY (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**FOOD ADULTERATION AND SAFETY**	**Short Title:**	FAS	**Course Code:**	**OE – 509 C**

Course description:
This course is designed to impart basic knowledge on identifying major types of food adulterants and contamination, food safety hazards using engineering and microbiological principles, Interpret food laws and regulatory standards relevant to engineering practice.
Also, to emphasize the roles of students in basic food safety management frameworks.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To introduce the principles of food safety, food adulteration, and regulatory standards.
2. To explain types, sources, and detection of food adulterants using scientific and engineering approaches.
3. To familiarize students with national and international food safety regulations including FSSAI, Codex, ISO and HACCP.
4. To develop understanding of food contaminants, toxicants, and risk assessment methodologies.
5. To apply quality assurance and analytical techniques relevant to food safety monitoring.

Course outcomes:

Upon successful completion of this course the student will be able to:

1. Explain concepts of food safety, hazards, and adulteration mechanisms.
2. Identify and classify food adulterants and contaminants in different food matrices.
3. Apply analytical and instrumental techniques for detection of adulterants.
4. Interpret regulatory frameworks and food safety management systems.
5. Analyze risk assessment models and quality control measures in food systems.

COURSE CONTENT

FOOD ADULTERATION AND SAFETY		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**	

Fundamentals of Food Safety and Adulteration

Concept and importance of food safety, Definitions: Food safety, food quality, food security, Types of food hazards: Biological, Chemical, Physical, Concept of food adulteration, Intentional and incidental adulteration, Food contamination vs adulteration, Food safety challenges in developing countries, Overview of global food safety issues, Role of regulatory bodies, Food standards and their significance

Unit–II:	**No. of Lectures: 06 Hours**	

Food Adulterants and Contaminants

Common food adulterants in cereals, pulses, milk, fats & oils, spices, Chemical contaminants:

Pesticide residues, heavy metals, industrial chemicals, Natural toxins: My co toxins , plant toxins, marine toxins, Veterinary drug residues, Food additives and misuse, Packaging contaminants, Emerging contaminants ,Health effects of adulterants ,Case studies of major food adulteration incidents.

Unit–III:	**No. of Lectures: 06 Hours**	

Detection and Analytical Techniques

Sampling methods and protocols ,Classical methods of detection ,Chromatographic techniques (HPLC, GC),Analytical Methods (UV-Vis, IR, NMR, Mass Spectrometry),Biosensors in food safety Molecular methods (PCR-based detection),Rapid detection kits, Validation of analytical methods

Unit–IV:	**No. of Lectures: 06 Hours**	

Food Safety Regulations and Standards

Codex Aliment varius Commission ,WTO agreements (SPS & TBT),Food Safety and Standards Act (India),FSSAI regulations ,ISO 22000 and Food Safety Management Systems ,HACCP principles and implementation, Good Manufacturing Practices (GMP),Good Hygienic Practices (GHP),Risk analysis framework, Traceability and recall systems.

Unit–V:	**No. of Lectures: 06 Hours**	

Risk Assessment and Quality Assurance

Risk assessment framework Hazard identification, Exposure assessment, Dose-response assessment, Risk characterization Quality control tools ,Statistical quality control in food industry, Validation and verification ,Food safety auditing Emerging technologies in food safety monitoring.

Text Books:

1. Food Safety and Standards, K. Ramawat & J. Kumar, CRC Press / Springer
2. Food Safety & Quality Assurance: Principles and Practices, Sunetra Roday, Wiley
3. Food Safety and Standards in India, B. Srilakshmi, New Age International

Reference Books:

1. Food Analysis, S. Suzanne Nielsen, Springer
2. Principles of Food Toxicology, D. R. Heldman & D. B. Lund (Ed.), Springer / CRC Press

NPTEL Links:

- **Food Safety and Quality Management**
  https://nptel.ac.in/courses/126105011
- **Food Packaging Technology**
  https://nptel.ac.in/courses/126105010
- **Food Chemistry and Technology**
  https://nptel.ac.in/courses/126105013
- **Food Processing and Preservation**
  https://nptel.ac.in/courses/126105012

Guidelines for ICA:

Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

INSURANCE MANAGEMENT (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**INSURANCE MANAGEMENT**	**Short Title:**	IM	**Course Code:**	**OE – 509 D**

Course description:
This course provides a fundamental understanding of insurance concepts, principles, and practices. It covers life and general insurance products, legal and regulatory frameworks, underwriting and claims management, and the role of insurance in economic development. The course equips students with essential knowledge of insurance operations and industry practices, preparing them for opportunities in the insurance and financial services sector.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Prerequisite course(s):
Basic knowledge of Commerce / Economics
Fundamental understanding of Financial Systems and Banking

Course objectives:
The objective of this course is:
1. To introduce students to the basic concepts, principles, and functions of insurance.
2. To provide knowledge of life and general insurance products and their features.
3. To familiarize students with the legal and regulatory framework of insurance in India.
4. To understand the role of insurance in economic development and financial stability.
5. To develop understanding of insurance operations including underwriting and claims management.

Course outcomes:
After successful completion of this course the student will be able to:
1. Explain the fundamental principles and functions of insurance.
2. Differentiate various life and general insurance products.
3. Describe the legal and regulatory framework governing insurance in India.
4. Analyze the contribution of insurance to economic development.
5. Understand underwriting, claims settlement, and operational practices in insurance companies.

COURSE CONTENT

INSURANCE MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**	

Fundamentals of Insurance
Meaning and definition of insurance Nature, scope and functions of insurance
Evolution and importance of insurance
Principles of insurance – Utmost Good Faith, Insurable Interest, Indemnity, Subrogation, Contribution, Proximate Cause
Types of insurance

Unit–II:	**No. of Lectures: 06 Hours**	

Life and General Insurance Products
Life Insurance – Term, Whole Life, Endowment, Annuities & Pension Plans
Basic concept of premium and mortality table

General Insurance – Fire, Marine, Motor and Health Insurance Crop, Rural and Group Insurance Maturity and Death Claims		
Unit–III:	**No. of Lectures: 06 Hours**	
Legal and Regulatory Framework of Insurance		
LIC Act, 1956 General Insurance Act, 1972 IRDA Act, 1999 and Functions of IRDA Actuaries Act, 2006 Regulatory and ethical practices in insurance		
Unit–IV:	**No. of Lectures: 06 Hours**	
Insurance and Economic Development		
Role of insurance in economic development Growth of life and general insurance in India Liberalization of insurance sector and its impact Issues, challenges and future potential of insurance industry		
Unit–V:	**No. of Lectures: 06 Hours**	
Insurance Operations and Governance		
Underwriting – Meaning and principles (Life & General Insurance) Claims Management – Life and General Insurance Insurance agents – Licensing, functions and code of conduct Consumer protection and grievance Redressal mechanism		
Text Books:		
1. **Fundamentals of Insurance** – Dr. P.K. Gupta, Himalaya Publishing House		
Reference Books: 1. Insurance: Principles And Practice – M.N. Mishra & S B Mishra, S Chand Publishing 2. Principles of Insurance Management – Neelam C Gulati, Excel Books 3. **Principles and Practice of Insurance by P. Periasamy** A.K. Basu, Himalaya Publishing House		
ONLINE COURSES SWAYAM Links: 1**.** (Fundamental of Insurance**)** By Dr. K.UMA https://onlinecourses.swayam2.ac.in/e-learning/preview/cec20_mg24		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

INDIAN SOCIAL PROBLEMS (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**INDIAN SOCIAL PROBLEMS**	**Short Title:**	ISP	**Course Code:**	**OE-509 E**

Course description:
This course introduces students to the sociological understanding of major social problems in India. The course includes the concept, characteristics, and approaches to the study of social problems and proceeds to examine key issues such as poverty, unemployment, population growth, and urbanization. It further explores violence against women, child labour, crime, and corruption as structural challenges affecting Indian society.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Prerequisite course(s):

Course objectives:

The objective of this course is:
1. Understand the concept and approaches to social problems in the Indian context.
2. Analyze fundamental economic and demographic social issues in India.
3. Examine population growth and urbanization and their effects on society.
4. Understand gender and child-related social problems with sociological insight.
5. Identify and evaluate crime and corruption as structural social problems.

Course outcomes:

After successful completion of this course the student will be able to:
1. Explain the sociological concept and approaches to social problems.
2. Discuss poverty and unemployment with causes and consequences.
3. Analyze the issues of population growth and urbanization in India.
4. Describe violence against women and child labour with social impacts.
5. Explain crime and corruption as social problems and suggest measures.

COURSE CONTENT

INDIAN SOCIAL PROBLEMS		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**

Social Problems: Meaning, Characteristics of Social Problems, Types of Social Problems, Approaches to the Study of Social Problems: Social Pathology Approach, Social Disorganization Approach, Value-Conflict Approach, Deviance Approach, Methods of Studying Social Problems

Unit–II:	**No. of Lectures: 06 Hours**

Poverty: Meaning & Types, Causes of Poverty, Consequences of Poverty, Measures for Eradication
Unemployment: Meaning & Types, Causes, Consequences, Measures to Reduce Unemployment

Unit–III:	**No. of Lectures: 06 Hours**

Population Growth: Growth of Population in India, Causes & Consequences, Population Control Measures
Urbanization: Meaning of Urbanization, Causes of Urbanization, Problems of Urbanization, Remedies for Urban Problems

Unit–IV:	**No. of Lectures: 06 Hours**

Violence Against Women: Meaning & Forms, Causes & Consequences, Measures to Control Child Labour & Child Abuse: Meaning & Causes, Problems of Child Labour & Abuse, Measures to Eliminate		
Unit–V:	**No. of Lectures: 06 Hours**	
Crime and Criminals: Meaning of Crime, Types of Crime, Causes, Prevention & Control Corruption: Meaning of Corruption, Causes & Consequences, Measures to Control Corruption		
Text Books:		
1. Ahuja , Ram. *Social Problems in India*. 4th ed, Rawat Publications, 2021.		
Reference Books: G. R. Madan – Indian Social Problems, Allied Publishers C. N. Shankar Rao – Sociology of Indian Society, S. Chand Publications Vidya Bhushan & D. R. Sachdeva – Introduction to Sociology, Kitab Mahal Publications M. N. Srinivas – Social Change in Modern India, Orient Longman / Oxford University Press R. Desai – Rural Sociology in India, Bombay Popular Prakashan		
NPTEL Links: 1.(Indian Society – Social Problems & Issues)By Dr.Sobhana Mishra|Madurai Kamaraj University https://onlinecourses.swayam2.ac.in/cec25_hs92/preview 2.(Indian Society: Sociological Perspectives) By Prof. R. Santhosh | IIT Madras https://onlinecourses.nptel.ac.in/noc24_hs140/preview		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

DISASTER MANAGEMENT (Open Elective-III)					
COURSE OUTLINE					
Course Title:	**DISASTER MANAGEMENT**	**Short Title:**	**DM**	**Course Code:**	**OE – 509 F**

Course description:
The course aims to develop an understanding of disaster management concepts, disaster risk reduction, preparedness, response, and recovery, with emphasis on managing natural and man-made disasters effectively.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**02**	**15**	**30**	02

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Understand fundamental concepts of disasters, hazard, vulnerability, risk and their engineering relevance.
2. Identify and classify natural and anthropogenic disasters and their underlying causes.
3. Explain disaster management principles, phases of disaster cycle and mitigation strategies.
4. Describe institutional frameworks, stakeholders, tools, and technologies used in Disaster Management in India and globally.
5. Apply learned skills to analyze disaster case studies, ethical issues and engineering interventions for disaster risk reduction.

Course outcomes:

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

1. Define and explain key disaster concepts, types and impacts.
2. Distinguish between natural and man-made disasters and summaries control measures.
3. Illustrate stages of disaster management cycle and preparedness planning.
4. Evaluate roles of different stakeholders and tools in managing disaster events.
5. Analyze disaster case studies and articulate ethical, legal and policy issues.

COURSE CONTENT

DISASTER MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 Marks**

Unit–I:	**No. of Lectures: 06**	

Introduction & Disasters Fundamentals

Overview of Disaster Management: Definitions: Disaster, Hazard, Risk, Vulnerability, Capacity,

Historical perspective & impacts (environment, society, economy) **Understanding Disasters**: Nature, causes & classification of disasters, Concept of exposure, resilience, capacity		
Unit–II:	**No. of Lectures:06**	
Natural & Anthropogenic Disasters		
Natural Disasters: Earthquakes, Tsunami, Volcanoes, Cyclones, Floods, Droughts, Landslides, Extreme weather events and climate change impacts. **Anthropogenic (Man-made) Disasters**: Industrial accidents, fires, pollution events, Transportation failures, structural failures.		
Unit–III:	**No. of Lectures: 06**	
Pandemics, Environmental Disasters & Management Principles		
Pandemics and Environmental Disasters: COVID-19 case insights and environmental disaster context. **Objectives & Principles of Disaster Management**: Prevention, preparedness, mitigation, response and recovery concepts. **Disaster Management Cycle**: Phases, actions and key engineering considerations		
Unit–IV:	**No. of Lectures: 06 Hours**	
Stakeholders & Institutional Framework		
Stakeholders in Disaster Management: Government agencies, NGOs, community groups, Technological tools (Early Warning Systems, GIS, Remote Sensing). **International Cooperation & Organizational Structures**: UN agencies, regional alliances and global frameworks **Disaster Management in India**: Institutional framework, NDMA, policy & legal context.		
Unit–V:	**No. of Lectures: 06 Hours**	
Ethical Issues & Case Studies		
Ethical Issues in Disaster Management: Resource allocation, social equity and engineering ethics **Case Studies**: Natural and man-made disaster case analyses, Lessons learnt, best practices.		
Text Books: 1. R. Subramanian, Disaster Management, Vikas Publishing House. 2. S.C.Sharma, Disaster Management Khanna Publishing House, New Delhi. 3. G. K. Ghosh, Disaster Management, APH Publishing Corporation, New Delhi		
Reference Books: 1. A.K. Singh, Disaster Management in India, New Royal Book Company, Lucknow 2. Anu Kapur Vulnerable India: A Geographical Study of Disasters, Sage Publications, New Delhi 3. Tushar Bhattacharya, Disaster Science and Management, McGraw-Hill Education (India) 4. Jagbir Singh (Ed.), Disaster Management: Future Challenges and Opportunities, Disaster, I.K. International Publishing House		
Online Courses: 1.NIDM E-Learning Courses (National Institute of Disaster Management) https://elearning.nidm.gov.in/local/home/index.php		

2.SWAYAM & NPTEL MOOCs https://archive.nptel.ac.in/courses/105/104/105104183/ 3.iGOT Karmayogi (For Govt. Officials) https://igotkarmayogi.gov.in/#/
Guidelines for ICA:
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

PHARMA MARKETING MANAGEMENT (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**PHARMA MARKETING MANAGEMENT**	**Short Title:**	PMM	**Course Code:**	OE – 509 G

Pharmaceutical Marketing Management focuses on the planning, implementation, and control of marketing strategies specific to the pharmaceutical industry, where ethical considerations, regulatory compliance, and patient safety play a critical role. It involves understanding healthcare markets, consumer and physician behavior, product life-cycle management, pricing strategies, distribution channels, and promotional activities such as medical detailing, digital marketing, and relationship management with healthcare professionals. The discipline integrates market research, brand management, and strategic decision-making to ensure effective product positioning while complying with national and international regulations. In an increasingly competitive and technology-driven environment, pharmaceutical marketing management emphasizes value-based marketing, patient-centric approaches, and sustainable growth.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Course objectives:

The objective of this course is to:

1. To study the scope of marketing.
2. To study the quantitative and qualitative aspects of pharmaceutical market.
3. To study the products decision in product life cycle, product portfolios, packaging and labelling decisions.
4. To study the promotion of products.
5. To study marketing channels and management of logistics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand and explain core marketing concepts and their application in the pharmaceutical industry.
2. Understand quantitative and qualitative aspects of pharmaceutical market.
3. Understand the product cycle, product portfolios.
4. Assess promotional tools including personal selling, advertising, digital marketing, and ethical promotion practices.
5. Understand the marketing channels and management of logistics.

