



Shirpur Education Society's

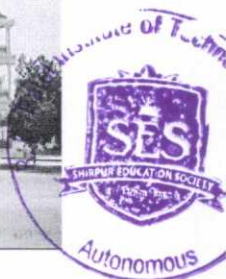
R. C. Patel Institute of Technology, Shirpur
(An Autonomous Institute)

Course Structure and Syllabus

Final Year B. Tech

Artificial Intelligence and Machine Learning

With effect from Year 2025-26



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Final Year B. Tech Artificial Intelligence and Machine Learning Semester-VII (w.e.f. 2025-26)

Sr	Course Category	Course Code	Course Title	Teaching Scheme		Evaluation Scheme					Total	Credit	
				L	T	P	Continuous Assessment (CA)			ESE			
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)		Average of (TT1 & TT2)		
1	PC	22PCAI7010T	High Performance Computing	3			[A]			[B]	[C]	[A+B+C]	
	PC	22PCAI7010L	High Performance Computing Laboratory				25	10	10	10	65	100	3
	PC	22PCAI7020T	Large Language Models	3		2	25				25	50	1
2	PC	22PCAI7020T	Large Language Models	3			25	10	10	10	65	100	3
	PC	22PCAI7020L	Large Language Models Laboratory			2	25				25	50	1
3	PC	22PCAI7030T	Big Data Analytics	2			25	10	10	10	65	100	2
	PC	22PCAI7030L	Big Data Analytics Laboratory			2	25				25	50	1
4@		22PEAI7041T	Robotics	3			25	10	10	10	65	100	3
		22PEAI7041L	Robotics Laboratory			2	25				25	50	1
	PE	22PEAI7042T	Artificial Intelligence in Finance	3			25	10	10	10	65	100	3
		22PEAI7042L	Artificial Intelligence in Finance Laboratory			2	25				25	50	1
		22PEAI7043T	Artificial Intelligence in Cyber Security	3			25	10	10	10	65	100	3
5#		22PEAI7043L	Artificial Intelligence in Cyber Security Laboratory			2	25				25	50	1
		22OEAI7051T	Product Life Cycle Management	3			25	10	10	10	65	100	3
		22OEAI7052T	Management Information System	3			25	10	10	10	65	100	3
		22OEAI7053T	Operations Research	3			25	10	10	10	65	100	3
		22OEAI7054T	Cyber Security and Laws	3			25	10	10	10	65	100	3
	OE	22OEAI7055T	Personal Finance Management	3			25	10	10	10	65	100	3
		22OEAI7056T	Energy Audit and Management	3			25	10	10	10	65	100	3
		22OEAI7057T	Disaster Management and Mitigation Measures	3			25	10	10	10	65	100	3
		22OEAI7058T	Science of Well-being	3			25	10	10	10	65	100	3
		22OEAI7059T	Research Methodology	3			25	10	10	10	65	100	3
6	PJ	22OEAI70510T	Public Systems and Policies	3			25	10	10	10	65	100	3
		22PJAI7060L	Project Stage-II			8	25				25	50	4
7	HM	22HMAI7070L	Employability Skill Development Program-III			2	25				25	50	1
Total				14		18	275			50	475	800	23

Prepared by:
Dr. N. G. Shinde

Prof. Dr. D. R. Patil
BOS Chairman

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director



Prof. S. P. Shukla
C.O.E.

Checked by:
Dr. S. P. Patil

Prof. Dr. J. B. Patil
Director

Institute Vision

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Institute Mission

To impart high quality Technical Education through

1. Innovative and Interactive learning process and high quality globally recognized instructional programs.
2. Fostering a collaborative scientific temper among students with ethical responsibility towards the society.
3. Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of Professionalism.
4. To contribute to nation's sustainable development.

Department Vision

Fostering technical excellence in Artificial Intelligence and Machine Learning through ethics, innovative research, and sustainable education.

Department Mission

1. Innovative and interactive learning processes with high-quality instructional programs in Artificial Intelligence and Machine Learning.
2. Fostering a collaborative scientific temper among students with ethical responsibility towards society in AI and ML applications.
3. Preparing students from diverse backgrounds to develop aptitude for employment, entrepreneurship, and research in AI and ML with a spirit of professionalism.

Programme Educational Objectives (PEOs)

1. Graduates will have proficiency in Artificial Intelligence and Machine Learning, with life-long learning skills to advance their careers as professionals, entrepreneurs, and leaders.
2. Graduates will possess strong expertise in Artificial Intelligence and Machine Learning, coupled with lifelong learning abilities to excel as professionals, entrepreneurs, and leaders.
3. Graduates will apply AI and ML knowledge to solve real-world problems, contributing to sustainable development and societal benefit.

Program Specific Outcomes (PSOs)

1. Apply programming, machine learning, statistics, data analysis, and cloud computing skills to develop efficient AI-driven solutions.
2. Graduates will excel in Computer Vision, Deep Learning, Natural Language Processing, and Cyber Security while respecting societal values.

Semester - VII

Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
High Performance Computing (22PCAI7010T)		
High Performance Computing Laboratory (22PCAI7010L)		

Prerequisite: System Fundamentals

Course Objective(s):

1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigm

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand different parallel processing approaches and platforms involved in achieving High Performance Computing.	L2	Understand
CO2	Explore GPU and CUDA Programming	L3	Apply
CO3	Understand the principles of Grid and Cloud Computing with practical examples and applications.	L2	Understand
CO4	Analyze the performance measures in high performance computing	L4	Analyze
CO5	Discover the advanced topic in GPU including libraries and framework	L3	Apply



High Performance Computing (22PCAI7010T)

Course Contents

Unit-I

04 Hrs.

Introduction to Parallel Processing:

Parallel processing, Levels of Parallelism, Models (SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation). Loosely coupled and Tightly coupled. Parallel Architecture (Interconnection network, processor Array, Multiprocessor). Challenges in Parallel Computing, Performance Metrics, Distributed vs. Parallel architectures.

Unit-II

06 Hrs.

Introduction to High Performance Computing:

Principles of HPC, HPC Architectures, HPC vs Parallel Processing, Data partitioning Techniques: Block, cyclic, and block-cyclic partitioning, Domain Decomposition: Spatial, temporal, and functional decomposition, Load balancing, Case Study: Partitioning strategies for matrix multiplication. Communication Models: Shared memory vs. message passing. Point-to-Point Communication: Send/Receive operations in MPI. Collective Communication: Broadcast, scatter, gather, and reduction operations in MPI (MPI.Reduce)

Unit-III

08 Hrs.

GPU and CUDA Programming:

Overview of GPU, evolution of GPU, CPU vs. GPU, overview of CUDA: Features, Benefits, Architecture. Programming Model CUDA: Kernels and kernel launches, Thread and block indexing, CUDA Memory Management: Memory Hierarchy and Memory Management, Case Studies: computational biology, data analytics, and machine learning.

Unit-IV

07 Hrs.

Grid and Cloud Computing:

Data & Computational Grids, Grid Architectures and its relation to various Distributed Technologies, Examples of The Grid Computing, Cloud Computing, High Performance Cloud Computing (HPC2), Cloud Tensor Processing Units (TPUs).

Unit-V

08 Hrs.

Performance Optimization:

Speedup, Efficiency and Scalability, Amdahl's Law, Gustafson's Law, Weak vs. Strong Scaling, Performance Bottlenecks, Data Races and Determinism, Data Race Avoidance, Profiling and performance analysis tools for GPUs, Techniques for optimizing GPU performance (warp divergence, loop unrolling).



rolling, vectorization), Memory bandwidth optimization techniques, Advanced GPU programming concepts (shared memory atomics, warp shuffling)

Case Studies: Scientific Computing with CUDA/Real-life application

Unit-VI

06 Hrs.

Advanced Topics in GPU:

Introduction to GPU accelerated libraries (cuBLAS, cuDNN, cuGraph), GPU computing frameworks (TensorFlow, PyTorch) and their integration with GPUs, Introduction to GPU clusters and distributed GPU computing, Cluster Setup & its Advantages. Case studies : Real- world applications of GPU computing

High Performance Computing Laboratory (22PCAI7010L)

List of Laboratory Experiments

Suggested Experiments: (Any 08)

1. Set up the CUDA environment, install the CUDA Toolkit, and write a basic CUDA program to understand the CUDA development environment.
2. Implement vector addition using CUDA to introduce students to parallelism, thread management, and memory allocation in GPU programming.
3. Develop a CUDA program for matrix multiplication to understand parallelism and optimization techniques in GPU computing
4. Apply CUDA for image processing tasks, like blurring and edge detection, to learn how to process images efficiently using GPU parallelism
5. Implement parallel reduction operations (e.g., sum, min, max) to grasp the concept of efficient parallel reduction.
6. Explore parallel sorting algorithms using CUDA, comparing their performance with CPU based sorting and optimizing CUDA sorting
7. Employ CUDA to perform a Monte Carlo simulation for estimating mathematical constants or solving real-world problems to understand the power of GPU parallelism.
8. Experiment with CUDA to implement concurrent data structures using locks and atomic operations to learn how to manage data concurrently
9. Optimize the reduction step in machine learning algorithms using CUDA, focusing on techniques for efficient large-scale data processing



10. Integrate CUDA-accelerated code with data science frameworks like TensorFlow or PyTorch to develop and run GPU-accelerated machine learning models for practical applications.
11. Perform the Log Analysis-Based Resource and Execution Time Improvement

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral examination will be based on the entire syllabus, including the practicals performed during laboratory sessions.

Text Books:

1. Edson Borin, Lúcia Maria A. Drummond, Jean-Luc Gaudiot, Alba Melo, Maicon Melo Alves, "High Performance Computing in Clouds: Moving HPC Applications to a Scalable and Cost-Effective Environment", Philippe Olivier Alexandre Navaux, Springer, ISBN-13 978- 3031297687, 2023.
2. Alexander Heifetz, "High Performance Computing for Drug Discovery and Biomedicine", Springer Nature, ISBN, 1071634496, 9781071634493, 2023.
3. Richard Ansorge, "Programming in Parallel with CUDA", Cambridge University Press, ISBN-13 978-1108479530, 2022.
4. Robert Robey, Yuliana Zamora, "Parallel and High Performance Computing", Manning publisher, ISBN-13 978-1617296468, 2021.
5. Sergey A. Babkin, "The Practice of Parallel Programming", CreateSpace Publisher ISBN-13: 978-1451536614, Online Edition 2021.
6. Georg Hager, Gerhard Wellein, "Introduction to High Performance computing for Scientist and Engineers", CRC press, 2019.
7. Dr Brian Tuomanen, "Hands-On GPU Programming with Python and CUDA", Packt Publishing, ISBN-13 978-1788993913, 2018.