COURSE CONTENT

PHARMA MARKETING MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 6 Hours**

Marketing:

Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical Market:

Quantitative and qualitative aspects; size and composition of the market; demographic

descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.		
Unit–II:	**No. of Lectures: 6 Hours**	
Product Decision:		
Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.		
Unit–III:	**No. of Lectures: 6 Hours**	
Promotion:		
Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.		
Unit–IV:	**No. of Lectures: 6 Hours**	
Pharmaceutical Marketing Channels		
Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **Management of Logistics:** Supply Chain, Cold Chain, Applications of IT & management information systems for efficient marketing, controlling expiry and returned goods.		
Unit–V:	**No. of Lectures: 6 Hours**	
Pricing:		
Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing:** Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing. **AI in Pharma Marketing:** Introduction to AI in Pharma Marketing: Role of AI in modern pharmaceutical marketing, Benefits, limitations, and future scope of AI in pharma, AI-driven market research and forecasting		
Text Books:		
1. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India. 2. Ramaswamy, U.S & Nanakamari, S: Marketing Management: Global Perspective, Indian Context, Macmilan India, New Delhi.		
3. Reference Books: 4. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India New Delhi		
NPTEL Links: 1. Marketing Management - I, IIT Kanpur Prof. Jayanta Chatterjee, Prof. Shashi Shekhar Mishr https://nptel.ac.in/courses/110104068		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

CIRCULAR ECONOMY (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**CIRCULAR ECONOMY**	**Short Title:**	**CE**	**Course Code:**	**OE-509 H**

Course description:
This course introduces the concept of Circular Economy, its principles, and its relevance in sustainable development. Students will learn about linear economy limitations, circular economy frameworks, business models, and its implementation in India.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	02	15	30	02

Prerequisite course(s):

Basic understanding of **Linear Economy and environmental sustainability concepts**.

Course objectives:

The objective of this course is:

1. To understand the basics of Circular Economy and its significance.
2. To familiarize students with circular economy frameworks, business models, and case studies.
3. To compare linear and circular economies, and understand traditional circular practices.
4. To understand the prospect of circular economy in India.
5. To analyze the role of government and benefits of circular economy.

Course outcomes:

1. After successful completion of this course the student will be able to:
2. Describe the principles and benefits of Circular Economy.
3. Apply circular economy frameworks and business models.
4. Compare and contrast linear and circular economies.
5. Identify opportunities for circular economy in India.
6. Understand the role of government and benefits of circular economy for various stakeholders.

COURSE CONTENT

CIRCULAR ECONOMY		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**	

Linear Economy and Circular Economy Basics

Linear Economy - Our Crumbling Planet: Law of Obsolescence, Disadvantages of Linear Economy,

Circular Economy: Think Ahead - Our Last Chance:- Elements of a Circular Economy, Why do we need to switch to a circular economy?

Unit–II:	**No. of Lectures: 06 Hours**	

Circular Economy Frameworks and Business Models

Fundamental Characteristics of Circular Economy - A Resource Multiplier: Innovation, Collaboration, Value optimization, Design out Waste, Renewable Energy, Closed and tighter loops, Business Models in a Circular Economy- Circular supply chain, Product as a service, Collaborations and sharing, Recovery and recycling, Product life extension, McKinsey Center for Business and Environment - the Re SOLVE framework

Unit–III:	**No. of Lectures: 06 Hours**	
Linear Vs. Circular Economy and Traditional Practices		
Linear Vs Circular Economy: Differential that whither the Planet and Us? - Material value preservation, Eco-effectiveness from eco-efficiency, Shift from Raw material to residual flows, Linear VS Circular economy, SWOT analysis of Circular Economy, Circular Economy - Old wine in new bottle: - Yoga – a circular alternate to gyms, Ayurveda – An old circular alternate to modern medicine, Earthen Pots – An old circular practice, Sun Drying – A circular alternate to laundry dryers		
Unit–IV:	**No. of Lectures: 06 Hours**	
Circular Economy in India		
India and Circularity - Showcasing Sustainable Future - Circularity in India, Prospect of Circular Economy in India, Role of Indian businesses, Invest in circular economy opportunities		
Unit–V:	**No. of Lectures: 06 Hours**	
Circular Economy Implementation and Benefits		
Role of Government -Set direction and show commitment, Enabling regulatory frameworks, Platforms for multi-stakeholder collaboration, Support circular models through public procurement and infrastructure Benefits of Circular Economy for India- Benefits for businesses and the Economy, Benefits for the environment, Benefits for citizens		
Text Books:		
Reference Books: Circular Economy: (Re)Emerging Movement by Shalini Goyal Bhalla		
NPTEL Links: SWAYAM **1.** (Linear to Circular Economy) By Shalini Goyal Bhalla https://onlinecourses.swayam2.ac.in/e-learning/preview/aic21_ge19		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Bachelor of Engineering

in

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – VI

W.E.F. 2026 – 27

BIG DATA ANALYTICS (PCC)					
COURSE OUTLINE					
Course Title:	**BIG DATA ANALYTICS (PCC)**	**Short Title:**	**BDA**	**Course Code:**	**AIDS-601**

Course Description:

This course introduces the fundamental concepts of Data Analytics and Big Data technologies used for extracting meaningful insights from large datasets. It covers the data analytics lifecycle, types of analytics, Big Data characteristics, Hadoop ecosystem, No SQL databases, and modern Big Data processing frameworks such as Apache Spark. The course also explores real-world applications of data analytics in domains like healthcare, banking, and e-commerce.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	15	45	3

Pre Requisite Course(s):

Basic programming knowledge in languages such as Python, Java, or any high-level programming language, Fundamental understanding of databases and SQL concepts, Basic knowledge of statistics and probability, Familiarity with operating systems and basic Linux commands.

Course Objectives:

1. To introduce fundamental concepts of data analytics and different types of analytics used in decision making.
2. To understand the evolution, characteristics, and importance of Big Data in modern data processing systems.
3. To study the Hadoop ecosystem and understand distributed storage and processing using HDFS and Map Reduce.
4. To understand No SQL database systems and their role in managing large-scale and unstructured data.
5. To explore Big Data processing frameworks and tools such as Spark, Hive, and Pig for real-world analytics applications.

Course Outcomes:

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

1. Explain fundamental concepts of data analytics, types of analytics, and the data analytics lifecycle.
2. Describe Big Data characteristics, types of data, and the differences between Big Data and traditional data processing systems.
3. Demonstrate understanding of Hadoop architecture and implement basic distributed data processing using HDFS and Map Reduce.
4. Analyse No SQL database concepts and perform data modelling using Mongo DB.
5. Apply Big Data processing frameworks such as Apache Spark and related tools to analyse data and solve real-world problems.

COURSE CONTENT			
Big Data Analytics		**Semester:**	**VI**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End-of-semester exam (ESE):**	**60 marks**

	Duration of ESE:	**03 hours**
	Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Foundations of Big Data Analytics:
Evolution of Data Analytics and Big Data, Big Data Characteristics (5Vs), Big Data Analytics Lifecycle, Traditional vs Modern Data Architectures, Batch Processing vs Stream Processing, Overview of Big Data Ecosystem (Hadoop, Spark, Kafka, Cloud Platforms), Industry Use Cases (Finance, Healthcare, E-commerce, Smart Cities)

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Distributed Storage and Processing Frameworks:
Hadoop Architecture and Ecosystem Overview, HDFS Design, Data Blocks, Replication, Fault Tolerance, Map Reduce Concepts (overview only – reduced emphasis), Apache Spark Architecture, Spark RDDs, Data Frames, and Spark SQL, Performance comparison: Hadoop Map Reduce vs Spark, Use cases for batch analytics

Unit–III:	**No. of Lectures: 9 Hours**	**Marks:12**

Real-Time and Streaming Big Data Analytics:
Need for Real-Time Analytics, Stream Processing Architecture, Apache Kafka, Architecture and Messaging Model, Kafka Producers, Consumers, Topics, Spark Streaming and Structured Streaming, Real-time analytics pipelines, Use cases: fraud detection, clickstream analysis

Unit– IV:	**No. of Lectures:09 Hours**	**Marks:12**

No SQL Databases and Cloud-Based Big Data Platforms:
Limitations of RDBMS for Big Data, No SQL Data Models (Key-Value, Column-Family, Document, Graph), H Base Architecture and Use Cases, Cassandra Architecture and Data Modeling, Mongo DB for Big Data Applications, Cloud-based Big Data Analysis by using any of the following platform:
AWS (S3, EMR, Redshift, Glue), Google Cloud (Big Query, Dataflow)

Unit– V:	**No. of Lectures:09 Hours**	**Marks:12**

Big Data Analytics with AI/ML and Visualization: Role of AI/ML in Big Data Analytics, Feature Engineering on Large-Scale Data, Machine Learning with Spark ML lib, Text Analytics and Recommendation Systems, Predictive and Prescriptive Analytics, Big Data Visualization Challenges, Visualization Tools and Dashboards: Power BI / Tableau, Spark + Visualization tools, Data-driven decision making

Text Books:

1. Seema Aacharya and Subhashini Chellappan, “Big Data and Analytics", Second Edition, Wiley India Pvt. Ltd.
2. Tom white, “Hadoop, The Definitive Guide”, Fourth Edition, O’Reilly Media Inc.
3. Gwen Shapira, Todd Palino, Rajini Sivaram, and Krit Petty, “Kafka, The Definitive Guide: Real-Time Data and Stream Processing at Scale”, Second Edition, 2nd Edition, O’Reilly.

Reference Books:

1. Raj Kamal and Preeti Saxena, “Big Data Analytics”, McGraw Hill Education (India) Pvt. Ltd.
2. Dr. John T Mesia Dhas, Dr. T. S. Shiny Angel and Dr. Adarsh T K , “Introduction to Big Data Analytics”, The Palm Series.

NPTEL VIDEO:
1. (Statistical Foundation for Big Data Analysis), IIT Kharagpur Prof. Arindam Banerjee
https://nptel.ac.in/courses/106105848
2. (Algorithms for Big Data), IIT Algorithms for Big Data, IIT Prof. John Augustine
https://nptel.ac.in/courses/106106142
3. (Big Data Computing), IIT Patna Prof. Rajiv Misra
https://nptel.ac.in/courses/106104189
1.

BIG DATA ANALYTICS LAB (PCC)					
LAB COURSE OUTLINE					
Course Title:	**BIG DATA ANALYTICS LAB (PCC)**	**Short Title:**	**BDAL**	**Course Code:**	**AIDS - 602**

Course description: This laboratory course provides hands-on experience with big data technologies and tools such as Hadoop, Apache Spark, Hive, and NoSQL databases. Students will learn to process, analyse, and visualize large-scale datasets using distributed computing frameworks. The course also covers real-time data streaming and cloud-based analytics platforms. Emphasis is placed on practical implementation of big data solutions for real-world applications.

	Hours/week	No. of weeks	Total hours	Semester credits
Practical	**2 Hours / Week**	**15 Weeks**	**30 hours**	**1**

Prerequisite course(s): Students should have prior knowledge of:
Database Management Systems (DBMS) – SQL, normalization, and query processing, Basic Programming using Python or Java, Data Structures – basic concepts such as arrays, lists, and file handling, Operating Systems – basic understanding of file systems and process management.

COURSE CONTENT

Big Data Analytics Lab		**Semester:**	**VI**
Teaching Scheme:		**Examination Scheme**	
Practical:	**2 hours/week**	**Internal Continuous Assessment**	**25 Marks**
		End Semester Examination (ESE) – UA	**25 Marks**

Concerned faculty member should suitably frame at least **SIX** laboratory assignments, from the following list.

List of Experiments: -

1. Installation and configuration of Hadoop/Spark environment.
2. Study and Implementation of HDFS Operations and Distributed File Management in Apache Hadoop
3. To perform Cloud-based Big Data analytics using AWS/Azure/GCP.
4. Study and implementation of machine learning techniques on big data using Apache Spark MLlib.
5. Visualization and Dashboard Creation for Big Data using dashboard creation tools, such as - Microsoft Power BI, Tableau etc.
6. Study and Implementation of Real-time Data Streaming using any platform, such as - Apache Kafka.
7. To implement the Word Count program using Map Reduce technique.
8. To perform Log File Analysis using Map Reduce technique.
9. To implement various Spark SQL operations for processing structured data.
10. To perform basic CRUD (Create, Read, Update, Delete) operations on any No SQL database, such as Mongo DB.
11. To study and perform SQL-based operations on big data using Spark SQL.
12. To study Apache Hive installation and perform basic and advanced queries, including GROUP BY, joins, and partitioning for big data analysis.

The concerned faculty may design one mini project based on a specific domain.

Note: - Use of Open-Source Software/Tool/Technology is recommended for laboratory assignments of the concerned subject.

Text Books:

1. Tom white, “Ha doop, The Definitive Guide”, Fourth Edition, O’Reilly Media Inc.
2. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing.
3. Seema Aacharya and Subhashini Chellappan, “Big Data and Analytics", Second Edition, Wiley India Pvt. Ltd.

Reference Books:

1. Martin Kleppmann, “Designing Data-Intensive Applications”, O’Reilly
2. Bill Chambers & Matei Zaharia, “Spark: The Definitive Guide”, O’Reilly
3. Powell & Baker, “Big Data Visualization”, CRC Press

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of a journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modifications. Evaluation will be based on the paperwork of the algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

COMPUTER NETWORKS (PCC)					
COURSEOUTLINE					
Course Title:	**COMPUTER NETWORKS (PCC)**	**Short Title:**	**CN**	**Course Code:**	**AIDS-603**

Course description:

The Internet has become one of the most important components of our life. We browse the Web, check e-mails, make VoIP phone calls, and have video conferences via computers. All of these applications are made possible by networking computers together, and this complex network of computers is usually referred to as the Internet. This course is designed to give you a clear understanding of how networks, from in-home local area networks, or LANS, to the massive and global Internet, are built and how they allow us to use computers to share information and communicate with one another.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	15	45	3

Pre requisite course(s):

Introduction to Computer Systems, Data Structures and Algorithms, and Program Design or a Program or courses of similar content.

Course objectives:

1. To study general principles of data communication.
2. To study OSI reference model and the TCP-IP reference model.
3. To study IP Layer.
4. To study transport layer.
5. To study application layer and network security.

Course outcomes:

After successful completion of this course the student will be able to:

1. Summarize fundamental concepts of Computer Networks & Illustrate the working & functions of data link layer
2. Analyze IP Protocol Mechanism
3. Analyze the working of different routing protocols and mechanisms
4. Analyze the structure and working of TCP & UDP at transport layer
5. Illustrate the role of application layer & comprehend the basics of Network Security

COURSECONTENT

Computer Networks		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End semester exam (ESE): UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams(ISE): CA TH	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Data Communications: Components, Types of Data Flow, Networks, Topologies, Categories

Network Models: Layered Task, The OSI Model, TCP/TP Protocol Suite
Addressing: Physical Addresses, Logical Addresses, Port Addresses, and Specific Addresses.
Data Link Layer: Framing, Flow and Error Control
Wired LANs Ethernet: IEEE Standards, Standard Ethernet,802.3MACFrameFormat Changes in the standard Ethernet

Unit–II:	No. of Lectures:09Hours	Marks:12

Logical Addressing: IPv4 Addresses: Address Space, Notations, Class full Addressing, Classless Addressing, Network Address Translation (NAT).
Internet Protocol: IPv4: Datagram, Fragmentation, Checksum, Options. IPv6: Structure, Address Space, Advantages, Packet Format, Extension Headers, Transition from IPv4 to IPv6: Dual Stack, Tunneling, Header Translation., **Address Mapping:** Mapping Logical to Physical Address: ARP, Mapping Physical to Logical Address: RARP, BOOTP and DHCP.

Unit–III:	No. of Lectures: 09 Hours	Marks:12

Error Reporting: ICMP: Types of Messages, Message Format, Error Reporting Messages, Query Massages, Ping and Trace route Debugging Tools.,**Delivery:** Direct Versus Indirect Delivery, **Forwarding:** Forwarding Techniques, Routing Table.,**Unicast Routing Protocols:** Intra and Inter domain Routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP

Unit– IV:	No. of Lectures:09 Hours	Marks:12

Transport Layer: Transport-layer services: Process-to-Process Communication,
Addressing: Port Numbers, Encapsulation and De capsulation, Multiplexing and De multiplexing, Flow Control and Error Control., **User Datagram Protocol (UDP):** User Datagram, UDP Operation, Uses of UDP, **Transmission Control Protocol (TCP):** TCP Services, TCP Features, TCP Segment, TCP Connection, Flow Control, Error Control and Congestion Control: open-loop congestion control and closed-loop congestion control techniques.

Unit– V:	No. of Lectures:09 Hours	Marks:12

Application Layer: Introduction to Domain Name System, Remote Logging, Electronic Mail: SMTP & POP, and File Transfer: FTP, WWW and HTTP, **Network Security:** Introduction to cryptography, symmetric-key and asymmetric key Cryptography, XOR Cryptography and RSA cryptography, Firewall

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.

Reference Books:

1. B.A.Forouzan and Firouz Mosharraf, "Computer Networks: A Top Down Approach", TMH, 2018.
2. A.S.Tanenbaum, "Computer Networks",Pearson Education ,Fourth Edition
3. S.Keshav,“ AnEngineering Approachto Computer Networking ”,Addison Wesley.
4. Mayank Dave,“ComputerNetworks”,CengageLearningIndia,Firstedition,2012
4.Bhavneet Sidhu,“An Integrated Approach to Computer Networks”,Khanna Publications.
6. Comer,“Internetworking with TCP/IP",Vol.1,Pearson Education, Fourth Edition.
7. W.Stallings,“Data and Computer Communications",Pearson Education,Fifth Edition.
8. B.A.Forouzan,“TCP/IP Protocol Suite",TMH,Fourth Edition.

NPTEL Link:
1. (Computer Networks And Internet Protocol) By Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty IIT Kharagpur https://onlinecourses.nptel.ac.in/noc23_cs48/preview

COMPUTER NETWORKS LAB (PCC)					
COURSEOUTLINE					
Course Title:	**COMPUTER NETWORKS LAB (PCC)**	**Short Title:**	**CNL**	**Course Code:**	**AIDS-604**

Course description:

This laboratory provides students with a comprehensive study of the Computer Networking and protocols. Classroom lectures stress the strengths of Computer Networks, which provide students with the means of writing efficient, maintainable, and portable code and simulating protocols and networks

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	**15**	**30**	**1**

Pre requisite course(s):

Introduction to Computer Systems, Data Structures and Algorithms, and Program Design or a Program or courses of similar content.

COURSECONTENT

Computer Networks		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**	**25 marks**
		Internal Continuous Assessment (ICA):CA	**25 marks**

Concerned faculty member should suitably frame at least **THREE** Laboratory assignments from Group - A and ALL Laboratory assignments from Group – B from the following list.

(Group A)

1. Implementation of Bit-Stuffing and Un-stuffing in Framing
2. Implementation of RLE data compression algorithm.
3. Write a program to demonstrate Sub-netting and find subnet masks
4. Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission
5. Implementation of TCP Socket.
6. Implementation of UDP Socket.
7. Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa
8. Encryption/Decryption using XOR symmetric-key cryptography algorithm.
9. Encryption/Decryption using RSA asymmetric-key cryptography algorithm.

(Group B)

1. Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool
2. Configuring DHCP, DNS, SMTP and HTTP Server in any Packet Tracer
3. Simulation of TCP in Cisco Packet Tracer
4. Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.

Reference Books:

1. B.A.Forouzan and Firouz Mosharraf, "Computer Networks: A Top Down Approach", TMH, 2018.
2. A. S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition
3. S. Keshav, “An Engineering Approach to Computer Networking”, Addison Wesley.
4. Mayank Dave, “Computer Networks”, Cengage Learning India, First edition, 2012
5. Bhavneet Sidhu, “An Integrated Approach to Computer Networks”, Khanna Publications.
6. Comer, “Internetworking with TCP/IP", Vol. 1, Pearson Education, Fourth Edition.
7. W. Stallings, “Data and Computer Communications", Pearson Education, Fifth Edition.
8. B. A. Forouzan, “TCP/IP Protocol Suite", TMH, Fourth Edition

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

WEB TECHNOLOGY LAB (PEC-II)					
LAB COURSE OUTLINE					
Course Title:	**Program Elective Course-II WEB TECHNOLOGY LAB**	**Short Title:**	**WTL**	**Course Code:**	**AIDS- 605A**

Course description:

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3 Hours / Week**	**15 Weeks**	**45 hours**	**3**
Practical	**4 Hours / Week**	**15 Weeks**	**60 hours**	**2**

Prerequisite course(s):

Course objectives:

The objective of this course is to:
1. Understand the fundamentals of client-side and server-side web technologies.
2. Design and develop interactive and responsive web pages.
3. Implement form handling, validation, and dynamic content.
4. Develop database-driven web applications.
5. Deploy and test complete web applications.

Course outcomes:

After successful completion of this course the student will be able to:
1. Design structured and styled web pages using HTML and CSS.
2. Implement client-side scripting for dynamic web interactions.
3. Develop server-side programs to process user data.
4. Create database-driven web applications with CRUD operations.
5. Build and deploy a complete functional web application.

COURSE CONTENT

Web Technology - Lab		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**	**End Semester Examination (ESE) UA:**	**25 marks**
		Internal Continuous Assessment	**50 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Unit–I:	**No. of Lectures: 09 Hours**	

Introduction to Web Technologies: Basics of Internet and World Wide Web, Web browsers and web servers, HTTP/HTTPS protocol, Client-server architecture, Introduction to HTML and web page structure

Unit–II:	**No. of Lectures: 09 Hours**	

HTML and CSS: HTML5 elements and attributes, Forms, tables, multimedia elements, CSS: Inline, internal, external styles, CSS selectors, box model, Responsive design basics.

Unit–III:	**No. of Lectures: 09 Hours**	

Client-Side Scripting: Introduction to JavaScript, Variables, operators, control structures, Functions and events, DOM manipulation, Form validation using JavaScript

Unit–IV:	**No. of Lectures: 09 Hours**	

Server-Side Scripting: Introduction to server-side programming, Basics of Node.js / PHP, Handling requests and responses, Session and cookies, File handling

Unit–V:	No. of Lectures: 09 Hours	

Database Integration and Web Applications: Introduction to databases (MySQL / MongoDB), CRUD operations, Connecting web app to database, Introduction to REST APIs, Basics of web

Text Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley Publications

Reference Books:

1. Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education
2. Achyut S. Godbole & Atul Kahate, Web Technologies, Tata McGraw Hill
3. Deitel & Deitel, Internet & World Wide Web: How to Program, Pearson.

NPTEL Links: 1.(Web Technologies) By Dr. S. Sasirekha|National Institute of Technical Teachers'

https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed123

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. Create a webpage using headings, paragraphs, lists, links, and images.
2. Design forms with text fields, radio buttons, checkboxes, dropdowns, and submit buttons.
3. Apply Styling using CSS using inline, internal, and external CSS. Format text, colors, borders, spacing.
4. Page Layout and Responsive Design using CSS Box Model, Flexbox or Grid to create structured and responsive layouts.
5. Write basic JavaScript programs using variables, operators, and alerts.
6. Implement conditions, loops, and user-defined functions using javascript
7. Validate user inputs like email, phone number, and password using JavaScript.
8. Access and modify HTML elements dynamically. Handle click, hover, and keyboard events.
9. Store and retrieve data in browser local storage using JSON.
10. Create a basic server-side script to process form data.

Text Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley Publications

Reference Books:

1. Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education
2. Achyut S. Godbole & Atul Kahate, Web Technologies, Tata McGraw Hill
3. Deitel & Deitel, Internet & World Wide Web: How to Program, Pearson

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

USER INTERFACE AND USER EXPERIENCE DESIGN LAB (PEC-II)					
LAB COURSE OUTLINE					
Course Title:	**USER INTERFACE AND USER EXPERIENCE DESIGN LAB (PEC-II)**	**Short Title:**	**UIUEDL**	**Course Code:**	**AIDS- 605B**

Course description:

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3 Hours / Week**	**15 Weeks**	**45 hours**	**3**
Practical	**4 Hours / Week**	**15 Weeks**	**60 hours**	**2**

Prerequisite course(s):

Course objectives:

The objective of this course is to:
1. To introduce students to the fundamentals of User Interface (UI) and User Experience (UX) design.
2. To develop skills in designing user-centered digital interfaces.
3. To train students in wire framing, prototyping, and usability testing.
4. To apply design principles to web and mobile applications.
5. To enable students to evaluate and improve user experiences through testing and feedback.

Course outcomes:

After successful completion of this course the student will be able to:
1. Apply UI design principles to create intuitive interfaces
2. Perform user research and create user personas.
3. Develop wireframes and interactive prototypes.
4. Conduct usability testing and analyze user feedback.
5. Design complete UI/UX solutions for real-world applications.

COURSE CONTENT

User Interface and User Experience		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**	**End Semester Examination (ESE) UA: PR**	**25 marks**
		Internal Continuous Assessment (ICA):CA	**50 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Unit–I:	**No. of Lectures: 9 Hours**	

Introduction to UI/UX Design: Definition of UI and UX, Importance of UX in software development, Difference between UI and UX, UX design lifecycle, Human-Computer Interaction (HCI) basics.

Unit–II:	**No. of Lectures: 9 Hours**	

User-Centered Design (UCD): User research techniques, Personas and user scenarios, User journey mapping, Information architecture, Task analysis.

Unit–III:	**No. of Lectures: 9 Hours**	

UI Design Principles: Design principles: Contrast, Alignment, Proximity, Repetition, Typography and color theory, Layout and composition, Responsive design, Accessibility (WCAG basics)

Unit–IV:	**No. of Lectures: 9 Hours**	

Wireframing and Prototyping: Low-fidelity vs high-fidelity design, Wire framing tools and techniques, Prototyping concepts, Interaction design basics, Design systems and components

Unit–V:	No. of Lectures: 9 Hours	

Usability and Evaluation: Usability principles, Heuristic evaluation, Usability testing methods, A/B testing, Feedback and iteration.

Text Books:

1. Don Norman – The Design of Everyday Things
2. Ben Shneidermanet al. – Designing the User Interface

Reference Books:

1. Steve Krug – Don't Make Me Think
2. Jesse James Garrett – The Elements of User Experience.

NPTEL Links:

1. (User Interface Design) By Prof. Saptarshi Kolay IIT Roorkee
https://onlinecourses.nptel.ac.in/noc26_ar15/preview

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. **Study of UI/UX Design Tools** – Familiarization with tools like Figma/Adobe XD.
2. **Analysis of UI Design Principles** – Evaluating interfaces based on contrast, alignment, consistency, and hierarchy.
3. **User Research Activity** – Creating surveys and conducting mock user interviews.
4. **User Persona Development** – Designing personas with goals, behaviors, and pain points.
5. **Information Architecture Design** – Creating sitemaps and user flow diagrams.
6. **Low-Fidelity Wire framing** – Sketching basic layouts for web/mobile screens.
7. **High-Fidelity Wire framing** – Designing detailed digital wireframes with typography and color.
8. **Interactive Prototyping** – Building clickable prototypes with navigation links.
9. **Mobile App UI Design** – Designing key screens for a mobile application.
10. **Web Application UI Design** – Designing homepage, dashboard, and form interfaces.
11. **UI Components and Design System** – Creating reusable components like buttons, cards, and nav bars.
12. **Accessibility-Focused UI Design** – Applying color contrast and readability standards.
13. **Usability Testing** – Conducting user testing and documenting usability issues.
14. **Heuristic Evaluation** – Evaluating interface using usability heuristics.
15. **Mini Project: Complete UI/UX Case Study** – End-to-end design from research to prototype and testing.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

INTERNET OF THINGS LAB (PEC-II)					
LAB COURSE OUTLINE					
Course Title:	**Program Elective Course-II INTERNET OF THINGS LAB**	**Short Title:**	**IOTL**	**Course Code:**	**AIDS -605C**

Course Description:

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3 Hours / Week**	**15 Weeks**	**45 hours**	**3**
Practical	**4 Hours / Week**	**15 Weeks**	**60 hours**	**2**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To provide hands-on experience in selecting suitable IoT hardware platforms such as Arduino and Raspberry Pi for real-world applications.
2. To design and implement sensor-based monitoring systems for health, safety, and smart home environments.
3. To develop IoT solutions using actuators, alerts, and automation for assisting elderly and differently-abled users.
4. To build cloud-connected IoT applications using Thing Speak, Blynk, GSM, and MQTT communication protocols.
5. To encourage students to develop mini-projects addressing societal challenges through secure and scalable IoT technologies.

Course outcomes:

After successful completion of this course the student will be able to:

1. Students will be able to interface sensors and actuators with IoT development boards for practical monitoring applications.
2. Students will be able to design alert-based IoT systems for fire detection, obstacle avoidance, and elderly care support.
3. Students will be able to implement automation and control tasks using real-time sensor data and embedded programming.
4. Students will be able to transmit IoT data using cloud platforms, GSM modules, and MQTT-based communication models.
5. Students will be able to develop an IoT-based mini project that solves a societal problem with security and connectivity considerations.

COURSE CONTENT

Internet of Things Lab		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**	**End Semester Examination (ESE) UA:**	**25 marks**

	Internal Continuous Assessment	**50 marks**
End Semester Exam (ESE) Pattern:	**Practical (PR)**	
Unit–I:	**No. of Lectures: 09**	
Fundamentals of IoT: Definition, Characteristics, Applications, Architecture (Physical & Logical), Communication Models and APIs (REST, Web Socket), IoT Levels, Enabling Technologies (WSN, RFID, Cloud, Big Data), Challenges (Security, Interoperability, Scalability)		
Unit–II:	**No. of Lectures: 09**	
IoT Platform Design Methodology: Purpose and Requirement Specification, Process Specification, Domain model specification, Information Model Specification, Service specifications, IoT Level Specifications, Functional view specification, Operational View Specification, Device and Component integration, Application development.		
Unit–III:	**No. of Lectures: 09**	
Sensors and IoT Hardware: Sensor types and categories, Actuators, Development Boards (Arduino, ESP8266, Raspberry Pi), Basics of Interfacing (GPIO, I2C, SPI)		
Unit–IV:	**No. of Lectures: 09**	
IoT Protocol Stack: PHY/MAC (BLE, Zigbee, Z-Wave, LoRa), Network (6LoWPAN, RPL), Application (CoAP, MQTT, XMPP, AMQP), Introduction to Next Generation Networks **IoT Security:** Types of Attacks, Vulnerabilities in IoT, Key Elements of IoT Security, Security Model		
Unit–V:	**No. of Lectures: 09**	
IoT Security and Computing Paradigms: IoT Security basics: Encryption, Authentication, and Privacy Challenges, Comparing Arduino vs. Raspberry Pi vs. ESP32 for IoT Projects, Comparison between Cloud, Edge, and Fog Computing in IoT, Research Paper Reading.		
Text Books:		
1. **A. Bahga and V. Madisetti**, *Internet of Things: A Hands-On Approach*, 1st ed., Hyderabad, India: Universities Press, 2015. ISBN: 978-8173719547. 2. **T. Pulver and M. Wuebbeling**, *Hands-On Internet of Things with MQTT*, 1st ed., Birmingham, UK: Packt Publishing, 2022. ISBN: 978-1800567993. 3. **A. Kaushik**, *6G: The Road to the Future Wireless Technologies 2030*, 1st ed., Hoboken, NJ, USA:		

Reference Books:

1. **P. Waher**, *Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3*, 2nd ed., Birmingham, UK: Packt Publishing, 2020. ISBN: 978-1800205260.
2. **P. A. Morreale and J. M. Anderson**, *Software Defined Networking: Design and Deployment*, 2nd ed., Boca Raton, FL, USA: CRC Press, 2021. ISBN: 978-0367332154
3. **A. Kurniawan**, *Internet of Things Projects with Arduino and ESP32*, 1st ed., Independently Published, 2021. ISBN: 979-8724812744.
4. **F. Hu (Ed.)**, *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations*, 1st ed., Boca Raton, FL, USA: CRC Press, 2022. ISBN: 978-0367558363.

NPTEL Links:

1.(Introduction To Internet Of Things) , IIT Kharagpur Prof. Sudip Misra
https://nptel.ac.in/courses/106105166

2. (Foundation of Cloud IoT Edge ML), IIT Patna Prof. Rajiv Misra
https://nptel.ac.in/courses/106104242

Concern faculty member should suitably frame at least **SIX** laboratory assignments

List of Experiments

1. A startup is developing an IoT-based home monitoring system. Engineers need to decide between Raspberry Pi and Arduino based on project requirements.
2. Design a system to monitor room temperature and alert the elderly if it crosses a safe limit. Interface LM-35 temperature sensor with Arduino. Display temperature values and activate a buzzer if it exceeds the threshold.
3. Build a wearable device for visually impaired users that alerts them to nearby obstacles. Interface an IR sensor with Arduino or Raspberry Pi. Light an LED or trigger a buzzer when an obstacle is detected.
4. Automate the Chrome Dino game using real-world sensors and actuators for STEM education tools. Use a light- dependent resistor (LDR) and servo motor with Arduino. Make the servo "jump" automatically based on game screen brightness.
5. A remote warehouse requires an automatic fire detection and alert system via SMS. Interface flame sensor with Arduino. Send SMS using GSM module or trigger buzzer when fire is detected.
6. An agricultural firm wants to remotely monitor field conditions using cloud services. Interface DHT11 or soil moisture sensor with Arduino. Push sensor data to ThingSpeak / Blynk platform for visualization.
7. Municipalities aim to monitor dustbin levels and optimize waste collection routes. Use ultrasonic sensor to detect fill level of a bin.Send alert when bin is full.
8. A smart greenhouse sends temperature and humidity data to a remote monitoring system using MQTT. Implement MQTT protocol using a NodeMCU or Raspberry Pi. Use DHT11 sensor, NodeMCU (ESP8266), Mosquitto broker or public broker (e.g., HiveMQ), MQTT Dash App, Publish sensor data to MQTT broker. Subscribe to data using mobile/PC.
9. Mini Project: Implement any societal problem using suitable IoT hardware and protocols.
   - Security management
   - Health emergencies
   - Road traffic management
   - Energy Conservation
   - Agricultural Problems

Text Books:

1. **A. Bahga and V. Madisetti**, *Internet of Things: A Hands-On Approach*, 1st ed., Hyderabad, India: Universities Press, 2015. ISBN: 978-8173719547.
2. **T. Pulver and M. Wuebbeling**, *Hands-On Internet of Things with MQTT*, 1st ed., Birmingham, UK: Packt Publishing, 2022. ISBN: 978-1800567993.
3. **A. Kaushik**, *6G: The Road to the Future Wireless Technologies 2030*, 1st ed., Hoboken, NJ, USA: Wiley-IEEE Press, 2023. ISBN: 978-1119903802.