Reference Books:

1. David B. Kirk and Wen-mei W. Hwu, Morgan Kaufmann, "Programming Massively Parallel Processors: A Handson Approach", 4th Edition, 2022.
2. Jason Sanders and Edward Kandrot, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison-Wesley, 1st Edition, 2010.
3. Hager, G. and Wellein, G. "Introduction to High Performance Computing for Scientists and Engineers", CRC Press, ISBN-13 9781439811931, 2010.



4. "High Performance Computing For Dummies", Sun and AMD Special Edition, Douglas Eadline Wiley Publishing, Inc., 2009.

Web Links:

Parallel Processing:

1. <https://hpc.llnl.gov/documentation/tutorials/introduction-parallel-computing-tutorial>
2. <https://nptel.ac.in/courses/106108055>
3. <https://nptel.ac.in/courses/112105293>

Introduction to high performance computing:

1. <https://www.cecam.org/workshop-details/an-introduction-to-high-performance-computing-1270>

GPU and CUDA Programming:

1. https://www.cs.cmu.edu/afs/cs/academic/class/15418s18/www/lectures/06_gpuarch.pdf

Grid and Cloud Computing:

1. <https://aits-tpt.edu.in/wp-content/uploads/2022/06/GCC-min.pdf>

Performance Optimization:

1. https://link.springer.com/chapter/10.1007/978-3-642-03644-6_12

Case Study:

1. <https://developer.nvidia.com/blog/a-cuda-dynamic-parallelism-case-study-panda/>
2. https://www.researchgate.net/publication/265817932_CUDA-based_scientific_computing_Tools_and_selectec



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Large Language Models (22PCAI7020T)		
Large Language Models Laboratory (22PCAI7020L)		

Prerequisite: Natural Language Processing, Deep Learning

Course Objective(s):

1. Introduce the fundamental concepts and applications of Generative AI.
2. Provide in-depth understanding of Transformer architecture, the core building block of most Large Language Models (LLMs).
3. Explore various LLM architectures and techniques like BERT, prompt engineering, and fine-tuning.
4. Introduce students to Multimodal LLMs that can process and understand different data modalities.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Introduce the fundamental concepts and applications of Generative AI and to provide in-depth understanding of Transformer architecture, the core building block of Large Language Models (LLMs).	L2	Understand
CO2	Explore various LLM architectures and techniques like BERT, GPT-3, T5 and Large Reasoning Models.	L2	Understand
CO3	Apply prompt engineering techniques for effective LLM interaction and understand the concept of Retrieval Augmented Generation (RAG) and its role in LLMs.	L3	Apply
CO4	Understand the different data modalities using Multimodal Architectures.	L5	Evaluate



Large Language Models (22PCAI7020T)

Course Contents

Unit-I

08 Hrs.

Introduction to Generative AI & Transformer Architecture:

Domains of Generative AI, Text Generation, Image Generation, Music Generation, Video Generation. Limitations of RNN & LSTM, Tokenization, Transformer Architecture: encoders, decoders, attention mechanisms - types, Self-attention vs Flash Attention, feed-forward layer, Reinforcement Learning with AI Feedback (RLAIF), Reinforcement Learning from Human Feedback (RLHF).

Unit-II

06 Hrs.

Language Models - Unveiling the Power of Words:

BERT (Bidirectional Encoder Representations from Transformers) and its applications, exploring other notable LLM architectures (e.g. GPT-3, T5), Mixture of Experts (MoE), various benchmarks to evaluate LLMs- perplexity, BLEU score, Needle in a Haystack.

Unit-III

05 Hrs.

Large Reasoning Models:

Deep seek- v2: Multi head Latent Attention, Deep seek MoE, Knowledge Distillation, Mistral 7-B Architecture: sliding Window attention, Grouped Query Attention, Titans: Learning to memorize at test time, Knowledge Distillation, QWQ models.

Unit-IV

06 Hrs.

Prompt Engineering & Agentic AI:

Introduction to prompt, examples of prompt, prompt engineering, prompt techniques, zero shot, one shot, few-shot learning, Agentic AI- a chain of thought, ReAct, self-consistency, Tree of thought, Multimodal CoT, Graph prompting, Large Action Models (LAMs), LLM based Agents, Auto Gen.

Unit-V

08 Hrs.

Retrieval Augmentation & Generation (RAG) and Fine-tuning for LLMs:

Understanding Retrieval and vector, vector storage: vector indexing and retrieval Algorithms: Annoy, HSNV, Inverted File System, LSH, vector quantization techniques: Scalar, Product, Binary, vector libraries, vector databases, Loading and retrieving in Lang Chain, Document loaders, Retrievers in Lang Chain. Fine-tuning: Quantization, PEFT, Full-Finetuning vs LoRA vs QLoRA, Fine-Tuning LLMs for different downstream tasks.



Unit-VI

06 Hrs.

Multimodal Architectures - Beyond Text:

Introduction to Multimodal LLMs, Exploring architectures for Multimodal LLMs: Vision Transformer, Next GPT, Applications of Multimodal LLMs (e.g., image captioning, video summarization), Multi-task LLMs, Empowering Time Series Analysis with Large Language Models .

Large Language Models (22PCAI7020L)

List of Laboratory Experiments

Suggested Experiments: (Any 08)

1. Case study on Applications of Generative AI.
2. Case study on role of Artificial Intelligence in achieving the Sustainable Development Goals.
3. Fine Tuning Pre-trained Model On Custom Dataset (synthetic data) Using Transformer.
4. Build your own LLM from scratch.
5. Query PDF using Lang Chain and Pine cone.
6. Fine Tune Mistral7-B With Custom Dataset Using LoRA And QLoRA Techniques.
7. Using in-built tools and creating custom tools for ReAct agent in Langchain.
8. Question Answering Application using LLM based agents.
9. Understanding various retrievers in Langchain
10. Case study on comparison of Large Reasoning Models
11. Understanding multimodal models like Gemini vision
12. Build a simple multimodal generative model that combines text and image inputs to generate captions
13. Mini project

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Oral examination will be based on the entire syllabus, including the practicals performed during laboratory sessions.

Text Books:

1. Ben Auffarth, "Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT, and other LLMs", Packt Publishing, 2023.



2. Valentina Alto, “Modern Generative AI with ChatGPT and OpenAI Models”, Packt Publishing, 2023.
3. Jay Alammar, Maarten Grootendorst, “Hands-On Large Language Models”, O’Reilly, 2023.
4. Thushan Ganegedara, “Natural Language Processing with TensorFlow”, Packt Publishing, 2nd Edition, 2022.

Reference Books:

1. David Foster, “Generative Deep Learning”, O’Reilly, 2020.
2. Lewis Tunstall, Leandro von Werra & Thomas Wolf, “Natural Language Processing with Transformers”, 2022.
3. Sebastian Raschka, “Build a Large Language Model (From Scratch)”, ISBN 9781633437166.

Web Resources Blogs and Websites:

1. Mixture of Experts: Mixture of Experts Explained (huggingface.co)
2. PEFT: Efficient Model Fine-Tuning for LLMs: Understanding PEFT by Implementation — by Shivansh Kaushik — Medium
3. Various benchmarks to evaluate LLMs: LLM Benchmarks: Understanding Language Model Performance (humanloop.com)
4. Types of attention mechanism: Understanding and Coding the Self-Attention Mechanism of Large Language Models From Scratch (sebastianraschka.com)
5. Agents— RAG: Intro to LLM Agents with Langchain: When RAG is Not Enough — by Alex Honchar — Mar, 2024 — Towards Data Science
6. React— Agent: Teaching LLMs to Think and Act: ReAct Prompt Engineering — by Bryan McKenney — Medium
7. LLM based Agents : Superpower LLMs with Conversational Agents — Pinecone
8. RAGAS: Evaluating RAG pipelines with Ragas + LangSmith (langchain.dev)
9. Model distillation: LLM distillation demystified: a complete guide — Snorkel AI
10. Sentence classifier —BERT: Classify text with BERT — Text — TensorFlow



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Big Data Analytics (22PCAI7030T)		
Big Data Analytics Laboratory (22PCAI7030L)		

Prerequisite: Database Management System

Course Objective(s):

1. To provide an overview of Big Data analytics and discuss the challenges traditional data mining algorithms face when analyzing Big Data.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce.
3. To demonstrate the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To introduce to the students several types of big data like social media, web graphs and data streams to solve complex real-world problems in for decision support.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the fundamentals of Big Data and its ecosystem.	L2	Understand
CO2	Illustrate distributed processing techniques using MapReduce and Spark.	L4	Analyze
CO3	Analyze stream data processing and core Spark concepts for efficient data manipulation.	L4	Analyze
CO4	Apply advanced analytics and mining techniques to extract insights from large datasets and real-world Big Data application.	L3	Apply



Big Data Analytics (22PCAI7030T)

Course Contents

Unit-I

05 Hrs.

Introduction to Big Data Analytics

Definition and evolution of Big Data. Characteristics and types, Traditional Versus Big Data Approach, Big Data Challenges, Introduction to Hadoop: Core components (HDFS, YARN), Hadoop Ecosystem. Introduction to NoSQL Databases: NoSQL patterns, key-value, document, column-family, graph stores. MongoDB Introduction: Detailed overview and hands-on example.

Unit-II

05 Hrs.

MapReduce and Distributed Processing

MapReduce Fundamentals: Map and Reduce tasks, grouping, combiners, execution. MapReduce Algorithms: Matrix-Vector Multiplication, Relational-Algebra Operations. Joins, grouping, aggregation, matrix multiplication. MapReduce Application: Real-life database and application examples.

Unit-III

05 Hrs.

Stream Data Processing and Spark Introduction

The Stream Data Model: Stream-management, sources, queries, issues.

Sampling and Filtering Streams: Techniques, Bloom filter. Counting Distinct Elements and Ones: Flajolet-Martin, DGIM algorithms. Apache Spark Overview: Introduction to Spark and core concepts.

Unit-IV

05 Hrs.

Advanced Analytics and Mining

Frequent Pattern Mining: Handling large datasets, basic algorithms. The SON Algorithm and MapReduce: Implementation detail. Clustering Algorithms: CURE, Canopy clustering, MapReduce clustering. Classification Algorithms: Parallel trees, Ensemble methods. Link Analysis: PageRank: Definition, web structure, using PageRank.