Reference Books:

1. **P. Waher**, *Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3*, 2nd ed., Birmingham, UK: Packt Publishing, 2020. ISBN: 978-1800205260.
2. **P. A. Morreale and J. M. Anderson**, *Software Defined Networking: Design and Deployment*, 2nd ed., Boca Raton, FL, USA: CRC Press, 2021. ISBN: 978-0367332154
3. **A. Kurniawan**, *Internet of Things Projects with Arduino and ESP32*, 1st ed., Independently Published, 2021. ISBN: 979-8724812744.
4. **F. Hu (Ed.)**, *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations*, 1st ed., Boca Raton, FL, USA: CRC Press, 2022. ISBN: 978-0367558363.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Online Sources:

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
3. https://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know about-the-iot-right-now/

BLOCKCHAIN SECURITY AND PERFORMANCE (PEC-III)					
COURSE OUTLINE					
Course Title:	**Program Elective Course-III BLOCKCHAIN SECURITY AND PERFORMANCE**	**Short Title:**	**BSP**	**Course Code:**	**AIDS-606A**

Course description:

Block chain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the crypto currencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. It has applications in finance, government, media and almost all other industries.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	3

Prerequisite course(s):

Fundamentals of Block chain , Cryptography Techniques

Course objectives:

1. Students should be able to understand the security and performance-related issues of block chain.
2. Students should be able to learn techniques and tools to tackle the security related issues of block chain.
3. Students should be able to learn new approaches required for enhancing block chain performance.

Course outcomes:

After successful completion of this course the student will be able to:

1. To understand the security perspective of block chain technology.
2. To learn the various Tools for Smart Contracts.
3. To understand performance related issues in block chain
4. To learn and apply security analysis and performance-enhancing techniques related to block chain.
5. To understand the real-life applications of block chain technology and apply it to provide solutions to some real-life problems.

COURSE CONTENT

BLOCKCHAIN SECURITY AND PERFORMANCE (PEC-III)		Semester:	VI	
Teaching Scheme:		**Examination scheme**		
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**
		Duration of ESE:		**03 hours**
		Internal Sessional Exams (ISE):		**40 marks**
Unit–I	**No. of Lectures: 08 Hours**		**Marks: 12**	

Security Issues: Block chain Related Issues, Higher-Level Language (Solidity) Related Issues, EVM Byte code Related Issues, Real-Life Attacks on Block chain Applications/ Smart Contracts, Trusted Execution Environments.		
Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**
Security Tools for Smart Contracts: Working, Advantages, And Disadvantages of Tools- Oyente, Securify, Main, Manticore, Mythril, Smart Check, Vertex. Secure Key Management, Quantum Resilience Keys.		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Performance Related Issues: Transaction Speed, Transaction Fees, Network Size, Complexity, Interoperability Problems, Lack of Standardization. Lack of Supportive Regulations Related to Block chain Applications.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Performance Improvements: Off-Chain State Channels, Side chains, Parallels Chains, Concurrent Smart Contract Transactions, Sharing Technique and Its Benefits, Atomic Swaps Between Smart Contracts.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Block chain Applications: Decentralized Crypto currency, Distributed Cloud Storage, E-Voting, Insurance Claims, Cross-Border Payments, Asset Management, Smart Appliances.		
Text Books:		
1. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O'Reilly Publisher.		
Reference Books:		
1. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015 2. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, De centralization and Smart Contracts Explained", Packt Publishing		
Online Resources: (Block chain and Fin Tech: Basics, Applications) 1. https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations		

BLOCKCHAIN SECURITY AND PERFORMANCE LAB (PEC-III)					
LAB COURSE OUTLINE					
Course Title:	**BLOCKCHAIN SECURITY AND PERFORMANCE LAB (PEC-III)**		**Short Title:**	**BSPL**	**Course Code:** **AIDS-607A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**
	02	**15**	**30**		**1**
Prerequisite course(s):					
Fundamentals of Block chain, Cryptography Techniques					

<table>
<tr><th colspan="4">COURSE CONTENT</th></tr>
<tr><td colspan="2">Name of the Subject: Block chain Security and Performance Lab</td><td colspan="2">Semester: VI</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="2">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td>Internal Continuous Assessment (ICA): CA</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="2">Practical (PR)</td></tr>
<tr><td colspan="4">Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.
1. Design, develop, and deploy a smart contract on the block chain that securely handles data storage and user interaction.
2. Design and implement a smart contract to demonstrate how integer overflow and underflow vulnerabilities can occur in block chain applications.
3. To design and simulate a 51% attack in a controlled block chain environment and analyze how majority control can compromise network security, transaction integrity, and consensus.
4. Develop a block chain wallet with multi-signature security that requires multiple approvals before a transaction can be executed.
5. Study the factors affecting block chain performance and explore techniques to improve it.
6. Design and develop a smart contract to implement a secure and transparent electronic voting system on the block chain
7. Design a block chain-based insurance system that offers a transparent, secure, and automated platform to accelerate claim settlements and enhance trust between insurers and policyholders</td></tr>
<tr><td colspan="4">Guide lines for ICA:</td></tr>
<tr><td colspan="4">Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.</td></tr>
<tr><td colspan="4">Guidelines for ESE:</td></tr>
<tr><td colspan="4">ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.</td></tr>
<tr><td colspan="4">Text Books:</td></tr>
<tr><td colspan="4">1. 1. Mastering Ethereum : Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Reference Books:</td></tr>
<tr><td colspan="4">1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing</td></tr>
<tr><td colspan="4">Online Resources: (Block chain and Fin Tech: Basics, Applications)
1. https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations</td></tr>
</table>

DEEP LEARNING AND NEURAL NETWORK (PEC-III)					
COURSE OUTLINE					
Course Title:	**Program Elective Course-III DEEP LEARNING AND NEURAL**	**Short Title:**	**DLNNL**	**Course Code:**	**AIDS-606B**

Course description: This course provides a comprehensive introduction to the principles and applications of neural networks and deep learning. It covers the mathematical foundations and computational techniques used to design, train, and evaluate artificial neural networks. Topics include single-layer and multi-layer perceptron s, activation functions, loss functions, back propagation, and optimization algorithms. The course further explores advanced deep learning architectures such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), and an introduction to modern architectures used in vision and sequence modeling. Emphasis is placed on practical implementation using deep learning frameworks, model evaluation, and real-world applications in areas such as image recognition, natural language processing, and predictive analytics.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

1. Fundamentals of Linear algebra
2. Data Structures and programming skills
3. Basic Knowledge of Data handling skills like date preprocessing, Normalization and standardization.

Course objectives:

The objective of this course is to:

1. Understand the fundamentals of deep learning.
2. Learn the working of Convolutional neural networks and RNN in decision making.
3. Study and Understand concept of advanced neural network
4. Understand Simple machine learning algorithms
5. Familiarize with GAN and challenges in NN training with pytorch , Tensor flow tool

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the learning components of neural network and apply standard neural network models to learning problems.
2. Analyze the learning strategies of deep learning – regularization, generalization, optimization , bias and variance
3. Analyze regular deep learning models for training, testing and validation in standard datasets.
4. Apply neural network for deep learning using standard tools.
5. Understand the mathematics for deep learning.

COURSE CONTENT

DEEP LEARNING AND NEURAL NETWORK (PEC-III)	**Semester:**	**VI**
Teaching Scheme:	**Examination scheme**	

Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction :
What is a Neural Network?, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures, Rosenblatt‟s Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Supervised and Unsupervised Neural Networks
Hebb Network theory and training algorithm, Perceptron Networks architecture and training algorithm, Back propagation Network architecture and training algorithm, Associative Memory Network architecture and training algorithm, Hopfield Networks architecture and training algorithm, Counterpropagation Networks architecture and training algorithm, Adaptive Resonance Theory Network architecture and training algorithm.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Advanced Neural Networks
Kohonen Self-Organising Feature Maps architecture and training algorithm, Learning Vector Quantization architecture and training algorithm, Boltzmann Machine, Cognitron Network, Neocognitron Network, Optical Neural Networks Electro-optical Multipliers and Holographic Correlators.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Deep Learning
Machine learning basics, Simple Machine Learning Algorithm -- Linear Regression, underfitting and overfitting challenges in Machine Learning, Supervised Learning approach for Support Vector Machine, Deep Feedforward Networks, Convolutional Networks, Deep Recurrent Networks, Deep Boltzmann Machine, Applications in Speech Recognition and Natural Language Processing.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to GAN – Encoder/Decoder, Generator/Discriminator architectures; Challenges in NN training – Data Augmentation – Hyper parameter Settings; Transfer Learning – Developing and Deploying ML Models (e.g., Tensor Flow/PyTorch)

Text Books:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville.”Deep Learning”,MIT Press, Second Edition 2016.
2. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016

Reference Books:

1. Koller, D and Friedman, N."Probablistic Graphical Models".MIT Press 2009
2. Hastie,T., Tibshirani, R. and Friedman, J. "The Elements of Statistical Learning".Second edition
3. Bishop, C. M. "Neural Networks for pattern Recognition."Oxford University Press: 1995.
4. Aggarwal, Charu C."Neural networks and deep learning."Springer, 2018.,Springer;2009

NPTEL Links:

1.(Deep Learning) By Prof. Prabir Kumar Biswas IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc22_cs22/preview

DEEP LEARNING AND NEURAL NETWORK LAB (PEC-III)						
COURSE OUTLINE						
Course Title:	**Program Elective Course – III DEEP LEARNING AND NEURAL NETWORK LAB**		**Short Title:**	**DPNNL**	**Course Code:**	**AIDS-607B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	02	**15**	**30**		**1**	

Prerequisite course(s):

1. Data Structures and programming skills
2. Basic Knowledge of Data handling skills like date preprocessing, Normalization etc

COURSE CONTENT

Program Elective Course – III DEEP LEARNING AND NEURAL NETWORK LAB		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA): CA**	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least **SIX** Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. To Write a program to implement Perceptron. OR Identify the problem with single unit Perceptron. Classify using Or, And and XOR data and analysis the result.
2. To write a program to implement AND OR gates using Perceptron.
3. To write a program to implement Wine Classification using Back propagation
4. Write a program for object detection using image labeling tools
5. Write a program for character recognition using CNN.
6. Write a program to detect Dog image using YOLO Algorithm
7. To study Image Net, Google Net, ResNet convolutional Neural Networks.
8. To study Convolutional Neural Network and Recurrent Neural Network.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

Text Books:

1. Navin Kumar Manaswi ,Deep Learning with Applications Using Python Chatbots and Face, Object, and Speech Recognition With Tensor Flow and Keras , Apress,2018.
2. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017.
3. M.Arif Wani Farooq Ahmad Bhat Saduf Afzal Asif Iqbal Khan, Advances in Deep Learning Springer, 2020

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press,2016.
2. N.D.Lewis, “Deep Learning Made Easy with R : A Gentle Introduction for Data Science”,January 2016

Online Resources:

1. (Mastering Deep Learning) By Naveen Kumar Bhansali
https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg36
2. (Deep Learning) Sargur N. Srihari (Hari)
https://cedar.buffalo.edu/~srihari/

DATBASE SECURITY AND ACCESS CONTROL(PEC-III)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – III Database Security and Access Control**	**Short Title:**	**DSAC**	**Course Code:**	**AIDS–606C**

Course Description:

This course focuses on principles and mechanisms for securing databases and controlling access to sensitive data. It covers access control models such as DAC, MAC, and RBAC, along with modern security techniques, vulnerabilities, and enterprise-level implementations. The course also explores smart card security, secure DBMS design, and intrusion detection systems. Emphasis is placed on both theoretical foundations and real-world applications.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	15	45	3

Pre Requisite Course(s):

Basic Knowledge of - Database Management Systems, Operating Systems, Computer Networks, Basic Programming (SQL, Python/Java)

Course Objectives:

1. Understand database security challenges, threats, and modern protection mechanisms.
2. Analyze and implement different access control models such as DAC, MAC, and RBAC.
3. Study advanced security models like Biba, Clark-Wilson, and role hierarchies.
4. Explore smart card security and secure system design principles.
5. Apply intrusion detection and statistical database protection techniques.

Course Outcomes:

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

1. Identify and analyze database vulnerabilities and security threats.
2. Implement and compare different access control mechanisms.
3. Design secure database systems using appropriate models.
4. Apply enterprise-level RBAC and security integration techniques.
5. Evaluate and implement intrusion detection and data protection strategies.

COURSE CONTENT

Big Data Analytics		**Semester:**	**VI**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End-of-semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Database Security:

Recent trends in Database security and access control mechanisms, Case study of Role-Based Access Control (RBAC) systems, Recent Trends related to data security management, vulnerabilities in different DBMS.

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC).
Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**

Models: Biba's integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructure: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi-line Insurance Company

Unit– IV:	**No. of Lectures:09 Hours**	**Marks:12**

Smartcard Security:
Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

Unit– V:	**No. of Lectures:09 Hours**	**Marks:12**

Security Software Design: A Methodological Approach to Security Software Design, Secure Operating System Design, Secure DBMS Design, Security Packages, Database Security Design, Statistical Database Protection & Intrusion Detection Systems, Introduction Statistics Concepts and Definitions, Types of Attacks, Inference Controls evaluation, Criteria for Control Comparison, Introduction IDES System, RETISS System, ASES System Discovery.

Text Books:

1. Hassan A. Afyouni, "Database Security and Auditing: Protecting Data Integrity and Accessibility", Thomson Course Technology.
2. Silvana Castano, Mariagrazia Fugini, Giancarlo Martella, Pierangela Samarati, "Database Security", Pearson Education Ltd.

Reference Books:

1. **Alfred Basta, Melissa Zgola, "Database Security", COURSE TECHNOLOGY** CENGAGE Learning.

NPTEL VIDEO : (Database Security and Access Control)

1. http://kcl.digimat.in/nptel/courses/video/106106156/L19.html

DATABASE SECURITY AND ACCESS CONTROL LAB(PEC-III)

COURSE OUTLINE

LAB COURSE OUTLINE

Course Title:	**Program Elective Course-III DATABASE SECURITY AND ACCESS CONTROL LAB**	**Short Title:**	**DSACL**	**Course Code:**	**AIDS–607C**

Course description: This lab provides hands-on experience in implementing database security mechanisms and access control techniques. Students will work with SQL-based privileges, RBAC models, encryption, and auditing. The lab also introduces practical aspects of intrusion detection and secure database design. Emphasis is on real-world implementation and security best practices.

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2 Hours / Week	**15 Weeks**	**30 hours**	**01**

Prerequisite course(s): Students should have prior knowledge of:
SQL (DDL, DML, DCL), Basic DBMS concepts, Basic Linux/OS commands (optional)

COURSE CONTENT

DATABASE SECURITY AND ACCESS CONTROL LAB		**Semester:**	**VI**
Teaching Scheme:		**Examination Scheme**	
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA)**	**25 Marks**

Concerned faculty member should suitably frame at least **SIX** laboratory assignments, from the following list.

List of Experiments: -

1. Study of Role-Based Access Control (RBAC) in MySQL
2. Implementation of Discretionary Access Control (DAC) Using GRANT and REVOKE
3. Simulation of Mandatory Access Control (MAC) Using Sensitivity Labels
4. Implementation of Access Control Lists (ACL) in a Database System
5. Biba's Integrity Model Implementation
6. Clark-Wilson Integrity Model Simulation
7. Role Hierarchy and Separation of Duty (SoD) in RBAC
8. Statistical Database Protection Against Inference Attacks
9. SQL Injection Attack — Detection and Prevention
10. Database Audit Trail and Intrusion Detection

Text Books:

1. Hassan A. Afyouni, "Database Security and Auditing: Protecting Data Integrity and Accessibility", Thomson Course Technology.
2. Silvana Castano, Mariagrazia Fugini, Giancarlo Martella, Pierangela Samarati, "Database Security", Pearson Education Ltd.

Reference Books:

1. Alfred Basta, Melissa Zgola, "Database Security", COURSE TECHNOLOGY **CENGAGE Learning**.

Guidelines for ICA: Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

INDUSTRIAL AUTOMATION (MD M)					
COURSE OUTLINE					
Course Title:	**INDUSTRIAL AUTOMATION (MD M)**	**Short Title:**	**IA**	**Course Code:**	**AIDS-608**

Course description:

This course introduces the principles and applications of industrial automation, focusing on the integration of mechanical, electrical, and computer-based systems to improve manufacturing efficiency, safety, and productivity. Students will explore automation technologies such as PLCs, sensors, robotics, SCADA systems, and industrial communication protocols. Practical case studies and hands-on exercises will prepare learners to design, implement, and troubleshoot automation systems in modern industries.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	2	15	30	2

Pre requisite course(s):

Basic Electrical Engineering, Basic Electronics Engineering, Control Systems, and Microprocessors/Microcontrollers.

Course objectives:

1. To provide foundational knowledge of industrial automation concepts and technologies.
2. To develop skills in programming and configuring PLCs, sensors, and actuators.
3. To understand industrial communication systems and SCADA applications.
4. To analyze automation requirements and design efficient control systems.
5. To prepare students for careers in manufacturing, robotics, and process industries.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the role and importance of automation in industrial processes.
2. Design and implement PLC-based control systems for real-world applications.
3. Apply knowledge of sensors, actuators, and robotics in automation projects.
4. Use SCADA and industrial communication protocols for monitoring and control.
5. Evaluate and troubleshoot automation systems to improve efficiency and safety.

COURSE CONTENT

Industrial Automation		**Semester:**	
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End semester exam (ESE): UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE): CA TH	**40 marks**
		Internal Continuous Assessment(ICA):CA	**25 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Fundamentals of Industrial Automation

Introduction to Industrial Automation,Types and levels of automation

Automation pyramid (Field level, Control level, Supervisory level, Enterprise level),Components of automation systems, Role of automation in manufacturing industries, Basic control concepts: open loop and closed loop control,Introduction to Industry 4.0 and smart manufacturing

Unit–II:	No. of Lectures:09 Hours	Marks:12

Sensors and Actuators in Automation

Principles of sensors and transducers ,Types of sensors used in automation ,Proximity sensors (Inductive, Capacitive, Photoelectric)Temperature sensors (RTD, Thermocouple),Pressure, flow and level sensors, Signal conditioning and interfacing, Actuators used in automation systems ,Pneumatic actuators ,Hydraulic actuators, Electric actuators (DC motor, AC motor, Stepper motor, Servo motor), Applications of sensors and actuators in industry

Unit–III:	No. of Lectures: 09 Hours	Marks:12

Programmable Logic Controllers (PLC)

Introduction to PLC and its advantages, PLC architecture and components, Input and Output modules, PLC programming concepts, Ladder logic programming, Basic instructions:, Logic instructions, Timers, Counters, Arithmetic operations, Simple PLC programming examples for industrial applications

Unit– IV:	No. of Lectures: 09 Hours	Marks:12

Human Machine Interface (HMI) and Industrial Communication

Introduction to Human Machine Interface (HMI)Functions and benefits of HMI
HMI architecture and components ,Basics of HMI screen design, Communication between PLC and HMI
Industrial communication networks, Serial communication (RS-232, RS-485),Modbus ,Profibus Industrial Ethernet

Unit– V:	No. of Lectures: 09 Hours	Marks:12

Industrial Process Automation and Applications

Introduction to process automation ,Basic control strategies in industry, PID control basics
Introduction to SCADA systems ,.Automation in manufacturing industries :Conveyor automation
Packaging systems: Automated assembly lines ,Safety and troubleshooting in industrial automation systems

Text Books:

1 Frank D. Petruzella — “Programmable Logic Controllers” (McGraw Hill)

Reference Books:

1. **Frank D. Petruzella** — Programmable Logic Controllers, McGraw-Hill.
2. **Terry L. M. Bartelt** — Industrial Automated Systems: Instrumentation and Motion Control, Cengage Learning.
3. **Hugh Jack** — Automating Manufacturing Systems with PLCs.
4. **Olushola Akande** — Industrial Automation: Hands-On Guide to Sensors, Actuators, PLCs, HMIs, and SCADA, Packt Publishing.
5. **Chanchal Dey and Sunit Kumar Sen** — Industrial Automation Technologies, CRC Press.

NPTEL Link-1.(Industrial Automation And Control) By Prof. Siddhartha Mukhopadhyay IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc20_me39/preview

INTRODUCTION TO NETWORK MANAGEMENT & VIRTUALIZATION (VSEC)					
COURSEOUTLINE					
Course Title:	**INTRODUCTION TO NETWORK MANAGEMENT & VIRTUALIZATION (VSEC)**	**Short Title:**	**INMV**	**Course Code:**	**AIDS-609**

Course description:

Network Management and Virtualization form the backbone of modern enterprise IT infrastructure. Network management is essential for ensuring that computer networks operate efficiently, securely, and reliably in organizations of all sizes. Virtualization plays a key role in modern data centers and cloud environments by improving efficiency and flexibility.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	**1**	**15**	**15**	**1**
Practical	**2**	**15**	**30**	**1**

Pre requisite course(s):

Introduction to Computer Systems, Computer Network

Course objectives:

1. To understand fundamental concepts and architecture of network management.
2. To learn performance monitoring and troubleshooting in computer networks.
3. To understand virtualization technologies and hypervisor architectures.
4. To analyze server and desktop virtualization solutions.
5. To study network and storage virtualization in enterprise systems.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain fundamental concepts of network management and SNMP.
2. Analyze and evaluate network performance using monitoring tools.
3. Describe virtualization architectures and hypervisors.
4. Apply server and desktop virtualization in enterprise environments.
5. Design basic network and storage virtualization solutions.

COURSECONTENT

Introduction to Network Management & Virtualization		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**1 hours/week**	**End semester exam (ESE):**	
		Duration of ESE:	
		Internal Sessional Exams(ISE):	
Practicals :	**2 hours/week**	**Internal Continuous Assessment (ICA):CA**	**25Mark**

Unit–I:Basics of Network Management	**No. of Lectures: 03 Hours**	**Marks:**

Need for Network Management, FCAPS Model, Network Management Framework and Architecture: Manager, Agent, MIB, SNMP Concepts, SNMP Versions (v1, v2, v3), SNMP Architecture and Operations, Protocol Data Units, Packet monitoring using Wireshark		
Unit–II: Network Monitoring and Performance	**No. of Lectures:03 Hours**	**Marks:**
Fault Management and Performance Management, Network Performance Metrics: Throughput, Delay, Jitter, Packet Loss, Network Troubleshooting Methods, Introduction to Monitoring Tools: Nagios, Zabbix.		
Unit–III: Introduction to Virtualization	**No. of Lectures: 03 Hours**	**Marks:**
Virtualization and Cloud Computing, Need for Virtualization, Cost Reduction, Administration, Fast Deployment, Infrastructure Optimization, Limitations, Types of Hardware Virtualization: Full Virtualization, Partial Virtualization, Para virtualization, Types of Hypervisors		
Unit– IV: Server and Desktop Virtualization	**No. of Lectures:03 Hours**	**Marks:**
Virtual Machine Basics, Types of Virtual Machines, Server Virtualization, Types of Server Virtualization, Uses of Virtual Servers, Server Consolidation, Platform Selection, Desktop Virtualization, Types of Desktop Virtualization.		
Unit– V: Network and Storage Virtualization	**No. of Lectures:03 Hours**	**Marks:**
Introduction to Network Virtualization, Advantages, Functions, Network Virtualization Tools, VLAN-WAN Architecture, WAN Virtualization, Memory Virtualization, Storage Virtualization, Types of Storage Virtualization.		
Text Books:		
1. Network Management: Principles and Practice – Mani Subramanian 2. Virtualization Essentials – Matthew Portnoy 3. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010. 4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress,2005		
Reference Books:		
1. Andrew S. Tanenbaum,” Computer Networks” ,Pearson Publication 2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “Cloud Computing (Principles and Paradigms)”, John Wiley & Sons, Inc. 2011. 3. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for systems and Processes”, Elsevier/Morgan Kaufmann, 2005. 4. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.		
NPTEL Link:		
1. (Advanced Computer Networks) By Sudeep Tanwar https://nptel.ac.in/courses/106105160		

EXIT COURSE

Internship / Apprenticeship:

Internship / Apprenticeship / OJT shall be corresponding to the programme (Major) subject. Internship / Apprenticeship / OJT shall be monitored jointly by faculty and Industry / organization mentor.

The role of a Mentor, nominated by institute, shall be to provide professional/research guidance to the student during the internship. They shall also facilitate networking with other subject matter experts/professionals, which will enhance the internship experience and learning of the students.

Internship / Apprenticeship / OJT corresponding to the programme (Major) subject in Exit course with an external organization / entity is desirable. External organization may be industries, research institutions, University research centers or CSIR laboratories. Internship / Apprenticeship / OJT shall be preferably in offline mode, however online mode may also be permitted.

Preferably the Mini Project in Exit course shall be based on Internship / Apprenticeship / OJT.

Activities under Internship / Apprenticeship / OJT include Project work, Seminar, Industrial Training (excluding credits for Advanced Courses). This can be Industrial / Govt. / NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship / academic / industry research project.

After completion of Internship, students shall prepare a comprehensive report highlighting their learnings and takeaways during the internship period. The students are mandated to give a seminar based on the internship undertaken before an expert committee constituted by the concerned department and the assessment of internship shall be based on the following criteria:

1) Quality and effectiveness of presentation
2) Depth of knowledge and demonstrated skills
3) Variety and relevance of learning experience
4) Practical applications and relationships with concepts taught in the course
5) Internship Report
6) Attendance record, student diary (log), supervisor evaluation

Attendance record shall include daily attendance with IN and OUT time. It shall be signed by Industry supervisor.

Student Diary (log) shall include daily activities carried out by the student during Internship with Task assigned, Activities performed, key learnings etc. It shall be signed by Industry supervisor.

Supervisor evaluation form shall include the following with ratings in FIVE-point scale.

1) Behaviours
2) Performs in a dependable manner
3) Cooperates with co-workers and supervisors
4) Shows interest in work
5) Learns quickly

6) Shows initiative
7) Produces high quality work
8) Accepts responsibility
9) Accepts criticism
10) Demonstrates organizational skills
11) Uses technical knowledge and expertise
12) Shows good judgment
13) Demonstrates creativity/originality
14) Analyzes problems effectively
15) Is self-reliant
16) Communicates well
17) Writes effectively
18) Has a professional attitude
19) Gives a professional appearance
20) Is punctual
21) Uses time effectively

Supervisor evaluation form shall be signed by Industry supervisor.

Mini project:

The student shall carry out a Mini project based on the knowledge acquired during the degree course and/or Internship. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the guide / mentor / department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship. The project may also be a sponsored project. The project shall be corresponding to the programme (Major) subject.

Upon completion of the Mini project, the student shall submit project report in the form of hard bound. Assessment for the Mini project shall also include presentation by the student. Assessment of Mini project shall be based on the following criteria:

1) Problem Identification / Project Objectives
2) Methodology / Design
3) Implementation
4) Results and Discussion
5) Conclusion
6) Report
7) Depth of Understanding
8) Presentation
9) Demonstration of the project

****

Honors offered by Artificial Intelligence and Data Science for students of the same Branch of Engineering

In addition to 168 credits of UG Engineering Programmes (Bachelor of Engineering) i.e. Major in which the student has taken admission, a student may opt for Honors in the same Engg. / Tech. discipline / branch / Emerging Areas.

A student is required to study additional 20 credits in the same Engg. / Tech. discipline/ branch / Emerging Areas for Honors distributed over semesters III to VIII.

The total number of credits required for completion of the Honors in the same Engg./ Tech. discipline/ Emerging Areas is 20 credits, in addition to 168 credits in Major.

Students will have to compulsorily choose Honors from the same Engg. / Tech. discipline / branch.

Honors Degree in the Bachelor of Engineering programme shall be awarded to students earning additional total credits of all six semesters from second year to final year, i.e., 20 Credits, in addition to 168 credits or 126 credits respectively. The student admitted in first year must earn 168 credits and 126 credits admitted in lateral entry (admitted after Diploma or B.Sc.) at second year.

Honors offered by Artificial Intelligence and Data Science are as follows.

A. Data Science in Healthcare

B. Visual Computing

C. Business Intelligence

The detail syllabus structure for the same is as follows.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors in
Data Science in Health Care
for
Third Year Bachelor of Engineering in
Artificial Intelligence and Data Science
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE
For Affiliated Colleges
Semester – V
W.E.F. 2026 – 27

Specialization Honors in "Data Science in Health Care"

Syllabus Structure for Specialization Honors in "Data Science in Health Care**": Additional Credit (Semester – V) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-510A	Deep learning for Medical Imaging and Diagnosis	PCC	3			3	40	60			100	3
AIDS-511A	Deep learning for Medical Imaging and Diagnosis Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Data Science in Health Care**": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-612A	AI Driven Drug Discovery and personalized medicine	PCC	3			3	40	60			100	3
AIDS-613A	AI Driven Drug Discovery and personalized medicine Lab	PCC			2	2			25	25 (PR)	50	1

DEEP LEARNING FOR MEDICAL IMAGING AND DIAGNOSIS(PCC)					
Course Title:	**DEEP LEARNING FOR MEDICAL IMAGING AND DIAGNOSIS(PCC)**	**Short Title:**	**DLMID**	**Course Code:**	**AIDS-510A**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

Understand fundamentals of deep learning in healthcare

1. Understand healthcare data and medical imaging systems, including different types of medical data and imaging modalities (X-ray, CT, MRI, Ultrasound, PET).
2. Explore advanced CNN architectures and techniques, such as transfer learning, image classification, segmentation, and detection.
3. Analyze real-world healthcare applications, including disease detection and multimodal learning approaches.
4. Understand ethical, regulatory, and privacy aspects in healthcare AI systems.
5. Develop skills for deploying AI models in healthcare environments using cloud, edge computing, and federated learning.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the types of healthcare data and medical imaging modalities, along with preprocessing techniques and challenges in medical imaging.
2. Apply neural network concepts and optimization techniques (SGD, Adam) to build basic deep learning models.
3. Implement and analyze CNN models for image classification tasks, including handling overfitting using regularization techniques.
4. Evaluate and utilize advanced CNN architectures (LeNet, AlexNet, VGG, ResNet, U-Net) for medical image classification, segmentation, and detection.
5. Analyze healthcare applications of AI, including disease detection, multimodal learning, and explainable AI techniques.

COURSE CONTENT

DEEP LEARNING FOR MEDICAL IMAGING AND DIAGNOSIS(PCC)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE)**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Healthcare data, medical imaging modalities (X-ray, CT, MRI, Ultrasound, PET), preprocessing, challenges, ethics.