Unit-V

06 Hrs.

Big Data Analytics Applications

Link Analysis: PageRank Definition, Structure of the web, Using Page rank in a search engine. Efficient PageRank Computation: Iteration, topic-sensitive, link spam, Hubs and Authorities, Mining Social- Network Graphs: Types, Clustering, Direct Discovery of Communities, counting triangles using Map-Reduce. Real-Time and Streaming Recommendation Engines, Automated Machine Learning (AutoML), Business Intelligence (BI) Dashboards and Reporting, Cloud-based ML platforms (SageMaker, Vertex AI, Azure ML).



Big Data Analytics Laboratory (22PCAI7030L)

List of Laboratory Experiments

Suggested Experiments:

1. One Case Study on Big data in Real life published in IEEE/ACM/Springer or any prominent journal. Objective: Identify and categorize real-world datasets based on the 5 Vs of Big Data (Volume, Velocity, Variety, Veracity, Value).

Tasks:

- Collect example datasets (e.g., social media data, sensor data, web logs).
 - Analyze and document how each dataset exemplifies the 5 Vs.
 - Discuss the challenges associated with analyzing each dataset.
2. Installation of Hadoop Framework, it's components and study the HADOOP ecosystem.
 3. Implement word count/frequency programs using MapReduce.
 4. Implementing algorithm in MapReduce Matrix multiplication, Aggregates, joins, sort.
 5. Create Hive Databases and Tables, Hive Partitioning and Indexing.
 6. Write Pig Latin Script Operators like Distinct, For-each, Union.
 7. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
 8. Implement clustering techniques using SPARK.
 9. Implement Page Rank Algorithm using Map-Reduce.
 10. Implement an application that stores big data in MongoDB using Hadoop / R.
 11. Data Visualization with Tableau.
 12. Mini Project:

SDG 13: Climate Change Impact Analysis

- Analyse temperature and air quality data to identify trends and patterns.
- Use social media data to assess public sentiment towards climate change.
- Visualize the impact of climate change on specific regions.

SDG 3: Healthcare Access Analysis

- Analyze data on healthcare access, disease prevalence, and mortality rates.
- Identify disparities in healthcare access across different populations.
- Visualize the impact of healthcare interventions.



Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Oral examination will be based on the entire syllabus, including the practicals performed during laboratory sessions.

Text Books:

1. Mayank Bhushan, "Big Data and Hadoop: Fundamentals, tools, and techniques for data-driven success", 2nd Edition, ISBN-13978-9355516664, 2024.
2. Jugnesh Kumar, Anubhav Kumar, Rinku Kumar, "Big Data and Analytics: The key concepts and practical applications of big data analytics", ISBN-13978-9355516176, 2024.
3. Greyson Chesterfield, "Mastering Apache Spark: Real-Time Big Data Analytics: Build Large-Scale Data Processing Pipelines with Apache Spark", 2024.
4. Ganeshkumar Pugalendhi, Anand Paul, Rathinaraja Jeyaraj, "Big Data with Hadoop MapReduce", 2022.
5. Mrs A S R Sulthana, Mr Micheal Yeboah Frimpong, "Demystifying the NoSQL", 2021.
6. Kristina Chodorow, Michael Dirolf, "MongoDB: The Definitive Guide Paperback", O'Reilly Publications, 2020.
7. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley Publications, 2019.

Reference Books:

1. Simhadri Govindappa, "Ultimate Big Data Analytics with Apache Hadoop: Master Big Data Analytics with Apache Hadoop Using Apache Spark, Hive, and Python", 2024.
2. Dr Sudhakar Ranjan (Author), Dr Anurag Bharatwal (Author), Dr Amit Kumar Goel (Author), "Hadoop in Action: Real World Applications and Best Practices for Big Data Processing", Kindle Edition, 2024.
3. Ali Soofastaei, "Advanced Analytics in Mining Engineering: Leverage Advanced Analytics in Mining Industry to Make Better Business Decisions", 2023.
4. Herbert Jones, "Data Analytics: The Ultimate Guide to Big Data Analytics for Business, Data Mining Techniques, Data Collection, and Business Intelligence Concepts", 2020.

Online References:

1. NPTEL Course: https://onlinecourses.nptel.ac.in/noc20_cs92
2. MongoDB: <https://www.mongodb.com/developer/products/mongodb/learn-mongodb-university-online-free-mooc/?msocid=07258624254b619719bf95cb24b36065>



3. <https://www.youtube.com/watch?v=S2MUhGA3lEw>

4. <https://www.youtube.com/watch?v=XhjIJGsAMsQlist=PL6UwySlcwEYKiC-EjEmN4f33c5fVpbzha>



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Robotics (22PEAI7041T)		
Robotics Laboratory (22PEAI7041L)		

Prerequisite: Basics of Artificial Intelligence

Course Objective(s):

1. Develop a comprehensive understanding of robot anatomy.
2. Gain proficiency in direct and inverse kinematics, coordinate frames, and rotations.
3. Learn the principles of workspace analysis, trajectory planning, and various motion operations to design and implement efficient robotic movements.
4. Integrate and Program Robotic Systems.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basics of robot anatomy, movement mechanisms, and classifications, and apply this knowledge to real-world robotic systems.	L2	Understand
CO2	Perform kinematic analysis and solve direct and inverse kinematics problems for various robot configurations, enhancing their problem-solving skills in robotics.	L3	Apply
CO3	Conduct workspace analysis and trajectory planning, and will implement pick-and- place.	L3	Apply
CO4	Capable of using ROS for robot programming, interface sensors and actuators.	L4	Analyze



Robotics (22PEAI7041T)

Course Contents

Unit-I

08 Hrs.

Robot Fundamentals: Basic of Robot Anatomy, Robot Movement, Mechanisms and transmission, Classification.

Direct and Inverse Kinematics: Co-ordinate frames, Rotations, Link Coordination Arm Equation, (Two axis , Three axis, Four-axis robot SCARA, Five-axis only Rhino XR-3 Robot). General properties of solutions Tool configuration Two axis, Three axis planar articulated, Four axis SCARA, Five axis robots only Rhino XR-3 Robot.

Unit-II

06 Hrs.

Workspace Analysis and Trajectory Planning: Introduction to Workspace Analysis and Trajectory Planning, Work Envelop and examples, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

Unit-III

08 Hrs.

Robot Sensor, Actuator, Interface & Programming: Principle of sensors, Sensor types: LiDAR (Light Detection and Ranging, Ultrasonic sensors, Camera. Sensor Input/output (I/O): Analog-to-Digital Converters (ADCs), Sensor Calibration, Interfacing and I2C, Actuator: Direct Control and Speed Control: PWM, Electric Motors, Pneumatic Actuator, Servo Motors. Basic Embedded File system, hex files, Simulators and Emulators, Integrated development environments, commonly used IDE. Python for Robot Programming, Program structure, data types, control structure.

Unit-IV

08 Hrs.

Robotics Convergence Technology: Telemetric camera Robotic System, Non- Imaging Sensors

Machine Learning for Robotics: Supervised learning for robot control, Reinforcement learning for robot decision making.

Computer Vision for Robotics: Object recognition, Image segmentation, Visual SLAM (Simultaneous Localization and Mapping),

Sensor Fusion and Perception: Combining data from multiple sensors for robot understanding. Knowledge representation, planning, and task scheduling. Sound and touch sensing, People sensing, Autonomous mobile robot, humanoid robots and simulated humans, human-robot interaction.

Unit-V

04 Hrs.

Robot Operating System: ROS Basics, Supporting ROS, ROS Architecture and Concepts, File system, ROS Computation Graph Level, ROS Community Level, ROS Workspace and Packages



ROS Client Library, ROS Programming Concept: Motion planning, Behavior control, Machine learning integration.

Unit-VI

05 Hrs.

Building the Robots: Introduction to Wheeled Robot, Hardware, Block Diagram and Assembling Robot Hardware, Programming Robot Firmware, path planning.

Robot Applications in AI (case studies): Exploration of self-driving cars, industrial robots, assistive robots, and other AI-powered robotic applications. Focus on the interplay between hardware and software aspects. Case study: Tetrix , NAO, Ned Niryo , Auto Auto.

Robotics Laboratory (22PEAI7041L)

List of Laboratory Experiments

Suggested Experiments: (Any 08)

1. Exploring Robot Anatomy

Objective: Identify and understand the various parts of a robot (e.g., sensors, actuators, controllers).

Objective: Study different types of mechanisms (e.g., gears, belts) and transmission systems in robots.

2. Simulation of Forward and Inverse Kinematics.

3. Workspace Analysis of a SCARA Robot

Objective: Analyse the workspace of a four-axis SCARA robot and identify its limitations using simulation software.

4. Create a Robot structure for pick and place operation.

5. Basic ROS Node Creation

Objective: Create and run basic publisher and subscriber nodes in ROS.
(Write simple nodes in Python/C++ and communicate between them.)

6. Implement a line following robot using ROS and appropriate sensors.

7. Interfacing Arduino/ Raspberry Pi with ROS.

8. Programs of Tetrix and NAO.

9. Programs on Ned Niryo and Auto Auto.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Oral examination will be based on the entire syllabus, including the practicals performed



during laboratory sessions.

Text Books:

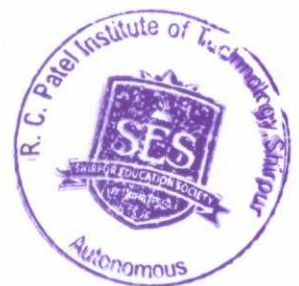
1. Dr. M. Purushotham, T V Sathyanarayana, Dr. Shafqat Nabi Mughal, Dr. Pallavi Sapkale, "Basic concepts of AI and Robotics", 1st Edition, AG Publishing House, ISBN: 9788119025343, 2023.
2. Ishwar Singh, Birinder Pal Kaur, "Fundamentals of Robot Kinematics and Dynamics", ISBN-13 979-8870762753, 2023.
3. Lentin Joseph, "Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy," 1st Edition, A Press, 2018.
4. W. Bolton, "Mechatronics", Pearson, 2018.
5. Jonathan Cacace; Lentin Joseph, "Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System", 2nd Edition, Packet Publishing, 2018.
6. Jacob Fraden, "Handbook of Modern Sensors", Springer, 2016.

Reference Books:

1. Catherine Régis (Editor), Jean-Louis Denis (Editor), Maria Luciana Axente (Editor), Atsuo Kishimoto (Editor), "Human-Centered AI: A Multidisciplinary Perspective for Policy-Makers, Auditors, and Users", ISBN 13- 978-1032341620, 2024.
2. "Introduction To AI Robotics", 2nd Edition, Bradford Books, ISBN 13- 978- 0262038485, 2019.
3. Mikell P. Groover, "Industrial Robotics", 2nd Edition, McGraw Hill, 2012.
4. John J. Craig, "Introduction to Robotics", 3rd Edition, Addison Wesley, ISE 2008.

Online Resources:

1. Robot Anatomy, Movement, Mechanisms, and Transmission
<https://motion.cs.illinois.edu/RoboticSystems/AnatomyOfARobot.html>
2. <https://nptel.ac.in/courses/107106090>
3. <https://nptel.ac.in/courses/112108298>
4. robot configurations and joint types
<https://instrumentationtools.com/robot-anatomy- configuration-reference-frame-characteristics/>
5. Workspace Analysis and Trajectory Planning
<https://motion.cs.illinois.edu/RoboticSystems/AnatomyOfARobot.html>



6. Robot Interface & Programming <https://www.wevolver.com/article/robot-joint>
7. Basic Embedded Systems and Python for Robot Programming
<https://motion.cs.illinois.edu/RoboticSystems/AnatomyOfARobot.html>
8. Robotics Convergence Technology
<https://www.wevolver.com/article/robot-joint>
9. Robot Operating System (ROS)
<https://instrumentationtools.com/robot-anatomy-configuration-reference-frame-characteristics/>
10. Building Robots and Path Planning
<https://instrumentationtools.com/robot-anatomy-configuration-reference-frame-characteristics/>
11. Robot Applications in AI (Case Studies)
<https://www.wevolver.com/article/robot-joint>



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Artificial Intelligence in Finance (22PEAI7042T)		
Artificial Intelligence in Finance Laboratory (22PEAI7042L)		

Course Objective:

To understand the role of AI in finance, learn risk and portfolio management, develop and evaluate the credit scoring models, and investigate the application of AI in detection and prevention of fraud.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Demonstrate Knowledge of AI Applications and its role in Finance.	L2	Comprehension
CO2	Implement Risk Management Models to assess and manage financial risks.	L4	Analyze
CO3	Optimize financial portfolio strategies that align with given risk profiles and investment goals.	L3	Apply
CO4	Develop AI-driven credit scoring models and compare their performance to traditional scoring systems.	L3	Apply
CO5	Design the fraud detection system that detect and prevent potential fraudulent activities.	L4	Analyze



Artificial Intelligence in Finance (22PEAI7042T) Course Contents

Unit-I

08 Hrs.

Introduction:

Taxonomy for finance- asset, liabilities, income, expenses, revenue, profit, cost of goods sold (COGS), gross margin, net income, balance sheet, income statement, ROI, liquidity, interest, inflation, financial markets (stock, Bond, commodity, forex), Equities, derivatives, Corporate and personal finance, Financial Statements and ratios, financial planning.

Unit-II

08 Hrs.

Role of AI in Finance:

AI and its significance in finance, evolution of AI in finance, AI techniques used in finance, Forecasting and its importance in finance, challenges in financial forecasting, Forecasting Methods: TSA, ML, DL, Semantics Analysis, Applications of AI in Finance: fraud detection, credit scoring, algorithmic trading, risk management.

Efficient Markets: Market Prediction Based on Returns Data, Market Prediction with More Features, Market Prediction Intraday,

Dense Neural Networks: The Data, Baseline Prediction, Normalization, Dropout, Regularization, Bagging, Optimizers.

Recurrent Neural Networks: Example - Financial Price Series, Financial Return Series, Financial Features, Estimation.

Unit-III

06 Hrs.

Risk Management using AI and ML Models:

Introduction to financial risk management, Types of financial risk (market, credit, operational), AI and ML models for risk management (e.g., Value at Risk, Conditional Value at Risk), Case studies: Implementing risk management strategies using AI and ML.

Unit-IV

05 Hrs.

Portfolio Optimization and Asset Allocation Strategies:

Basics of portfolio theory, Portfolio optimization techniques (Markowitz, Black-Litterman, etc.), Application of AI and ML in portfolio optimization, Hands-on: Portfolio optimization using Python libraries.

Unit-V

06 Hrs.



Credit Scoring in Finance:

Credit scoring and its importance in lending decisions, development of credit scoring models, regulation in credit scoring, Data Collection and Preprocessing for Credit Scoring, models for credit scoring - traditional, machine learning and Deep learning, Evaluation and Validation of Credit Scoring Models - ROC, AUC, etc. Case studies of credit scoring model.

Unit-VI

06 Hrs.

Fraud Detection in Finance:

Fraud in finance and its impact, Types of financial fraud (e.g., identity theft, payment fraud), Importance of fraud detection in financial institutions, Data Collection and Preprocessing for Fraud Detection, traditional fraud detection methods (e.g., rule-based systems, anomaly detection) and its limitations, machine learning for fraud detection, anomaly detection techniques- supervised and unsupervised, Case studies of fraud detection model.

Artificial Intelligence in Finance Laboratory (22PEAI7042L)

List of Laboratory Experiments

Suggested Experiments: (Minimum 08)

1. Case Study: Predicting Stock Prices with a Simple Neural Network.

2. Exploratory Data Analysis (EDA) with Financial Data:

Use Python libraries like Pandas and Matplotlib to analyze and visualize historical financial data. Identify trends, patterns, and correlations in stock prices, market indices, or other financial indicators.

3. Predictive Modelling for Stock Prices

Build machine learning models (e.g., linear regression, decision trees, or LSTM neural networks) to predict future stock prices based on historical data. Evaluate the performance of the models using metrics like mean squared error (MSE) or accuracy.

4. Sentiment Analysis of Financial News

Use natural language processing (NLP) techniques to analyze the sentiment of news articles or social media posts about specific stocks or companies. Determine the impact of sentiment on stock price movements.

5. Case Study: Research a historical example of a financial market crash. Analyze how AI might have influenced the event, for better or worse.

6. Portfolio Optimization

Develop an algorithm to optimize a portfolio of stocks based on risk and return objectives. Use techniques like mean-variance optimization or Monte Carlo simulation.



7. Credit Risk Assessment

Build a machine learning model to predict the creditworthiness of individuals or companies based on financial and non-financial data.

Evaluate the model's performance using metrics like precision, recall, and F1-score.

8. Risk Management:

Implement and backtest simple trading strategies (e.g., moving average crossover) using historical stock price data. Use Python libraries like Pandas and NumPy for data manipulation and strategy implementation.

9. Fraud Detection in Financial Transactions

Develop a fraud detection model using machine learning techniques to identify fraudulent transactions in a financial dataset. Evaluate the model's performance using metrics like precision, recall, and ROC-AUC.

10. Time Series Forecasting for Financial Data

Use time series forecasting models (e.g., ARIMA, Prophet) to predict future values of financial indicators like stock prices or exchange rates. Evaluate the accuracy of the forecasts using metrics like mean absolute error (MAE) or mean absolute percentage error (MAPE).

11. Use of Autotransformers for Long-Term Dependency Modeling in Financial Time Series Data.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Oral examination will be based on the entire syllabus, including the practicals performed during laboratory sessions.

Text Books:

1. Edward P. K. Tsang, "AI for Finance", CRC Press, ISBN13 978-1032391205, 2023.
2. Bohdan Popovych, "Application of AI in Credit Scoring Modeling", Springer Gabler, ISBN- 13 978-3658401795, 2022.
3. William Kinlaw, Mark P. Kritzman, David Turkington, Harry M. Markowitz, "Asset Allocation: From Theory to Practice and Beyond (Wiley Finance)", ISBN-13 978-1119817710, 2021.
4. Marcos López de Prado, "Advances in Financial Machine Learning", Wiley, 2018.
5. Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications: With R Examples", 2017.
6. Yves Hilpisch, "Python for Finance: Analyze Big Financial Data", 2015.
7. Allan M. Malz, "Financial Risk Management: Models, History, and Institutions", 2011.



8. Frank J. Fabozzi, Harry M. Markowitz, and Petter N. Kolm, "Portfolio Construction and Analytics", 2007.

Reference Books:

1. Ila Sweda, "AI In Banking & Finance: How AI Plays A Significant Role In Banking And Financial Services Industry: Artificial Intelligence Definition", ISBN-13 979-8465705233, 2021.
2. Matthew F. Dixon, Igor Halperin, and Paul Bilokon, "Machine Learning in Finance: From Theory to Practice", Springer, ISBN-13 978-3030410674, 2020.
3. Marcos Lopez de Prado, "Machine Learning for Financial Engineering", Cambridge University Press, ISBN-13 978-1108792899, 2018.
4. Marcos Lopez de Prado, "Advances in Financial Machine Learning", Wiley, ISBN-13 978-1119482086, 2018.
5. Mark J. Bennett and Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science", 2016.

Online Resources:

1. What Is Artificial Intelligence in Finance? – IBM
<https://www.ibm.com/think/topics/artificial-intelligence-finance>
2. How Finance & Banking Professionals Can Capitalize on AI
<https://corporatefinancceinstitute.com/resources/datascience/bots-bard-and-chatgpt/>
3. AI in Finance: Applications, Examples & Benefits – Google Cloud
<https://cloud.google.com/discover/finance-ai>
4. 33 Examples of AI in Finance 2024 – Built In
<https://builtin.com/artificial-intelligence/ai-finance-banking-applications-companies>
5. AI for portfolio management: An overview (leewayhertz.com)
<https://www.leewayhertz.com/ai-for-portfolio-management/>
6. Generative AI transforming wealth and asset management – EY - US
<https://shorturl.at/erLVY>
7. Use of Artificial Intelligence (AI) in Investment Management – Infosys BPM
<https://www.infosysbpm.com/blogs/financial-services/artificial-intelligence-an-asset-management-perspective.html>
8. AI-based credit scoring (leewayhertz.com)
<https://www.leewayhertz.com/ai-based-credit-scoring/>



9. Responsible AI Credit Scoring – A Lesson from Upstart.com (degruyter.com)
<https://www.degruyterbrill.com/document/doi/10.1515/9783110749472-006/html?lang=en>
10. How Fraud Detection Using AI in Banking Works? – Infosys BPM
<https://www.infosysbpm.com/blogs/bpm-analytics/fraud-detection-with-ai-in-banking-sector.html>
11. How Is AI Used in Fraud Detection? – NVIDIA Blog
<https://blogs.nvidia.com/blog/ai-fraud-detection-rapids-triton-tensorrt-nemo/>
12. (PDF) - Deep Learning for Time Series Forecasting: A Survey
<https://www.researchgate.net/publication/347364694DeepLearningforTimeSeriesForecastingASurvey>



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Artificial Intelligence in Cyber Security (22PEAI7043T)		
Artificial Intelligence in Cyber Security Laboratory (22PEAI7043L)		

Prerequisite: Artificial Intelligence, Machine Learning and Computer Network

Course Objective(s):

The primary objective of the Artificial Intelligence for Cyber Security subject is to equip students with the knowledge and practical skills to leverage Artificial Intelligence (AI) techniques and tools to enhance cybersecurity efforts. This subject focuses on the integration of AI, machine learning, and deep learning algorithms into cybersecurity applications to detect, prevent, and mitigate cyber threats effectively.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the various concept of Cyber Security.	L2	Understand
CO2	Apply Machine learning and deep learning techniques to detect intrusions, malware, and anomalous activities in cybersecurity datasets.	L3	Apply
CO3	Evaluate the effectiveness of emerging cybersecurity technologies .	L5	Evaluate
CO4	Describe key ethical considerations in the use of AI in cybersecurity.	L2	Understand



Artificial Intelligence in Cyber Security (22PEAI7043T) Course Contents

Unit-I

07 Hrs.

Introduction to Cyber Security:

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

Unit-II

06 Hrs.

Artificial Intelligence in Cyber Security:

Role of AI in Cyber Security and Security Framework: Artificial Intelligence in Cyber Security, Challenges and Promises, Security Threats of Artificial Intelligence, Use-Cases: Artificial Intelligence Email Observing, Model Stealing & Watermarking, Network Traffic Analysis, Malware Analysis, United Family Healthcare by IBM.