Overview of Healthcare Systems and Data ,Types of Medical Data: Structured, Unstructured, Imaging Medical Imaging Modalities: X-ray, CT, MRI, Ultrasound, PET ,Image Acquisition and Preprocessing Challenges in Medical Imaging (noise, artifacts,) ,Ethical and Regulatory Aspects in Healthcare AI

Unit–II:	**No. of Lectures: 09 Hours**	**Marks:12**

Neural networks, backpropagation, optimization (SGD, Adam), CNN basics, regularization. Introduction to Neural Networks ,Perceptron, Activation Functions ,Feedforward and Backpropagation Optimization Techniques (SGD, Adam) ,Introduction to Convolutional Neural Networks (CNNs) Overfitting, Regularization, Dropout		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**
CNN architectures (LeNet, AlexNet, VGG, ResNet), classification, segmentation (U-Net), detection, transfer learning. Introduction to Neural Networks ,Perceptron, Activation Functions ,Feedforward and Back propagation Optimization Techniques (SGD, Adam) ,Introduction to Convolutional Neural Networks (CNNs) Overfitting, Regularization, Dropout		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks:12**
Disease detection, case studies (tumor, lung disease, retinopathy), multimodal learning, explainable AI, evaluation metrics,Case Studies: Tumor Detection ,Lung Disease Classification, Diabetic Retinopathy Detection Multimodal Learning (Image + Clinical Data) Explainable AI in Healthcare , Model Evaluation Metrics: Accuracy, Precision, Recall, F1-score, ROC		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks:12**
Deployment, cloud/edge AI, federated learning, privacy, future trends, mini project. Model Deployment in Healthcare Systems ,Edge AI and Cloud-based Healthcare Solutions Federated Learning in Healthcare ,Data Privacy and Security (HIPAA concepts) ,Future Trends: AI in Personalized Medicine ,AI-assisted Surgery Mini Project / Case Study Discussion		
Text Books:		
1. Deep Learning for Medical Image Analysis – Zhou et al. 2. Deep Learning – Ian Goodfellow, YoshuaBengio, Aaron Courville		
Reference Books: 1. Medical Image Analysis – Atam P. Dhawan 2. Hands-On Machine Learning – AurélienGéron 3. Artificial Intelligence in Healthcare – Adam Bohr		
NPTELLinks: 1. (Medical Image Analysis) By Prof. Ganapathy krishnamurthi IIT Madras https://onlinecourses.nptel.ac.in/noc25_bt61/preview		

DEEP LEARNING FOR MEDICAL IMAGING AND DIAGNOSIS LAB(PCC)					
COURSE OUTLINE					
Course Title:	**DEEP LEARNING FOR MEDICAL IMAGING AND DIAGNOSIS LAB(PCC)**	**Short Title:**	**BPUCL**	**Course Code:**	**AIDS-511A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
DEEP LEARNING FOR MEDICAL IMAGING AND DIAGNOSIS LAB		**Semester:**	VI		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA): CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1: Healthcare Data Exploration Load and analyze medical datasets Perform basic statistics and visualization

2: Medical image classification project
3: Image preprocessing using Python/ OpenCV
4: Neural Network Basics Implement a simple neural network Train on a small dataset
5: Case study implementation
6 CNN model implementation using TensorFlow/PyTorch
7: Transfer Learning with CNN Architectures Use pretrained models
8 Segmentation using U-Net

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

AI DRIVEN DRUG DISCOVERY AND PERSONALIZED MEDICINE (PCC)					
COURSE OUTLINE					
Course Title:	**AI DRIVEN DRUG DISCOVERY AND PERSONALIZED MEDICINE (PCC)**	**Short Title:**	**ADDDPM**	**Course Code:**	**AIDS-612A**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Introduce the fundamentals of drug discovery and highlight the transition from traditional methods to AI-driven approaches.
2. Provide knowledge of biomedical data types and sources such as Drug Bank database and Pub Chem database used in drug discovery.
3. Develop understanding of machine learning techniques including QSAR modelling and feature engineering for molecular data analysis.
4. Familiarize students with deep learning approaches such as Graph Neural Networks and protein structure prediction for molecular modelling.
5. Explain the role of AI in personalized medicine, biomarker discovery, and clinical decision-making systems.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the drug discovery pipeline, compare traditional and AI-based methods, and identify challenges in biomedical data analysis.
2. Analyze different types of biomedical data (genomic, proteomic, clinical, chemical) and utilize databases such as DrugBank database and PubChem database for data retrieval.
3. Apply machine learning techniques including regression, classification, and QSAR modeling for predicting drug activity and evaluating models.
4. Demonstrate the use of deep learning methods such as Graph Neural Networks and neural networks for molecular representation and drug–target interaction prediction.
5. Evaluate AI applications in personalized medicine, including genomics, biomarker discovery, and clinical decision support systems.

COURSE CONTENT

AI DRIVEN DRUG DISCOVERY AND PERSONALIZED MEDICINE		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam(ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Introduction to drug discovery, traditional vs AI methods, biological data types.
Traditional Drug Discovery Process (Target Identification, Validation, Screening) ,Limitations of Conventional Methods ,Role of Artificial Intelligence in Drug Discovery ,Types of Biomedical Data: Genomic, Proteomic, Clinical, Chemical Data ,Data Sources: DrugBank, PubChem, Clinical datasets Challenges in Biomedical Data Analysis

Unit–II:	No. of Lectures: 09 Hours	Marks:12

Machine learning for drug discovery, feature extraction, QSAR models.
Overview of Machine Learning in Healthcare ,Feature Engineering for Molecular Data ,Quantitative Structure–Activity Relationship (QSAR) Models ,Supervised Learning Algorithms: ,Regression, Classification (SVM, Random Forest) ,Model Evaluation Techniques ,Case Study: Drug Activity Prediction

Unit–III:	No. of Lectures: 09 Hours	Marks:12

Deep learning for molecular modeling, graph neural networks, protein structure prediction.
Introduction to Deep Learning in Life Sciences ,Neural Networks for Drug Discovery ,Graph Neural Networks (GNNs) for Molecular Representation ,SMILES Representation and Embedding ,Protein Structure Prediction Concepts ,Drug–Target Interaction Prediction

Unit–IV:	No. of Lectures: 09 Hours	Marks:12

Personalized medicine, genomics, precision healthcare, biomarker discovery.
Introduction to Personalized/Precision Medicine ,Genomics and Biomarker Discovery ,AI in Disease Risk Prediction ,Patient Stratification Techniques ,Clinical Decision Support Systems (CDSS) ,Ethical Issues in Personalized Medicine

Unit–V:	No. of Lectures: 09 Hours	Marks:12

Clinical trials, ethics, regulatory aspects, future trends in AI healthcare.
AI in Clinical Trials and Drug Repurposing ,Regulatory and Ethical Considerations (FDA Guidelines basics) ,Data Privacy and Security in Healthcare ,Explainable AI in Drug Discovery ,Future Trends:
AI for Rare Diseases ,Digital Twins in Healthcare ,Case Studies and Mini Project

Text Books:

1. Deep Learning for the Life Sciences – Bharath Ramsundar et al.
2. Artificial Intelligence in Drug Discovery – Nathan Brown

Reference Books:

1. Bioinformatics and Machine Learning – Jason T. L. Wang
2. Machine Learning in Medicine – Ton J. Cleophas
3. AI for Healthcare – ArjunPanesar

NPTEL Links:

1. (Artificial Intelligence in Drug Discovery and Development) By Prof. Rajnish Kumar IIT (BHU) Varanasi

https://onlinecourses.nptel.ac.in/noc25_ch96/preview

AI DRIVEN DRUG DISCOVERY AND PERSONALIZED MEDICINE LAB(PCC)					
COURSE OUTLINE					
Course Title:	**AI DRIVEN DRUG DISCOVERY ANDPERSONALIZED MEDICINE LAB(PCC)**	**Short Title:**	**ADDDPML**	**Course Code:**	**AIDS-613A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
AI DRIVEN DRUG DISCOVERY AND PERSONALIZED MEDICINE LAB(PCC)		**Semester:**	**VI**		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE):UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA):CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1: Introduction to Drug Discovery Data Explore biological datasets:
2: Drug-target interaction prediction
3: Molecular data preprocessing using Python
4: QSAR model implementation
5:Basic GNN model implementation
6:Case study using real biomedical datasets
7: Graph Neural Networks / Protein Modeling Represent molecules as graphs
8: Personalized Medicine & Evaluation note on ethics, clinical trials, and regulations

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors

in

Visual Computing

for

Third Year Bachelor of Engineering in Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – V & VI

W.E.F. 2026 – 27

Specialization Honors in "Visual Computing"

Syllabus Structure for Specialization Honors in "Visual Computing**": Additional Credit (Semester – V) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-510B	Image Processing and Feature Extraction	PCC	3			3	40	60			100	3
AIDS-511B	Image Processing and Feature Extraction Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Visual Computing**": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-612B	Deep Learning for computer vision	PCC	3			3	40	60			100	3
AIDS-613B	Deep Learning for computer vision Lab	PCC			2	1			25	25 (PR)	50	1

IMAGE PROCESSING AND FEATURE EXTRACTION (PCC)					
Course Title:	**IMAGE PROCESSING AND FEATURE EXTRACTION (PCC)**	**Short Title:**	**IPFE**	**Course Code:**	**AIDS-510B**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand fundamentals of digital image processing.
2. To learn image enhancement and restoration techniques.
3. To analyze image segmentation and representation methods.
4. To extract meaningful features from images.

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain basic concepts of digital image processing.
2. Apply image enhancement and filtering techniques.
3. Perform image segmentation and morphological operations.
4. Extract features using various descriptors.
5. Implement feature extraction techniques for real-world applications.

COURSE CONTENT

IMAGE PROCESSING AND FEATURE EXTRACTION (PCC)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Fundamentals of Digital Image Processing

Introduction to Image Processing , Applications of Image Processing ,Image Formation and Acquisition ,Sampling and Quantization ,Image Representation and Storage

Basic relationships between pixels ,Color Image Fundamentals (RGB, HSV models)

Unit–II:	**No. of Lectures: 09 Hours**	**Marks:12**

Image Enhancement Techniques Spatial Domain Methods ,Point Processing (Brightness, Contrast) ,Histogram Processing (Equalization, Matching) ,Filtering Techniques ,Smoothing Filters (Mean, Gaussian) ,Sharpening Filters (Laplacian, Gradient) ,Frequency Domain Basics ,Fourier Transform ,Low-pass and High-pass filtering		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**
Image Restoration and Morphological Processing Image Degradation Models , Noise Types and Noise Reduction (Median, Wiener Filter) Image Restoration Techniques ,Morphological Operations ,Dilation, Erosion Opening and Closing ,Boundary Extraction		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks:12**
Image Segmentation and Representation Segmentation Techniques, Thres holding ,Edge Detection (Sobel, Canny) Region-Based Segmentation ,Representation Methods ,Boundary Representation Region Representation ,Shape Descriptors		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks:12**
Feature Extraction Techniques Introduction to Feature Extraction ,Types of Features ,Color Features Texture Features (GLCM, LBP) ,Shape Features ,Feature Selection and Dimensionality Reduction (PCA) ,Applications in Computer Vision and AI ,Face Recognition ,Object Detection Medical Image Analysis		
Text Books:		
1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson Education 2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall		
Reference Books		
1. S. Jayaraman, S. Esakkirajan – Digital Image Processing 2. Milan Sonka – Image Processing, Analysis and Machine Vision 3. Pratt William – Digital Image Processing		
NPTEL Links: 1.(Computer Vision And Image Processing - Fundamentals And Applications) By Prof. M. K. Bhuyan IIT Guwahati https://onlinecourses.nptel.ac.in/noc26_ee31/preview		

IMAGE PROCESSING AND FEATURE EXTRACTION LAB (PCC)					
COURSE OUTLINE					
Course Title:	**IMAGE PROCESSING AND FEATURE EXTRACTION LAB (PCC)**	**Short Title:**	**IPFEL**	**Course Code:**	**AIDS-511B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
IMAGE PROCESSING AND FEATURE EXTRACTION LAB		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA): CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. Image acquisition and display using tools (MATLAB/Python OpenCV)
2. Implementation of image sampling and quantization
3. Histogram equalization and contrast enhancement
4. Implementation of smoothing and sharpening filters
5. Noise addition and noise removal techniques
6. Morphological operations (dilation, erosion, opening, closing)
7. Edge detection and segmentation techniques
8. Feature extraction (texture, color, shape) and simple classification

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

DEEP LEARNING FOR COMPUTER VISION (PCC)					
Course Title:	**DEEP LEARNING FOR COMPUTER VISION (PCC)**	**Short Title:**	**DLCV**	**Course Code:**	**AIDS-612B**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3 Hours/Week**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand fundamentals of deep learning in computer vision.
2. To learn convolutional neural networks (CNNs) and architectures.
3. To explore advanced vision models for detection and segmentation.
4. To apply deep learning techniques to real-world vision problems.
5. To gain hands-on experience with deep learning frameworks.

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain deep learning concepts and architectures for vision.
2. Design and implement CNN models.
3. Apply object detection and segmentation techniques.
4. Use transfer learning and pretrained models.
5. Develop real-world computer vision applications.

COURSE CONTENT

DEEP LEARNING FOR COMPUTER VISION (PCC)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 06 Hours**	**Marks:12**

Introduction to Deep Learning and Computer Vision

Introduction to Computer Vision, Basics of Neural Networks, Perceptron, Multilayer Perceptron (MLP),Activation Functions (ReLU, Sigmoid, Tanh),Loss Functions and Optimization (SGD, Adam),Introduction to Deep Learning Frameworks (TensorFlow, PyTorch)

Unit–II:	**No. of Lectures: 09Hours**	**Marks:12**

Convolutional Neural Networks (CNNs) Introduction to CNNs, Convolution Operation and Filters, Padding and Stride, Pooling Layers (Max, Average), CNN Architectures, LeNet, AlexNet ,VGGNet ,Training CNNs (Backpropagation, Regularization, Dropout)		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**
Advanced CNN Architectures Deep Architectures, ResNet, GoogLeNet (Inception) , DenseNet ,Transfer Learning and Fine-Tuning ,Data Augmentation Techniques ,Hyperparameter Tuning 'Model Evaluation Metrics (Accuracy, Precision, Recall, F1-score)		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks:12**
Object Detection and Segmentation Object Detection, R-CNN, Fast R-CNN, Faster R-CNN,YOLO (You Only Look Once),SSD (Single Shot Detector),Image Segmentation, Semantic Segmentation, Instance Segmentation, Segmentation Models, U-Net, Mask R-CNN		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks:12**
Advanced Topics and Applications Feature Extraction using CNNs, Vision Transformers (ViT) – Introduction, Image Captioning and Multimodal Learning, GANs (Generative Adversarial Networks) for Vision Applications: Face Recognition, Autonomous Driving, Medical Imaging, Surveillance Systems		
Text Books:		
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press 2. Adrian Rosebrock, Deep Learning for Computer Vision with Python, PyImage Search		
Reference Books		
1. Richard Szeliski – Computer Vision: Algorithms and Applications 2. Francois Chollet – Deep Learning with Python 3. Dive into Deep Learning – Aston Zhang et al. 4. Simon J.D. Prince – Computer Vision: Models, Learning, and Inference		
NPTEL Links: 1. (Deep Learning for Computer Vision) By Prof. Vineeth N Balasubramanian IIT Hyderabad https://onlinecourses.nptel.ac.in/noc21_cs93/preview		

DEEP LEARNING FOR COMPUTER VISION LAB (PCC)					
COURSE OUTLINE					
Course Title:	**DEEP LEARNING FOR COMPUTER VISION LAB (PCC)**	**Short Title:**	**DLCVL**	**Course Code:**	**AIDS-613B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
DEEP LEARNING FOR COMPUTER VISION LAB		**Semester:**	**VI**		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA): CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. Implementation of basic neural network using Python (NumPy/Keras)
2. Image preprocessing and augmentation techniques
3. Implementation of CNN for image classification (MNIST/CIFAR-10)
4. Experiment with different CNN architectures (LeNet/VGG)
5. Transfer learning using pretrained models (VGG16/ResNet50)
6. Object detection using YOLO or SSD
7. Image segmentation using U-Net
8. Mini project: Real-world application (face mask detection / object recognition)

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors

in

Business Intelligence

for

Third Year Bachelor of Engineering in Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – V & VI

W.E.F. 2026 – 27

Specialization Honors in "Business Intelligent"

Syllabus Structure for Specialization Honors in "Business Intelligent**": Additional Credit (Semester – V) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-510C	Data ware Housing and ETL Process	PCC	3			3	40	60			100	3
AIDS-511C	Data ware Housing and ETL Process Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Business Intelligent**": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-612C	Data Visualization and Dashboard Design	PCC	3			3	40	60			100	3
AIDS-613C	Data Visualization and Dashboard Design Lab	PCC			2	2			25	25 (PR)	100	1

DATA WAREHOUSING AND ETL PROCESS (PCC)					
Course Title:	**DATA WAREHOUSING AND ETL PROCESS (PCC)**	**Short Title:**	**DWEP**	**Course Code:**	**AIDS-510C**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand the fundamentals of data warehousing concepts.
2. To learn dimensional modeling and warehouse design techniques.
3. To understand ETL (Extract, Transform, Load) processes.
4. To explore OLAP operations and tools.
5. To apply data warehousing concepts in real-world decision-making systems.

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain concepts of data warehousing and business intelligence.
2. Design dimensional models using fact and dimension tables.
3. Implement ETL processes for data integration.
4. Analyze data using OLAP operations.
5. Develop data warehouse solutions for business applications.