Unit-III

07 Hrs.

Machine Learning in Security:

Introduction to Machine Learning in Security domain, Applications of Machine Learning in Cyber Security Domain, Machine Learning: tasks and Approaches, Anomaly Detection, Privacy Preserving Nearest Neighbor Search, Machine Learning Applied to Intrusion Detection, Online Learning Methods for Detecting Malicious Executables.

Unit-IV

06 Hrs.

Deep Learning in Security:

Introduction to deep learning in Security domain, Cyber Security Mechanisms Using Deep Learning Algorithms, Applying deep learning in various use cases, Network Cyber threat Detection. Using Deep Learning to Detect DGA-Generated Domains Detecting Non-Malware Threats.

Unit-V

07 Hrs.

Emerging Issues in Cybersecurity:

Evolving Threat Landscape: Advanced Persistent Threats (APTs), Ransomware evolution and double extortion, Cybercrime-as-a-Service (CaaS). Cloud and Hybrid Security: Security risks in multi-cloud



environments, Shared responsibility model, Cloud-native security tools and posture management. Emerging Threats and Challenges: Adaptive Honeypots and Honeytokens, Capsule Networks, Threat Intelligence, Security Automation and Orchestration.

Unit-VI

06 Hrs.

AI Ethics in Cybersecurity:

Ethical Considerations in AI: Bias and fairness in AI algorithms, Privacy and data protection in AI, Transparency and explainability of AI models, Accountability and responsibility for AI decisions. Ethical Challenges: Bias in AI-powered cybersecurity systems, Privacy implications of AI-driven threat intelligence, Transparency concerns in AI-based security products, Accountability for AI-driven security decisions.

Artificial Intelligence in Cyber Security Laboratory (22PEAI7043L)

List of Laboratory Experiments

Suggested Experiments: (Any 08)

1. Python basics review and introduction of common data analysis libraries.
2. Machine learning pipeline for cybersecurity problems
Case study: spam email detection.
3. To implement Time Series Analysis techniques to detect anomalies, predict cybersecurity threats, or identify unusual behaviors in network traffic or system logs. The focus will be on using machine learning and statistical models like ARIMA (Auto-Regressive Integrated Moving Average), LSTM (Long Short-Term Memory), and Anomaly Detection techniques to analyze time-dependent data.
Case study: DDoS network traffic analysis
4. A small step into deep learning and convolutional neural network (CNN).
Case study: breaking Captchas with neural network.
5. Dimensionality reduction and visualization for Network Anomaly Detection using the KDD Cup 1999 Dataset
Case study: network anomaly detection and visualization
Dataset: KDD Cup 1999 dataset (We will reuse these in lab 6)
6. To detect anomalies in network traffic data using deep learning-based auto encoders and clustering methods like K-Means, and compare their effectiveness for identifying cyber attacks.
7. To explore the impact of data oversampling techniques on improving the performance of Decision Tree algorithms for intrusion detection in cybersecurity datasets.



Case study: detecting and categorizing network attacks

Dataset: Kaggle credit card fraud detection dataset (We will reuse these in lab 8)

8. To implement and evaluate ensemble learning algorithms for intrusion detection, and compare their performance against individual classifiers.
9. To implement and evaluate Machine Learning (ML) and Deep Learning (DL) models for detecting cybersecurity threats (such as intrusion detection, malware, phishing, etc.) in network traffic or datasets. Students will apply supervised learning techniques to classify normal vs. malicious activities based on features extracted from network data.
10. To apply Cloud AI Solutions (such as Machine Learning, Anomaly Detection, and Fraud Detection APIs) to detect fraudulent activities in financial transactions and evaluate the performance of different cloud-based models for fraud prevention.
11. To develop and evaluate an AI model that detects and analyzes brute force attacks using machine learning techniques on login attempt data.
12. To use artificial intelligence techniques to analyze cybersecurity incidents, identify patterns, and provide actionable insights for threat detection and response.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Oral examination will be based on the entire syllabus, including the practicals performed during laboratory sessions.

Text Books:

1. Mark Stamp, "Artificial Intelligence for Cybersecurity: Techniques, Tools, and Applications", Springer, 2022.
2. Gupta, Brij B., and Quan Z. Sheng, eds. "Machine learning for computer and cyber security: principle, algorithms, and practices", CRC Press, 2019.
3. Nccraj Bhargava, Ritu Bhargava, Pramod Singh Rathore, Rashmi Agrawal, "Artificial Intelligence and Data Mining Approaches in Security Frameworks", Editor(s): 2021.

Reference Books:

1. Alessandro Parisi, "Hands-On Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventing cyber-attacks and detecting threats and network anomalies", Packt Publications, 2019
2. P.W. Singer and Allan Friedman, "Cybersecurity and Cyberwar: What Everyone Needs to Know", Oxford University Press, 2014.



3. Leslie F. Sikos, "AI in Cybersecurity", Springer, 2018.
4. Nina Godbole and Sunit Belpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley, 2018
5. Tsai, Jeffrey JP, and S. Yu Philip, eds. "Machine learning in cyber trust: security, privacy, and reliability", Springer Science & Business Media, 2009.
6. Kevin P Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press.
7. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Web Links:

GPU Gen AI in Cybersecurity <https://www.coursera.org/learn/gen-ai-in-cybersecurity>



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Product Life Cycle Management (22OEAI7051T)		

Prerequisite: Knowledge of basic concepts of Management

Course Objective(s):

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

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.	L2	Understand
CO2	Illustrate various approaches and techniques for designing and developing products.	L3	Apply
CO3	Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.	L3	Apply
CO4	Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.	L2	Understand



Product Life Cycle Management (22OEAI7051T) Course Contents

Unit-I

09 Hrs.

Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications

PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM

Unit-II

08 Hrs.

Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process.

Unit-III

08 Hrs.

Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation

Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies

Unit-IV

07 Hrs.

Integration of Environmental Aspects in Product Design:

Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.

Unit-V

07 Hrs.



Life Cycle Assessment and Life Cycle Cost Analysis:

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

Text Books:

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

Reference Books:

1. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, 2009.
2. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006.
3. François Villeneuve, Luc Mathieu, Max Giordano, "Product Life-Cycle Management: Geometric Variations", Wiley, 2010.



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Management Information System (22OEAI7052T)		

Course Objective(s):

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain how information systems Transform Business.	L2	Understand
CO2	Identify the impact information systems have on an organization.	L3	Apply
CO3	Describe IT infrastructure and its components and its current trends.	L2	Understand
CO4	Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making.	L2	Understand
CO5	Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.	L3	Apply



Management Information System (22OEAI7052T) Course Contents

Unit-I 03 Hrs.

Foundation Concepts: Information Systems in Business, Functional Area Information System, The Components of Information Systems, Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.

Unit-II 07 Hrs.

Information Technologies: Hardware and Software

Computer Systems: End User and Enterprise Computing

Computer Peripherals: Input, Output, and Storage Technologies

Application Software: End User Applications

System Software: Computer System Management

Data Resource Management: Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts, Knowledge Management.

Networks: The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models.

Unit-III 08 Hrs.

MIS Tools and applications for Decision making: ERP and ERP support of Business Process Reengineering.

Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Visualization.

Artificial Intelligence Technologies in Business

Unit-IV 06 Hrs.

Security and Ethical Challenges: Security, Ethical, and Societal Challenges of IT Security Management of Information Technology

Unit-V 07 Hrs.

Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.



Unit-VI

08 Hrs.

Information System within Organization: Acquiring Information Systems and Applications: Various System development life cycle models.

Enterprise and Global Management of Information Technology: Managing Information Technology, Managing Global IT.

Reference Books:

1. James A O'Brien, George M., RameshBehl, "Management Information Systems", 11th Edition.
2. Kelly Rainer, Brad Prince, "Management Information Systems", Wiley.
3. K.C. Laudon and J.P. Laudon, "Management Information Systems: Managing the Digital Firm", 10th Edition, Prentice Hall, 2007.
4. D. Boddy, A. Boonstra, "Managing Information Systems: Strategy and Organization", Prentice Hall, 2008.



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Operations Research (22OEAI7053T)		

Prerequisite: Basic Knowledge of Algebra, Probability and Statistics.

Course Objective(s):

1. To formulate a real-world decision problem as a mathematical programming model.
2. To learn the mathematical tools that are employed to solve mathematical programming models.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Convert a real-world problem in to a Linear Programming Problem and analyse the solution obtained using Simplex method or other algorithms.	L4	Analyze
CO2	Identify real-world problems as Transportation Problem and Assignment Problem and Solve the decision problem by choosing appropriate algorithm.	L3	Apply
CO3	Identify the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.	L3	Apply
CO4	Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.	L2	Understand
CO5	Understand the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.	L2	Understand
CO6	Describe concept of simulation and apply Monte Carlo Simulation technique to systems such as inventory, queuing and recommend solutions for them.	L2	Understand
CO7	Understand need for right replacement policy and determine optimal replacement age.	L2	Understand



Operations Research (22OEAI7053T)

Course Contents

Unit-I

10 Hrs.

Introduction to Operations Research: Concept of decision making. Definition of OR. Formulation of decision problem as OR model, Concept of Optimization,

Linear Programming Problem: Mathematical Formulation. Finding optimal solution - Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.

Unit-II

08 Hrs.

Assignment Problems: Mathematical Formulation, Finding optimal solution - Hungarian Method

Transportation problem: Mathematical Formulation, Finding initial basic feasible solution – Northwest corner rule, row minima, column minima, least cost method and Vogel's approximation method.

Optimality test: The stepping stone method and MODI method. Improving the solution.

Unit-III

05 Hrs.

Dynamic Programming: Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortest path problem, cargo loading problem

Unit-IV

10 Hrs.

Queuing Models: Characteristics of queuing models.

Single Channel-Single and multi-phase servers, Poisson arrivals, exponential service time - with infinite population and finite population models – with infinite and finite capacity.

Multichannel- Single phase server- Poisson arrivals, exponential service time with infinite population.

Game Theory: Introduction. Minimax & Maximin Criterion and optimal strategy. Solution of games with saddle points, rectangular games without saddle points - 2 x 2 games, dominance principle.

Approximate methods - Iterative method, m x 2 & 2 x n games -Graphical method and method of sub-games. Expressing game as LPP.

Unit-V

06 Hrs.

Simulation: Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages.

Replacement Models: Replacement of items that deteriorate with time - when money value



counted and counted, Replacement of items that fail suddenly – individual and group replacement policy

Text Books:

1. Sharma J. K., "Operations Research", Trinity Press.
2. Gupta P. K., Hira D. S., "Operations Research", S. Chand Limited.

Reference Books:

1. Taha, H.A, "Operations Research - An Introduction", Prentice Hall
2. Ravindran, A, Phillips, D. T and Solberg, J. J., "Operations Research: Principles and Practice", John Willey and Sons
3. Hiller, F. S. and Lieberman, G. J., "Introduction to Operations Research", Tata McGraw Hill
4. Pradeep Prabhakar Pai, "Operations Research Principles and Practice", Oxford University Press
5. R. Panneerselvam, "Operations Research", PHI Publications.
6. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education.
7. Kanti Swarup, P. K. Gupta and Man Mohan, "Operations Research", Sultan Chand & Sons.



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Cyber Security and Laws (22OEAI7054T)		

Course Objective(s):

1. To understand and identify different types cybercrime and cyber offences.
2. To recognized Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Understand the different types of cybercrime and security issues E Business.	L2	Understand
CO2	Analyses different types of cyber threats and techniques for security management.	L4	Analyze
CO3	Explore the legal requirements and standards for cyber security in various countries to regulate cyberspace.	L4	Analyze
CO4	Impart the knowledge of Information Technology Act and legal frame work of right to privacy, data security and data protection.	L2	Understand



Cyber Security and Laws (22OEAI7054T)

Course Contents

Unit-I

10 Hrs.

Introduction to Cybercrime

Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus & Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow, Phishing Identity Theft (ID Theft), How criminal plan the attacks, Social Engineering, Cyber stalking.

Unit-II

06 Hrs.

Cyber Threats Analysis

Knowledge of Dynamic and Deliberate Targeting

Knowledge of Indications and Warning

Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities and Actions

Knowledge of Key Cyber Threat Actors and their Equities

Knowledge of Specific Target Identifiers and Their Usage

Unit-III

06 Hrs.

Electronic Business and legal issues

Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E- Cheque, E-Cash, E-Payment, Threats & Protections, Security for E-Commerce.

Unit-IV

08 Hrs.

Indian IT Act

Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments

Security aspect in cyber Law

The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law.

Unit-V

09 Hrs.

Security Industries Standard Compliances



IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI- DSS.

OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet Security Controls).

Reference Books:

1. Nina Godbole, Smit Belapure, "Cyber Security", Wiley India, New Delhi.
2. Suresh T. Vishwanathan, "The Indian Cyber Law", Bharat Law House New Delhi.
3. "The Information Technology Act", Bare Act- Professional Book Publishers, New Delhi, 2000.
4. Anup K. Ghosh, "E-Commerce Security and Privacy", Springer Science and Business Media, 2012.
5. Izzat Alsmadi, "The NICE Cyber Security Framework Cyber Security Intelligence and Analytics", Springer.
6. Advocate Prashant Mali, "Cyber Law & Cyber Crimes", Snow White Publications, Mumbai.
7. Nina Godbole, "Information Systems Security", Wiley India, New Delhi.
8. Kenneth J. Knapp, "Cyber Security & Global Information Assurance", Information Science Publishing.
9. William Stallings, "Cryptography and Network Security", Pearson Publication.

Web Links:

1. The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
2. A Compliance Primer for IT professional:
<https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Personal Finance Management (22OEAI7055T)		

Prerequisite: Basic Knowledge of Algebra, Probability, and Statistics.

Course objective(s):

1. To create awareness and educate consumers about access to financial services.
2. To make the students understand the basic concepts, definitions, and terms related to direct taxation.
3. To help students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familiarize students with microfinance to accelerate the expansion of local micro-businesses.

Course outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use a framework for financial planning to understand the overall role finances play in his/her personal life.	L2	Understand
CO2	Compute income from salaries, house property, business/profession, capital gains and income from other sources.	L3	Apply
CO3	Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit. .	L3	Apply
CO4	Understand how Microfinance can help in financial inclusion.	L2	Understand



Personal Finance Management (22OEAI7055T) Course Contents

Unit-I

07 Hrs.

Overview of Indian Financial System: Characteristics, Components, and Functions of Financial System. Financial Instruments and Financial Markets, Financial Inclusion.

Introduction to Personal Finance: Personal Financial Planning in Action, Money Management Skills, Taxes in Your Financial Plan, Savings and Payment Services.

Consumer Credit: Advantages, Disadvantages, Sources and Costs.

Unit-II

07 Hrs.

Personal Financial Management:

Loans: Home, Car, Education, Personal, Loan against property, and Jewel loan.

Insurance: Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance.

Investment: Investing Basics and Evaluating Bonds, Investing in Stocks and Investing in Mutual Funds, Planning.

Unit-III

07 Hrs.

Income Tax:

Income Tax Act Basics- Introduction to Income Tax Act, 1961

Heads of Income and Computation of Total Income and Tax Liability- Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, set off and carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons.

Tax Management, Administrative Procedures and ICDS - TDS, TCS and Advance Tax Administrative Procedures, ICDS.

Unit-IV

09 Hrs.

Goods and Services Tax:

GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; Major Defects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration.

Levy and Collection of GST:

Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses;



Unit-V

09 Hrs.

Introduction to Micro – finance: Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinances, Customers of Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation & Operation of Self-Help Groups (SHGs).

Models in Microfinance: Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges.

Institutional Mechanism: Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints & Governance Issues, Institutional Structure of Microfinance in India: NGO-MFIs, NBFC- MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand & Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs

Reference Books:

1. Asha Singh, M.S. Gupta, "Banking and Financial Sector Reforms in India", Serials Publication.
2. M.S. Gupta & J.B. Singh, "Indian Banking Sector: Essays and Issues", 1st Edition, Serials Publication.
3. K.M. Bhattacharya O.P. Agarwal, "Basics Of Banking & Finance", Himalaya Publishing House.
4. S. Subba Reddy , P. Raghu Ram, "Agricultural Finance And Management".
5. Dr.Vasant Desai, "The Indian Financial System And Development", 4th Edition, Himalaya Publishing House.
6. Sanjay Kumar Satapathy, "Income Tax Management Simple Way of Tax Management, Tax Planning and Tax Saving".
7. Dr. R. K. Jain, "Direct Tax System Income Tax", SBPD Publications.
8. S K Mishra, "Simplified Approach to GST Goods and Services Tax", Educreation Publishing.
9. Todd A Watkins, "Introduction To Microfinance", World Scientific Publishing Company.



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Energy Audit and Management (22OEAI7056T)		

Prerequisite: Nil

Course objective(s):

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To identify and describe present state of energy security and its importance.	L2, L3	Understand, Apply
CO2	To identify and describe the basic principles and methodologies adopted in energy audit of a utility.	L2, L3	Understand, Apply
CO3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.	L2	Understand
CO4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.	L2	Understand
CO5	To analyze the data collected during performance evaluation and recommend energy saving measures.	L4	Analyze



Energy Audit and Management (22OEAI7056T) Course Contents

Unit-I

05 Hrs.

Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms. Material and Energy balance.

Unit-II

09 Hrs.

Energy Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting, Energy audit instruments. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit.

Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI) Internal rate of return (IRR).

Unit-III

10 Hrs.

Energy Management and Energy Conservation in Electrical System:

Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.

Unit-IV

09 Hrs.

Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation-types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.

Unit-V

06 Hrs.

Energy conservation in Buildings:

Energy Conservation Building Codes(ECBC): Green Building, LEED



Application of Non-Conventional and Renewable Energy Sources, Energy sources and energy management in electric vehicles.

Reference Books:

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

Web Links:

1. www.energymanagertraining.com
2. www.bee-india.nic.in



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Disaster Management and Mitigation Measures (22OEAI7056T)		

Prerequisite: Nil

Course Objective(s):

1. To provide basic understanding hazards, disaster and various types and categories of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand roles and responsibilities of individual and various organization during and after disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Know natural as well as manmade disaster and their extent and possible effects on the economy.	L2	Understand
CO2	Know the institutional framework and organization structure in India for disaster management and get acquainted with government policies, acts and various emergency laws.	L2	Understand
CO3	Get to know the simple dos and don'ts in such extreme events and build skills to respond accordingly.	L2	Understand
CO4	Understand the importance of disaster prevention and various mitigation measure with the exposure to disasters hotspots across the globe.	L2	Understand



Disaster Management and Mitigation Measures (22OEAI7056T)

Course Contents

Unit I

09 Hrs.

General Information about Disaster: Brief concept of Hazards, definition and types of Disasters–Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters, Impact of disaster on National development.

Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc.

Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit II

08 Hrs.

Disaster Management: Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc.

Prior, During and Post disaster management activities: (Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration.

Unit III

07 Hrs.

Institutional framework and Mechanism for disaster management in India: Institutions in India for dealing with various disasters, Organizational structure, functions and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central and state government during and after disaster NGO's involved in disasters and their task, Jobs carried out by armed forces. Financial Relief During disaster (State, National and International Disaster Assistance)

Unit IV

08 Hrs.

Disaster risk reduction and Mitigation Measures: Need of disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.



Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality, climate change, land use, winter storms and aquatic biology etc.

Use of information management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.

Unit V

07 Hrs.

Case studies on disaster (National /International): Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004) , Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on.

(Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)

Reference Books & Reports:

1. Harsh K.Gupta, "Disaster Management", Universities Press Publications, 2003.
2. O.S.Dagur, "Disaster Management: An Appraisal of Institutional Mechanisms in India", published by Centre for land warfare studies, New Delhi, 2011.
3. Damon Copolla, "Introduction to International Disaster Management", Butterworth Heinemann Elsevier Publications 2015.
4. Jack Pinkowski, "Disaster Management Handbook", CRC Press, Taylor and Francis group 2008.
5. Rajdeep Dasgupta, "Disaster management & rehabilitation", Mittal Publications, New Delhi 2007.
6. R B Singh, "Natural Hazards and Disaster Management, Vulnerability and Mitigation", Rawat Publications 2006.
7. C.P.Lo Albert, K.W. Young, "Concepts and Techniques of GIS", Prentice Hall (India) Publications 2006.
8. Claudia G. Flores Gonzales, "Risk management of natural disasters", KIT Scientific Publishing 2010.
9. W. Nick Carter, "Disaster Management – a disaster manager's handbook", Asian Development Bank 2008.
10. R. K. Srivastava, "Disaster Management in India", Ministry of Home Affairs. GoI, New Delhi 2011.
11. Wil Mara, "The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy", Marshall Cavendish Corporation, New York, 2011.



12. Ronald Eisler, "The Fukushima 2011 Disaster", Florida, 2013. (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Science of Well-being (22OEAI7058T)		

Prerequisite: Nil

Course Objective(s):

1. To create consciousness about importance of holistic health and physical as well as mental well-being.
2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathy etc.
3. To introduce the learners to the means of mental and physical well-being, ill effects of malpractices like alcoholism, smoking etc.
4. To equip the learners to manage and cope up with stress in their daily living.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe concepts of holistic health and well-being, differentiate between its true meaning and misconceptions and understand the benefits of well-being.	L2	Understand
CO2	Recognize meaning of happiness, practice gratitude and self-compassion and analyze incidents from one's own life.	L4	Analyze
CO3	Understand the causes and effects of stress, identify reasons for stress in one's own surrounding and self.	L2	Understand
CO4	Recognize the importance of physical health and fitness, assess their life style and come up with limitations or effectiveness.	L5	Evaluate
CO5	Inspect one's own coping mechanism, assess its effectiveness, develop and strategize for betterment and execute it.	L4	Analyze



Science of Well-being (22OEAI7058T)

Course Contents

Unit I

06 Hrs.

Health and well-being: The concept of health, dimensions of health, the notion of well-being, various facets of well-being, relation between health and well-being.

Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.

Unit II

08 Hrs.

Concepts of happiness: Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.

Unit III

09 Hrs.

Stress and mental health/well-being: Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms of stress, effects of stress, different models of stress.

Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.

Unit IV

08 Hrs.

Physical Well-being / Health management: concept of health behaviours, dimensions of health behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, Concept of Malnutrition, Health compromising behaviours: Alcoholism, Smoking and its effects on health.

Unit V

08 Hrs.

Dealing with Difficult Times / Coping mechanisms: The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders.

Concept of coping, Ways of coping and stress management, basic knowledge about stress management, various techniques of stress management, stress management programs.



Mental strengths and virtues, Hope, Optimism, Resilience – concept, pathways and models, Meditation and Self-introspection.

Text Books:

1. Felicia Huppert, Nick Baylis, Barry Keverne, "The Science of well-being", Oxford University Press.
2. S. Ojha, U. Rani Srivastava, Shobhna Joshi, "Health and Well-Being: Emerging Trends", Global Vision Publishing House.
3. Shane J. Lopez, Jennifer Teramoto Pedrotti, Charles Richard Snyder, "Positive psychology: The scientific and practical explorations of human strengths", Sage Publications.

Reference Books:

1. Kitayama S. & Markus H. R., "The pursuit of happiness and the realization of sympathy: Cultural patterns of self, social relations, and well-being.", Culture and subjective well-being, The MIT Press.
2. Dubos R., "Man Adapting", New Haven: Yale University Press.
3. McMahon D. M., "Happiness a history", Atlantic Monthly Press.
4. D. Kahneman, E. Diener & N. Schwarz, "Well-being: The foundations of hedonic psychology", New York: Russell Sage.
5. Selye H., "The Stress of Life." New York; McGraw-Hill; 1984.



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech.	Semester: VII
Research Methodology (22OEAI7059T)		

Prerequisite: Basic knowledge of Probability and Statistics

Course Objective(s):

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

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Prepare a preliminary research design for projects in their subject matter areas.	L3	Apply
CO2	Accurately collect, analyze and report data.	L4	Analyze
CO3	Present complex data or situations clearly.	L2	Understand
CO4	Review and analyze research findings.	L4	Analyze
CO5	Write report about findings of research carried out.	L3	Apply



Research Methodology (22OEAI7059T)

Course Contents

Unit-I 07 Hrs.

Basic Research Concepts:

Meaning of research, Objectives of research, Types of research, Significance of research Research process.

Unit-II 09 Hrs.

Research Methodology:

Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.

Unit-III 09 Hrs.

Research and Sample Design::

Meaning of research and sample design, Need of research design, Features of good research design, Important concepts, Different research designs, Types of sampling designs

Unit-IV 09 Hrs.

Data Collection and Data Analysis:

Types of data, Methods for collecting data: Experiments and surveys, Collection of primary and secondary data, Hypothesis testing and interpretation of Data

Unit-V 05 Hrs.

Interpretation and Report Writing:

Interpretation and drawing conclusions on the research, Preparation of the report, Ethical Issues

Reference Books:

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



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Public Systems and Policies (22OEAI70510T)		

Prerequisite: Basic Knowledge of Social Science and Current Affairs

Course Objective(s):

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
2. To understand public systems in a fast-changing environment in the global context.
3. To provide an in-depth understanding of the ills prevailing in society and identify solutions.
4. To explain public policy and its operations, with special focus on policies relating to government finance.
5. To analyze and evaluate the impact of the public policy on firms and economy at large.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Bloom's Level	Bloom's Description
CO1	Understand the importance of public systems in a fast-changing environment in the global context.	L2	Understand
CO2	Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.	L4	Analyze
CO3	Explain public policy and its operations with special focus on policy relating to Government finance.	L3	Explain
CO4	Make policies and know about the happenings in the world, in the nation and those in their locality.	L3	Apply
CO5	Analyze and evaluate the impact of the public policy on firms and economy at large and work under various fields as policymakers.	L4	Analyze



Public Systems and Policies (22OEAI70510T)

Course Contents

Unit-I

09 Hrs.

Introduction and Overview of Public Systems: Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size of Government.

Unit-II

06 Hrs.

Public Sector in the Economic Accounts: Public Sector in the circular flow; Public Sector in the National Income Accounts.

Unit-III

07 Hrs.

Public Choice and Fiscal Politics: Direct Democracy; Representative Democracy; The Allocation Function: The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.

Unit-IV

11 Hrs.

Introduction and Overview of Public Policy: Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Public policy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.

Unit-V

06 Hrs.

Case Studies in Expenditure Policy: Public Services

A) National Defense B) Highways C) Outdoor Recreation D) Education

Reference Books:

1. Charles Wheelan, "Introduction to Public Policy", W.W. Norton & Company.
2. Thomas R. Dye, "Understanding Public Policy", Prentice Hall.
3. J.E. Anderson, Houghton, "Public Policy-Making: An Introduction".
4. Avasthi & Maheshwari, "Public Administration", Lakshminarayan Agarwal, Agra.
5. Mohit Bhattacharya, "New Horizons of Public Administration", Jawahar Publishers, New Delhi.
6. Nicholas Henry, "Public Administration and Public Affairs", Prentice Hall of India, New Delhi.



7. Harvey S. Rosen and Ted Gayer, "Public Finance", 10th Edition, McGraw-Hill Education, 2013.
8. Musgrave and Musgrave, "Public Finance in Theory and Practice".



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Project Stage-II (22PJAI7060L)		

Course Objectives:

- To implement the solution as per the problem statement.
- To develop the team building, writing, logical reasoning and management skills.
- To provide the connections between the designs and concepts across different disciplinary boundaries.
- To encourage students to become independent personnel, critical thinkers and lifelong learners

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply engineering knowledge to produce solution of a problem considering cultural, social, environmental, and economic factors using appropriate tool and method.	L4	Analyze
CO2	Demonstrate project based learning that allows students to transfer existing ideas into new applications.	L2	Understand
CO3	Develop an ability to work in teams and manage the conduct of the research study.	L3	Apply
CO4	Integrate different perspectives from relevant disciplines which help them to get internships, jobs and admission for higher studies.	L3	Apply
CO5	Present the research in the form of technical writing, understand what constitutes to plagiarism and how to use proper referencing styles.	L2	Understand



Syllabus:

Project-I work done in VI semester shall be continued as Project-II in semester VII.

Students should complete remaining implementation of ideas given in synopsis/Abstract of semester VI.

Students / group must plan their execution of project, so that project work should be completed before end of semester.

Project-II involves fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.

The stage also includes testing, possible results and report writing.

Each project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VII in the form of Hard bound.

Domain knowledge (any beyond) needed from the various areas in the field of AIML for the effective implementation of the project.

The above areas can be updated based on the technological innovations and development needed for specific project.

Guidelines:

The main purpose of this activity is to improve the students' technical skills, communication skills by integrating writing, presentation and teamwork opportunities.

Each group will be reviewed twice in a semester and marks will be allotted based on the various points mentioned in the evaluation scheme.

In the first review of this semester, each group is expected to complete 70% of project.

In the second review of this semester, each group is expected to complete 100% of project.

The students may use this opportunity to learn different computational techniques towards development of a product.

Interaction with alumni mentor will also be appreciated for the improvement of project.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).
- The candidate must bring the Project Stage-I report and the final report completed in all respect while appearing for End Semester Examination.
- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration based on their project.



Prescribed project report guidelines:

Every group should prepare hard bound report (preferable LaTeX) of about minimum 40 pages on the work carried out by a batch of students in respect of the project work done during semester-VII.