COURSE CONTENT

DATA WAREHOUSING AND ETL PROCESS (PCC)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Introduction to Data Warehousing

Introduction to Data Warehousing ,OLTP vs OLAP systems ,Characteristics of Data Warehouse Data Warehouse Architecture (3-tier architecture) ,Data Warehouse vs Database Systems Metadata and Data Marts , Introduction to Business Intelligence (BI)

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Dimensional Modeling

Fact Tables and Dimension Tables, Star Schema, Snowflake Schema, Fact Constellation, Dimension Types (Slowly Changing Dimensions – SCD Type 1, 2, 3) ,Granularity of Data, Surrogate Keys Schema Design and Case Studies

Unit–III:	**No. of Lectures:09 Hours**	**Marks:12**

ETL Process
Introduction to ETL , Data Extraction Techniques (Structured, Semi-structured, Unstructured)
Data Transformation ,Data Cleaning ,Data Integration ,Data Reduction ,Data Discretization
Data Loading Strategies (Full Load, Incremental Load) ,ETL Tools Overview (Informatical , Talend, Pentaho)

Unit–IV:	**No. of Lectures:09 Hours**	**Marks:12**

OLAP and Data Analysis
OLAP Concepts ,OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot) ,ROLAP, MOLAP, HOLAP ,Cube Design ,Query Processing in OLAP ,Introduction to Data Mining in Data Warehouse

Unit–V:	**No. of Lectures:09 Hours**	**Marks:12**

Data Warehouse Implementation and Applications
Data Warehouse Design Methodology , Performance Tuning and Optimization, Data Quality and Governance, Security Issues in Data Warehouse, Real-world Applications, Banking ,Retail Healthcare, Introduction to Cloud Data Warehousing (AWS Redshift, Google Big Query)

Text Books:

1. Ralph Kimball & Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley
2. Sam Anahory & Dennis Murray, Data Warehousing in the Real World, Pearson Education

Reference Books

1. W.H. Inmon – Building the Data Warehouse
2. Paulraj Ponniah – Data Warehousing Fundamentals
3. Pieter Adriaans – Data Mining Techniques
4. Jiawei Han & Micheline Kamber – Data Mining: Concepts and Techniques

NPTEL Links:
1.(Introduction to Data Warehousing and Data Mining) By Dr. Vaibhav Panwar

https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg200

s

DATA WAREHOUSING AND ETL PROCESS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**DATA WAREHOUSING AND ETL PROCESS LAB (PCC)**	**Short Title:**	**DWEPL**	**Course Code:**	**AIDS-511C**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
DATA WAREHOUSING AND ETL PROCESS LAB		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA): CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. Study of OLTP vs OLAP systems using sample datasets
2. Design a Star Schema for a retail database
3. Design a Snowflake Schema for a real-world scenario
4. Implementation of Slowly Changing Dimensions (SCD Type 1 & 2)
5. ETL process using Python (data extraction and transformation)
6. Data cleaning and preprocessing using Pandas
7. Perform OLAP operations (roll-up, drill-down) using SQL
8. Mini project: Build a simple data warehouse and ETL pipeline

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

DATA VISUALIZATION AND DASHBOARD DESIGN(PCC)					
Course Title:	**DATA VISUALIZATION AND DASHBOARD DESIGN(PCC)**	**Short Title:**	**DVDD**	**Course Code:**	**AIDS-612C**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3 Hours/Week**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand principles of data visualization and storytelling.
2. To learn various visualization techniques and tools.
3. To design interactive dashboards for decision-making.
4. To analyze and present data effectively.
5. To apply visualization techniques in real-world scenarios.

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain principles of effective data visualization.
2. Create different types of charts and graphs.
3. Design interactive dashboards using modern tools.
4. Apply storytelling techniques to present insights.
5. Develop real-world visualization solutions for business analytics.

COURSE CONTENT

DATA VISUALIZATION AND DASHBOARD DESIGN(PCC)		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Fundamentals of Data Visualization

Introduction to Data Visualization, Importance of Visualization in Data Analytics
Data Types (Categorical, Numerical, Temporal, Spatial), Principles of Visual Perception
Data Visualization Process, Introduction to Tools (Tableau, Power BI, Matplotlib)

Unit–II:	**No. of Lectures: 09 Hours**	**Marks:12**

Visualization Techniques

Basic Charts, Bar Chart, Line Chart, Pie Chart , Histogram, Scatter Plot , Advanced Visualizations
Heat maps , Box Plots ,Tree Maps ,Choosing the Right Visualization ,Data Encoding and Aesthetics
Color Theory and Design Principles

Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**

Dashboard Design Principles

Introduction to Dashboards, Types of Dashboards (Operational, Analytical, Strategic)
Dashboard Design Best Practices, Layout and User Interface Design, Interactivity (Filters, Drill-downs, Slicers), KPI Design and Visualization

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks:12**
Tools and Technologies Tableau Fundamentals, Power BI Fundamentals, Data Preparation for Visualization Creating Interactive Dashboards, Publishing and Sharing Dashboards, Integration with Data Sources (SQL, Excel, APIs)		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks:12**
Advanced Topics and Applications Data Storytelling Techniques, Real-time Data Visualization, Big Data Visualization Challenges Ethical Issues in Data Visualization, Case Studies: Business Intelligence Dashboards Healthcare Analytics ,Financial Data Visualization		
Text Books:		
1. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley 2. Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly		
Reference Books		
1. Edward R. Tufte – The Visual Display of Quantitative Information 2. Stephen Few – Information Dashboard Design 3. Andy Kirk – Data Visualization: A Handbook for Data Driven Design 4. Alberto Cairo – The Functional Art		
NPTEL Links: 1. (Introduction to Statistics), IIT Hyderabad Prof. Sameen Naqvi https://onlinecourses.swayam2.ac.in/e-learning/preview		

DATA VISUALIZATION AND DASHBOARD DESIGN LAB(PCC)					
COURSE OUTLINE					
Course Title:	**DATA VISUALIZATION AND DASHBOARD DESIGN LAB(PCC)**	**Short Title:**	**DVDDL**	**Course Code:**	**AIDS-613C**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
DATA WAREHOUSING AND ETL PROCESS LAB		**Semester:**	**VI**		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA): CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. Create basic visualizations (bar, line, pie charts) using Excel/ Matplotlib
2. Visualization of datasets using scatter plots and histograms
3. Design advanced visualizations (heat maps, box plots)
4. Data cleaning and preparation for visualization
5. Build interactive dashboards using Tableau
6. Create dashboards using Power BI (filters, slicers, KPIs)
7. Connect dashboards to real-time or live datasets
8. Mini project: Design a complete dashboard for a business problem

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

Specialization Minor offered by Artificial Intelligence and Data Science for students of other Branch of Engineering

In addition to 168 credits of UG Engineering Programmes (Bachelor of Engineering) i.e. Major in which the student has taken admission, a student may opt for Specialization Minor in another Engg. / Tech. discipline / branch / Emerging Areas, not in Major Engg. / Tech. discipline / branch.

A student is required to study additional 20 credits in another Engg. / Tech. discipline/ branch / Emerging Areas for Specialization Minor distributed over semesters III to VIII.

The total number of credits required for completion of the Specialization Minor in another Engg./ Tech. discipline/ Emerging Areas is 20 credits, in addition to 168 credits in Major.

Students will have to compulsorily choose Specialization Minor from other Engg. / Tech. discipline / branch, not from Major Engg. / Tech. discipline / branch.

Specialized Minor Degree in the Bachelor of Engineering programme shall be awarded to students earning additional total credits of all six semesters from second year to final year, i.e., 20 Credits, in addition to 168 credits or 126 credits respectively. The student admitted in first year must earn 168 credits and 126 credits admitted in lateral entry (admitted after Diploma or B.Sc.) at second year.

Specialization Minors offered by Artificial Intelligence and Data Science are as follows.

A. Health Informatics
B. Business Data Analytics
C. Cyber Security

The detail syllabus structure for the same is as follows.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA
UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Minors
in
Health Informatics
for
Third Year Bachelor of Engineering
offered by
Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE
For Affiliated Colleges
Semester – V &VI
W.E.F. 2026 – 27

Specialization Minor in "Health Informatics"

Syllabus Structure for Specialization Minor in "Health Informatics**": Additional Credit (Semester – V) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-512A	AI & Data Analytics in Healthcare	PCC	3			3	40	60			100	3
AIDS-513A	AI & Data Analytics in Healthcare Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Minor in "Health Informatics**": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-614A	Telemedicine & IoT in Healthcare	PCC	3			3	40	60			100	3
AIDS-615A	Telemedicine & IoT in Healthcare Lab	PCC			2	2			25	25 (PR)	50	1

AI & DATA ANALYTICS IN HEALTHCARE (PCC)					
Course Title:	**AI & DATA ANALYTICS IN HEALTHCARE (PCC)**	**Short Title:**	**ADAH**	**Course Code:**	**AIDS-512A**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand the role of AI and data analytics in healthcare.
2. To learn healthcare data types and data management techniques.
3. To apply machine learning models for healthcare applications.
4. To explore clinical decision support systems.
5. To understand ethical, legal, and privacy issues in healthcare analytics.

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain healthcare data and analytics concepts.
2. Apply machine learning techniques to healthcare datasets.
3. Analyze medical data for prediction and diagnosis.
4. Design AI-based healthcare solutions.
5. Understand ethical and legal challenges in healthcare AI.

COURSE CONTENT

AI & Data Analytics in Healthcare (PCC)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures:09 Hours**	**Marks:12**

Introduction to Healthcare Analytics

Overview of Healthcare Systems ,Role of AI in Healthcare ,Types of Healthcare Data Electronic Health Records (EHR) ,Medical Imaging ,Clinical Data ,Data Sources and Standards (HL7, FHIR) ,Challenges in Healthcare Data

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Data Preprocessing and Management

Data Cleaning and Integration ,Handling Missing Data, Data Transformation and Normalization Feature Engineering in Healthcare Data , Data Warehousing in Healthcare , Introduction to Big Data in Healthcare

Unit–III:	**No. of Lectures:09 Hours**	**Marks:12**

Machine Learning in Healthcare

Supervised Learning, Classification (Disease Prediction),Regression (Risk Prediction) ,Unsupervised Learning ,Clustering (Patient Segmentation) ,Model Evaluation (Accuracy, ROC, AUC) ,Case Studies: Diabetes Prediction, Heart Disease Prediction

Unit–IV:	**No. of Lectures:09 Hours**	**Marks:12**
Deep Learning and Medical Imaging Introduction to Deep Learning in Healthcare, CNNs for Medical Image Analysis , Applications: Tumor Detection, X-ray Analysis, MRI/CT Scan Processing, Natural Language Processing in Healthcare (Clinical Notes Analysis)		
Unit–V:	**No. of Lectures:09 Hours**	**Marks:12**
Applications, Ethics and Future Trends Clinical Decision Support Systems (CDSS) ,Predictive Analytics in Healthcare, Telemedicine and Remote Monitoring, Ethical, Legal, and Privacy Issues (HIPAA basics) ‘ Explainable AI (XAI) in Healthcare ‘Future Trends (AI-driven personalized medicine)		
Text Books:		
1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press 2. Sergios Theodoridis, Machine Learning: A Bayesian and Optimization Perspective, Academic Press		
Reference Books		
1. Mihaela van der Schaar et al. – Machine Learning for Healthcare 2. Arjun Panesar – Machine Learning and AI for Healthcare 3. Deepak Gupta – Artificial Intelligence for Healthcare Applications 4. Tom Mitchell – Machine Learning		
NPTEL Links: 1. Exploring Survey Data on Health Care) By Prof. Pratap C. Mohanty IIT Roorkee https://onlinecourses.nptel.ac.in/noc22_hs40/preview		

AI & DATA ANALYTICS IN HEALTHCARE LAB (PCC)					
COURSE OUTLINE					
Course Title:	**AI & DATA ANALYTICS IN HEALTHCARE LAB (PCC)**	**Short Title:**	**ADAHL**	**Course Code:**	**AIDS-513A**

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**15**	**30**	**1**

Prerequisite course(s):

Fundamentals of Deep Learning for Medical Imaging and Diagnosis

COURSE CONTENT

AI & Data Analytics in Healthcare (PCC)LAB		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**	**25 marks**
		Internal Continuous Assessment (ICA): CA	**25 marks**

Concerned faculty member should suitably frame at least **SIX** Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. Exploration of healthcare datasets (EHR/CSV datasets)
2. Data preprocessing (handling missing values, normalization)
3. Feature engineering and visualization of healthcare data
4. Classification model for disease prediction (Logistic Regression / Decision Tree)
5. Clustering for patient segmentation (K-Means)
6. Model evaluation using confusion matrix, ROC curve
7. Basic deep learning model for medical image classification (CNN)
8. Mini project: Healthcare analytics system (disease prediction / patient risk analysis)

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

TELEMEDICINE & IOT IN HEALTHCARE (PCC)					
Course Title:	**TELEMEDICINE & IOT IN HEALTHCARE (PCC)**	**Short Title:**	**TIH**	**Course Code:**	**AIDS-614A**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3 Hours/Week**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand concepts of telemedicine and IoT in healthcare.
2. To learn architecture and components of IoT-based healthcare systems.
3. To explore remote patient monitoring and smart healthcare solutions.
4. To analyze data collected from IoT devices.

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain telemedicine concepts and healthcare IoT systems.
2. Design IoT-based healthcare applications.
3. Analyze data from wearable and medical devices.
4. Implement remote monitoring systems

COURSE CONTENT

TELEMEDICINE & IOT IN HEALTHCARE (PCC)		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Introduction to Telemedicine and IoT

Introduction to Telemedicine, Evolution and Scope of Telemedicine, Types of Telemedicine (Synchronous, Asynchronous, Remote Monitoring), Introduction to Internet of Things (IoT) IoT Architecture (Sensors, Devices, Gateways, Cloud), Applications of IoT in Healthcare

Unit–II:	**No. of Lectures: 09 Hours**	**Marks:12**

IoT Technologies for Healthcare

Sensors and Actuators in Healthcare , Wearable Devices and Smart Medical Devices Communication Protocols (Bluetooth, ZigBee, Wi-Fi, MQTT) ,Embedded Systems for Healthcare Cloud Computing for IoT Healthcare Systems

Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**

Remote Patient Monitoring Systems
Design of Remote Monitoring Systems, Vital Sign Monitoring (Heart Rate, Temperature, Blood Pressure), Data Acquisition and Transmission ,Real-Time Data Processing ,Alert Systems and Decision Support

Unit–IV:	**No. of Lectures: 09 Hours:**	**Marks:12**

Data Analytics and Integration
Data Collection and Storage in Healthcare IoT ,Data Analytics for Health Monitoring ,Integration with Electronic Health Records (EHR), Visualization of Healthcare Data ,AI Integration in Telemedicine Systems,

Unit–V:	**No. of Lectures: 09 Hours**	**Marks:12**

Security, Privacy and Applications
Security Challenges in IoT Healthcare, Data Privacy and Regulations, Authentication and Encryption Techniques, Ethical Issues in Telemedicine, Case Studies:
Smart Hospitals, Teleconsultation Systems, Remote Surgery (Overview)

Text Books:

1. Pethuru Raj & Anupama C. Raman,The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press
2. Arshdeep Bahga & Vijay Madisetti,Internet of Things: A Hands-On Approach, Universities Press

Reference Books

1. Jude Hemanth – Internet of Medical Things (IoMT)
2. Niranjan Dey – Smart Healthcare Systems using IoT
3. Robert Istepanian – M-Health: Emerging Mobile Health Systems
4. S. Mukherjee – Introduction to Telemedicine Technology

NPTELLinks:
1. (Introduction To Internet Of Things) By Prof. Sudip Misra | IIT Kharagpur
https://onlinecourses.nptel.ac.in/noc22_cs53/preview

s

TELEMEDICINE & IOT IN HEALTHCARE LAB (PCC)							
COURSE OUTLINE							
Course Title:	**TELEMEDICINE & IOT IN HEALTHCARE LAB (PCC)**			**Short Title:**	**TIHL`**	**Course Code:**	**AIDS-615 A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**		
	02	**15**	**30**		**1**		
Prerequisite course(s):							
Fundamentals of Deep Learning for Medical Imaging and Diagnosis							
COURSE CONTENT							
TELEMEDICINE & IOT IN HEALTHCARE (PCC)LAB			**Semester:**		**VI**		
Teaching Scheme:			**Examination scheme**				
Practical:	**2 hours/week**		**End semester exam (ESE): UA PR**				**25 marks**
			Internal Continuous Assessment (ICA): CA				**25 marks**

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

1. Introduction to IoT platforms (Arduino/Raspberry Pi simulation)
2. Interface basic sensors (temperature/heart rate) with microcontroller
3. Data acquisition and transmission using IoT protocols (MQTT/HTTP)
4. Develop a simple remote monitoring system
5. Cloud integration for IoT healthcare data (Thing Speak/AWS)
6. Data visualization of healthcare sensor data
7. Implement alert system for abnormal health parameters
8. Mini project: IoT-based healthcare monitoring system

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Minors

in

Business Data Analytics

for

Third Year Bachelor of Engineering

offered by

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – V & VI

W.E.F. 2026 – 27

Specialization Minor in "Business Data Analytics"

Syllabus Structure for Minor in Business Data Analytics**: Additional Credit (Semester – V) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -512B	Data Warehousing & ETL Processes	PCC	3			3	40	60			100	3
AIDS -513B	Data Warehousing & ETL Processes Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Minor in Business Data Analytics**: Additional Credit (Semester – VI) (w.e.f. 2026 – 27)**

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -614B	Predictive Analytics & ML for Business	PCC	3			3	40	60			100	3
AIDS -615B	Predictive Analytics & ML for Business Lab	PCC			2	2			25	25 (OR)	50	1

DATA WAREHOUSING AND ETL PROCESS (PCC)					
Course Title:	**DATA WAREHOUSING AND ETL PROCESS (PCC)**	**Short Title:**	**DWEP**	**Course Code:**	**AIDS-512B**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

6. To understand the fundamentals of data warehousing concepts.
7. To learn dimensional modeling and warehouse design techniques.
8. To understand ETL (Extract, Transform, Load) processes.
9. To explore OLAP operations and tools.
10. To apply data warehousing concepts in real-world decision-making systems.

Course Outcomes (COs)

After completion of this course, students will be able to:

6. Explain concepts of data warehousing and business intelligence.
7. Design dimensional models using fact and dimension tables.
8. Implement ETL processes for data integration.
9. Analyze data using OLAP operations.
10. Develop data warehouse solutions for business applications.

COURSE CONTENT

DATA WAREHOUSING AND ETL PROCESS (PCC)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**

Introduction to Data Warehousing

Introduction to Data Warehousing ,OLTP vs OLAP systems ,Characteristics of Data Warehouse Data Warehouse Architecture (3-tier architecture) ,Data Warehouse vs Database Systems Metadata and Data Marts , Introduction to Business Intelligence (BI)

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Dimensional Modeling

Fact Tables and Dimension Tables, Star Schema, Snowflake Schema, Fact Constellation, Dimension Types (Slowly Changing Dimensions – SCD Type 1, 2, 3) ,Granularity of Data, Surrogate Keys Schema Design and Case Studies

Unit–III:	**No. of Lectures:09 Hours**	**Marks:12**

ETL Process

Introduction to ETL , Data Extraction Techniques (Structured, Semi-structured, Unstructured)
Data Transformation ,Data Cleaning ,Data Integration ,Data Reduction ,Data Discretization
Data Loading Strategies (Full Load, Incremental Load) ,ETL Tools Overview (Informatica, Talend, Pentaho)

Unit–IV:	**No. of Lectures:09 Hours**	**Marks:12**

OLAP and Data Analysis

OLAP Concepts ,OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot) ,ROLAP, MOLAP, HOLAP ,Cube Design ,Query Processing in OLAP ,Introduction to Data Mining in Data Warehouse

Unit–V:	**No. of Lectures:09 Hours**	**Marks:12**

Data Warehouse Implementation and Applications

Data Warehouse Design Methodology , Performance Tuning and Optimization, Data Quality and Governance, Security Issues in Data Warehouse, Real-world Applications, Banking ,Retail Healthcare, Introduction to Cloud Data Warehousing (AWS Redshift, Google Big Query)

Text Books:

3. Ralph Kimball & Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley
4. Sam Anahory & Dennis Murray, Data Warehousing in the Real World, Pearson Education

Reference Books

5. W.H. Inmon – Building the Data Warehouse
6. Paulraj Ponniah – Data Warehousing Fundamentals
7. Pieter Adriaans – Data Mining Techniques
8. Jiawei Han & Micheline Kamber – Data Mining: Concepts and Techniques

NPTEL Links:

1.(Introduction to Data Warehousing and Data Mining) By Dr. Vaibhav Panwar

https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg200

DATA WAREHOUSING AND ETL PROCESS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**DATA WAREHOUSING AND ETL PROCESS LAB (PCC)**	**Short Title:**	**DWEPL**	**Course Code:**	**AIDS-513B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Deep Learning for Medical Imaging and Diagnosis					
COURSE CONTENT					
DATA WAREHOUSING AND ETL PROCESS LAB		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**		**25 marks**	
		Internal Continuous Assessment (ICA): CA		**25 marks**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

9. Study of OLTP vs OLAP systems using sample datasets
10. Design a Star Schema for a retail database
11. Design a Snowflake Schema for a real-world scenario
12. Implementation of Slowly Changing Dimensions (SCD Type 1 & 2)
13. ETL process using Python (data extraction and transformation)
14. Data cleaning and preprocessing using Pandas
15. Perform OLAP operations (roll-up, drill-down) using SQL
16. Mini project: Build a simple data warehouse and ETL pipeline

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

PREDICTIVE ANALYTICS & ML FOR BUSINESS (PCC)					
Course Title:	**PREDICTIVE ANALYTICS & ML FOR BUSINESS (PCC)**	**Short Title:**	**PAMB**	**Course Code:**	**AIDS-614B**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

1. To understand predictive analytics and its role in business decision-making.
2. To learn machine learning techniques for business applications.
3. To analyze business data for forecasting and prediction.
4. To build predictive models using real-world datasets.
5. To interpret and communicate analytical results effectively

Course Outcomes (COs)

After completion of this course, students will be able to:

1. Explain predictive analytics concepts in business contexts.
2. Apply machine learning algorithms to business problems.
3. Build and evaluate predictive models.
4. Interpret results for business decision-making.
5. Develop end-to-end analytics solutions.

COURSE CONTENT

PREDICTIVE ANALYTICS & ML FOR BUSINESS (PCC)		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures:08 Hours**	**12 marks**

Introduction to Predictive Analytics

Introduction to Business Analytics ,Types of Analytics (Descriptive, Diagnostic, Predictive, Prescriptive) ,Predictive Analytics Process (CRISP-DM) ,Data Types and Sources in Business Data Preprocessing and Cleaning ,Introduction to Tools (Python, R, Excel)

Unit–II:	**No. of Lectures:09 Hours**	**12 marks**

Data Exploration and Feature Engineering

Exploratory Data Analysis (EDA) ,Data Visualization Techniques ,Feature Selection and Feature Engineering ,Handling Missing Values and Outliers , Data Transformation and Scaling, Dimensionality Reduction (PCA)

Unit–III:	**No. of Lectures:09 Hours**	**12 marks**

Machine Learning for Prediction

Supervised Learning, Regression (Linear, Multiple Regression) ,Classification (Logistic Regression, Decision Trees, k-NN) , Model Evaluation , Confusion Matrix , Accuracy, Precision, Recall, F1-score , ROC-AUC

Unit–IV:	**No. of Lectures:09 Hours**	**12 marks**
Advanced Predictive Models Ensemble Methods, Random Forest, Gradient Boosting, Time Series Forecasting Trend and Seasonality, ARIMA (Introduction) , Model Tuning and Cross-Validation Overfitting and Regularization		
Unit–V:	**No. of Lectures:09 Hours**	**12 marks**
Business Applications and Deployment Applications in Business : Sales Forecasting, Customer Segmentation , Churn Prediction Fraud Detection, Model Deployment Basics ,Dash boarding and Reporting Ethical Issues in Business Analytics ,Case Studies		
Text Books:		
1. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie or Die, Wiley 2. Tom Mitchell, Machine Learning, McGraw-Hil		
Reference Books		
1. Jiawei Han & Micheline Kamber – Data Mining: Concepts and Techniques 2. Gareth James et al. – An Introduction to Statistical Learning 3. Trevor Hastie et al. – The Elements of Statistical Learning 4. Foster Provost & Tom Fawcett – Data Science for Business		
NPTEL Links: 1.(Predictive Analytics - Regression and Classification) By Prof. Sourish Das https://onlinecourses.nptel.ac.in/noc23_ma46/preview		

PREDICTIVE ANALYTICS & ML FOR BUSINESS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**PREDICTIVE ANALYTICS & ML FOR BUSINESS LAB (PCC)**	**Short Title:**	**PAMBL**	**Course Code:**	**AIDS-615 B**

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**15**	**30**	**1**

Prerequisite course(s):

COURSE CONTENT			
PREDICTIVE ANALYTICS & ML FOR BUSINESS LAB (PCC)		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**	**25 marks**
		Internal Continuous Assessment (ICA): CA	**25 marks**

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

Laboratory Assignments

1. Data preprocessing and cleaning using Python (Pandas)
2. Exploratory Data Analysis and visualization
3. Implementation of regression models (Linear Regression)
4. Classification models (Logistic Regression, Decision Tree)
5. Model evaluation using confusion matrix and ROC curve
6. Implementation of ensemble methods (Random Forest)
7. Time series forecasting (basic ARIMA model)
8. Mini project: Business predictive model (churn prediction/sales forecasting)

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on practical, paper work and performance in the ESE

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering Minors

in

Cyber Security

for

Third Year Bachelor of Engineering

offered by

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – V & VI

W.E.F. 2026 – 27

Specialization Minor in "Cyber Security"

Syllabus Structure for Specialization Minor in "Cyber Security": Additional Credit (Semester – V) (w.e.f. 2026 – 27)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-512C	Steganography and Digital Watermarking	PCC	3				40	60			100	3
AIDS-513C	Steganography and Digital Watermarking Lab	PCC			2	5			25	25 (PR)	50	1

Syllabus Structure for Specialization Minor in "Cyber Security": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS-614C	Security Assessment and Risk Analysis	PCC	3			3	40	60			100	3
AIDS-615C	Security Assessment and Risk Analysis Lab	PCC			2	2			25	25 (PR)	50	1

STEGANOGRAPHY AND DIGITAL WATERMARKING (PCC)					
COURSE OUTLINE					
Course Title:	**STEGANOGRAPHY AND DIGITAL WATERMARKING (PCC)**	**Short Title:**	**SDW**	**Course Code:**	**AIDS-512C**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To understand the fundamental concepts, principles, and importance of steganography and digital watermarking in multimedia security.
2. To study various information hiding techniques used for secure data embedding in images, audio, video, and text.
3. To analyze different watermarking and steganographic algorithms with respect to security, robustness, and capacity.
4. To examine attacks, vulnerabilities, and countermeasures in multimedia information hiding systems.
5. To explore real-world applications and emerging trends in steganography, watermarking, and

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the basic principles and techniques of steganography and digital watermarking.
2. Apply different data hiding and watermarking techniques to multimedia data.
3. Analyse and design secure multimedia information hiding systems.
4. Evaluate the robustness, security, and performance of steganography and watermarking methods.
5. Investigate advanced research trends and real-world applications in multimedia security and information hiding.

COURSE CONTENT

		Semester:	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**02 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	No. of Lectures:09 Hours	Marks:12

Introduction to Information Hiding

Overview of Information Security ,Information Hiding vs Cryptography vs Steganography Steganography Principles and Models ,Characteristics: Imperceptibility, Capacity, Robustness Applications of Steganography and Watermarking

Unit–II:	No. of Lectures: 09 Hours	Marks:12

Image Steganography Techniques

Spatial Domain Techniques (LSB Method) ,Transform Domain Techniques (DCT, DWT) Steganography Algorithms and Tools ,Image Formats and Their Impact ,Performance Metrics (PSNR, MSE)

Unit–III:	No. of Lectures: 09 Hours	Marks:12

Audio and Video Steganography

Audio Steganography Techniques ,Video Steganography Methods ,Compression Effects (MP3, MPEG) , Real-time Steganography Systems ,Case Studies

Unit–IV:	No. of Lectures: 09 Hours	Marks:12

Digital Watermarking

Fundamentals of Digital Watermarking ,Types: Visible, Invisible, Robust, Fragile Watermark Embedding and Extraction ,Applications: Copyright Protection, Ownership Verification, Watermarking in Images, Audio, and Video

Unit–V:	No. of Lectures: 09 Hours	Marks:12

Security, Attacks, and Advanced Topics

Steganalysis Techniques ,Attacks on Steganography and Watermarking ,Robustness and Security Evaluation ,Legal and Ethical Issues ,Emerging Trends and Research Directions

Text Books:

1. Digital Image Steganography and Watermarking – Amine Bouchentouf, Digital Image Steganography and Watermarking, Wiley.
2. Information Hiding Techniques for Steganography and Digital Watermarking – Stefan Katzenbeisser& Fabien Petitcolas, Artech House.
3. Digital Watermarking and Steganography – Ingemar Cox et al., Morgan Kaufmann.

Reference Books:

1. Multimedia Security – Borko Furht& Darko Kirovski, CRC Press.
2. Handbook of Image and Video Processing – Alan Bovik, Academic Press.
3. Network Security Essentials – William Stallings, Pearson.

NPTEL Links:

1. Neural Networks and Application IIT Kharagpur Prof. Somnath Sengupta
nptel.ac.in/courses/117105084

STEGANOGRAPHY AND DIGITAL WATERMARKING LAB (PCC)					
COURSE OUTLINE					
Course Title:	**STEGANOGRAPHY AND DIGITAL WATERMARKING LAB (PCC)**	**Short Title:**	**SDWL**	**Course Code:**	**AIDS-513C**

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	**2**	**15**	**30**	**1**

COURSE CONTENT			
		Semester:	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Sessional Exam (ISE) CA:PR	**25marks**

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. Implementation of LSB Image Steganography
2. Image Steganography using DCT/DWT
3. Audio Steganography Techniques
4. Video Steganography Demonstration
5. Watermark Embedding and Extraction
6. Performance Evaluation using PSNR/MSE
7. Steganalysis Tools Study
8. Mini Project on Multimedia Security

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on Practical, paper work and performance in the ESE

SECURITY ASSESSMENT AND RISK ANALYSIS(PCC)					
COURSEOUTLINE					
Course Title:	**SECURITY ASSESSMENT AND RISK ANALYSIS(PCC)**	**Short Title:**	**SARA**	**Course Code:**	**AIDS-614C**

Course description:

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**3**	**15**	**45**	**3**

Prerequisite course(s):

Course Objectives:

The objective of this course is to:

1. To understand fundamental concepts of security assessment including CIA triad, threats, vulnerabilities, and risk.
2. To learn risk analysis and risk management techniques used in information security.
3. To study various security assessment techniques such as vulnerability assessment, penetration testing, and security auditing.
4. To analyze network and system security assessment methods including intrusion detection and log analysis.
5. To explore advanced security assessment topics such as cloud security, compliance standards, and incident response through real-world case studies.

Course Outcomes:

After successful completion of this course the student will be able to:

1. Explain basic security concepts, threats, vulnerabilities, and risk assessment principles.
2. Apply risk analysis and risk mitigation strategies in security management.
3. Perform vulnerability assessment, penetration testing, and security auditing using appropriate tools and methodologies.
4. Analyze network and system security issues and implement system hardening and monitoring techniques.
5. Evaluate cloud security, compliance standards, and incident response strategies using real-world case studies.

COURSECONTENT

SECURITY ASSESSMENT AND RISK ANALYSIS		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No. of Lectures:09 Hours**	**Marks:12**

Introduction to Security Assessment

Security concepts, CIA triad, threats, vulnerabilities, risk, security policies and standards.

Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**

Risk Analysis and Management

Risk assessment process, qualitative and quantitative analysis, risk mitigation strategies.

Unit–III:	No. of Lectures:09 Hours	Marks:12
Security Assessment Techniques Vulnerability assessment, penetration testing, security auditing, tools and methodologies.		
Unit–IV:	**No. of Lectures:09 Hours**	**Marks:12**
Network and System Security Assessment Network vulnerabilities, system hardening, intrusion detection, log analysis.		
Unit–V:	**No. of Lectures:09 Hours**	**Marks:12**
Advanced Topics and Case Studies Cloud security assessment, compliance standards, incident response, real-world case studies.		
Text Books:		
1. Mike Chapple, James Stewart, Darril Gibson, CISSP Official Study Guide, Wiley. 2. Nina Godbole, Information Systems Security, Wiley.		
ReferenceBooks: 1. Ross Anderson, Security Engineering, Wiley. 2. Charles P. P fleeger, Security in Computing, Prentice Hall. 3. William Stallings, Network Security Essentials, Pearson.		
NPTEL Links: 1.(Safety and Risk Analytics) By Prof. Jhareswar Maiti | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_mg55/preview		

SECURITY ASSESSMENT AND RISK ANALYSIS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**SECURITY ASSESSMENT AND RISK ANALYSIS LAB (PCC)**	**Short Title:**	**SARAL**	**Course Code:**	**AIDS-615C**
Course description:					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	**2 Hours/Week**	**15**	**30**	**1**

Prerequisite course(s):			
Course objectives:			
COURSE CONTENT			
		Semester:	**VI**
Teaching Scheme:		**Examination scheme**	
Practical	**2 hours/week**		
		End Semester Examination (ESE) UA:PR	**25 marks**
		Internal Continuous Assessment (ICA):CA	**25marks**
	No. of Experiments:08	**Marks:12**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference

1. **Introduction to Information Security Tools**
   Study of security concepts: CIA triad, threats, vulnerabilities, Installation of tools (Kali Linux / Virtual Machine setup), Familiarization with tools like Nmap, Wireshark
2. **Network Scanning using Nmap**
   Perform host discovery, Port scanning techniques (TCP, SYN, UDP), Service and OS detection
3. **Packet Analysis using Wireshark**
   Capture network traffic, Analyze protocols (HTTP, TCP/IP, DNS) ,Identify suspicious packets
4. **Vulnerability Scanning**
   Scan systems using vulnerability scanners, identify common vulnerabilities (CVEs), Generate scan reports
5. **Password Cracking Techniques**
   Dictionary and brute-force attacks ,Password strength evaluation ,Hash cracking basics
6. **Web Application Security Testing**
   Identify vulnerabilities like SQL Injection, XSS ,Perform basic web penetration testing
7. **Risk Assessment and Analysis**
   Identify assets, threats, and vulnerabilities ,Risk calculation (qualitative and quantitative methods) ,Risk mitigation strategies