Project Report should include appropriate content for:

- Title
- Abstract
- Introduction
- Problem identification and project objectives
- Literature Survey
- Related Theory
- Project design and Implementation details
- Case study/Analysis/Design Methodology
- Project Outcomes
- Result and Conclusion
- Future scope
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintain	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:



Each group will be reviewed twice in a semester by faculty guide and faculty coordinator based on the following criteria:

- Project progress
- Documentation/Technical paper writing
- Key findings
- Validation of results
- Product Development

Each review consists of 25 marks. Average of the marks scored in both the two reviews will be considered for final grading. The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Fabrication/ Modeling/ Simulation	Result Verification	Presentation	Total
			5	5	5	5	5	25



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VII
Employability Skill Development Program-III (22HMAI7070L)		

Course Objective(s):

- To build a solid foundation in programming fundamentals.
- To enhance problem-solving abilities through mathematical reasoning.
- To develop algorithmic thinking.
- To provide hands-on experience with essential data structures.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply basic programming skills to write and debug simple programs using conditions, loops, and functions	L3	Apply
CO2	Analyze mathematical problems and use techniques like number theory and modular arithmetic in problem-solving.	L4	Analyze
CO3	Design and implement algorithms to solve real-world problems using methods like recursion, greedy, and sorting.	L6	Create
CO4	Use common data structures such as arrays, strings, sets, and maps effectively in programming tasks.	L3	Apply



Employability Skill Development Program-III (22HMAI7070L) Course Contents

Unit-I

06 Hrs.

Programming Fundamentals:

- Basic Programming Concepts
- Conditional Statements
- Loops
- Inbuilt functions
- Data Types
- Python

Unit-II

06 Hrs.

Mathematics:

- Mathematics
- Basic Math
- Arithmetic
- Modular Arithmetic
- Divisibility
- Integer Division
- GCD
- Geometry
- Number System
- Binary

Unit-III

06 Hrs.

Algorithms:

- Algorithms
- Brute Force
- Greedy



- Constructive
- Sorting
- Simple Algos
- Recursion
- Recurrence Relation
- Observation
- Implementation

Unit-IV

08 Hrs.

Data Structures:

- Data Structures
- Arrays
- 1D Arrays
- String
- Subsequence
- Frequency Arrays
- Maps
- Sets

Reference Books:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 5th Edition, Career-Monk Publications, 2016.
2. Dr. R. S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand Publishing, 2021.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 4th Edition, The MIT Press, 2022.





Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur
(An Autonomous Institute)

Course Structure and Syllabus

Final Year B. Tech

Artificial Intelligence and Machine Learning

With effect from Year 2025-26



Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Final Year B. Tech Artificial Intelligence and Machine Learning Semester-VIII (w.e.f. 2025-26)														
Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Total	Credit	
				L	T	P	Continuous Assessment (CA)				ESE			
							TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)				
				L	T	P	[A]			[B]	[C]	[A+B+C]		
1@	PE1	22PEAI8011T	Reinforcement and Federated Learning*	3			25	10	10	10	65	100	3	3
		22PEAI8012T	AI in Healthcare*	3			25	10	10	10	65	100	3	
		22PEAI8013T	Quantum Computing*	3			25	10	10	10	65	100	3	
		22PEAI8014T	NPTEL/Swayam Course#	3			25	10	10	10	65	100	3	
2@	PE2	22PEAI8021T	Responsible AI*	3			25	10	10	10	65	100	3	3
		22PEAI8022T	Image Generative AI*	3			25	10	10	10	65	100	3	
		22PEAI8023T	Social Network Analysis*	3			25	10	10	10	65	100	3	
		22PEAI8024T	NPTEL/Swayam Course#	3			25	10	10	10	65	100	3	
3	INT	22INTAI8030L	Internship			20	150				150	300	10	
4	MC	22MCAI8040T	Disaster Management and Preparedness	2										Audit
Total				8		20	200			20	280	500	16	

1. @ Any 1 Elective Course. *Professional Elective Courses offered for the students doing Internship at institute level
2. #Professional Elective Courses offered for the students doing Internship at Industry. These courses are to be studied in self study mode using NPTEL/Swayam platform.
3. Students doing internship at industry shall submit certificate of successfully passing respective NPTEL examination OR they have to appear examinations conducted by institute like TT1, TT2 and ESE.
4. Students undergoing internship have the option to appear for both the NPTEL examination and the End Semester Examination (ESE) conducted by the institute for the respective course. In such cases, the better of the two scores (NPTEL or ESE) shall be considered for final grading.
5. List of NPTEL courses will be declared by concerned BOS at the beginning of semester-VIII.

Prepared by:
Dr. N. G. Shinde

Prof. Dr. D. R. Patil
BOS Chairman

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Checked by:
Dr. S. P. Patil

Prof. S. P. Shukla
C.O.E.

Prof. Dr. J. B. Patil
Director



**Artificial Intelligence and Machine
Learning
Final Year B. Tech
Semester - VIII**



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Reinforcement and Federated Learning (22PEAI8011T)		

Prerequisite: Machine Learning, Knowledge of Probability, Linear Algebra, and Calculus, Python programming and deep learning frameworks (TensorFlow / PyTorch).

Course Objectives: To provide a comprehensive understanding of Reinforcement Learning (RL) principles, algorithms, and applications, including multi-armed bandits, dynamic programming, temporal difference learning, and deep RL. Students will acquire practical skills in model-free and model-based RL, policy evaluation, and function approximation using neural networks. The course covers real-world applications in robotics, gaming, recommender systems, and industry. It also introduces Federated Learning (FL) fundamentals for privacy-preserving distributed learning. Learners will explore the integration of RL and FL in practical scenarios.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the fundamental concepts of reinforcement learning, including agents, environments, rewards, policies, and the mathematical foundations such as value functions and Bellman equations.	L2	Understand
CO2	Formulate and solve Markov Decision Processes (MDPs) and multi-armed bandit problems using dynamic programming, Monte Carlo methods, and temporal difference learning.	L6	Create
CO3	Apply deep reinforcement learning algorithms, including Deep Q-Networks (DQN) and Policy Gradient methods, for practical problems in games, robotics, and industrial applications.	L3	Apply
CO4	Explain the principles of federated learning, including FedAvg, privacy mechanisms, and communication challenges, and analyze potential applications in healthcare, finance, and personalized AI systems.	L2	Understand



Reinforcement and Federated Learning (22PEAI8011T) Course Contents

Unit-I

07 Hrs.

Introduction to Reinforcement Learning: Introduction to reinforcement learning. RL Elements: Agent, Environment, Rewards, States, Actions, Policy, History and applications (Games, Robotics, Recommenders, Industry), Mathematical foundations: Rewards, returns, discounting, Value functions (V and Q), Bellman equations, Markov Decision Processes (MDPs): States, actions, transitions, rewards, Episodic vs continuing tasks, Difference between Immediate and Full Reinforcement Learning.

Unit-II

07 Hrs.

Bandit Problems: k-armed bandit, Stochastic rewards, Action-value methods, Exploration vs Exploitation, Bandit Algorithms: ϵ -greedy method, Optimistic initial values, Softmax / Boltzmann exploration, Upper Confidence Bound (UCB), Thompson Sampling Relationship between MAB and RL Non-stationary bandits, Real-world applications: Online advertising: A/B testing, Recommendation systems, Clinical trials.

Unit-III

07 Hrs.

Dynamic Programming & Planning: Model-based RL, Policy evaluation, Policy improvement, Policy iteration, Value iteration, Generalized Policy Iteration (GPI), Convergence issues, Applications: Gridworld, path planning.

Unit-IV

07 Hrs.

Model-Free Prediction & Control: Monte Carlo Methods, Monte Carlo prediction, First-visit vs every-visit MC, Monte Carlo control, Exploring Starts, Off-policy MC & importance sampling, Temporal Difference Methods: TD(0) prediction, SARSA (on-policy control), Q Learning (off-policy control), Expected SARSA, Advanced TD Methods, n-step bootstrapping, Eligibility traces, TD(λ).

Unit-V

07 Hrs.

Deep Reinforcement Learning: Function approximation, Deep neural networks for RL, Deep Q-Network (DQN), Experience replay, Target networks, Variants: Double DQN, Dueling DQN (optional), Policy Gradient Methods: REINFORCE algorithm, Actor-Critic Methods, Case studies: Atari games, CartPole, Robotics control & navigation, Samuel's Checkers Player, Dynamic Channel Allocation, Job-Shop Scheduling.



Federated Learning Fundamentals, Privacy & Applications:

Motivation for Federated Learning, FL architecture: Clients, server, communication cycles, Federated Averaging (FedAvg) algorithm, Data heterogeneity & communication challenges, Differential privacy, Secure aggregation, Adversarial attacks & model poisoning Benchmark frameworks: TensorFlow Federated, PySyft, Flower, Applications: Healthcare, Finance, Personalized AI, (Optional) RL + FL combined applications.

**Text Books:**

1. Soumyadip Sarkar, “An Introduction to Reinforcement Learning”, Notion Press, 2025.
2. Saravanan Krishnan, A. Jose Anand, R. Srinivasan, R. Kavitha, S. Suresh, “Handbook on Federated Learning: Advances, Applications and Opportunities”, CRC Pr I Llc, 2025.
3. Milad Farsi, Jun Liu, Maria Domenica Di Benedetto, “Model-Based Reinforcement Learning: From Data to Continuous Actions with a Python-based Toolbox (IEEE Press Series on Control Systems Theory and Applications)”, Wiley-IEEE Press, 2022.
4. Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction”, MIT Press, 2nd Edition, 2020.
5. Laura Graesser Wah Loon Keng, “Foundations of Deep Reinforcement Learning”, Pearson Education, 1st Edition, 2020.

Reference Books:

1. Marcus C Lauritsen, “Reinforcement Learning for Beginners: A Step-by-Step Guide to Training Smart AI Agents”, Independently Published, 2025.
2. Qiang Yang , Yang Liu, “Federated Learning”, Springer / BSP Books, 1st Edition, 2025.
3. George Jenö, “Federated Learning with Python: Design and implement a federated learning system and develop applications using existing frameworks”, Packt Publishing, 1st Edition, 2022.
4. Phil Winder, “Reinforcement Learning Industrial Applications of Intelligent Agents”, O’Reilly, 1st Edition, 2020.
5. Csaba Szepesvari, “Algorithms for Reinforcement Learning”, Morgan & Claypool Publishers, 1st Edition, 2019.
6. Enes Bilgin, “Mastering Reinforcement Learning with Python”, Packt publication, 1st Edition, 2020.

7. Brandon Brown, Alexander Zai, “Deep Reinforcement Learning in Action”, Manning Publications, 1st Edition, 2020.
8. Micheal Lanham, “Hands-On Reinforcement Learning for Games”, Packt Publishing, 1st Edition, 2020.
9. Abhishek Nandy, Manisha Biswas, “Reinforcement Learning: With Open AI, TensorFlow and Keras using Python”, Apress, 1st Edition, 2018.

Weblinks:

1. NPTEL Course in Reinforcement Learning:
https://onlinecourses.nptel.ac.in/noc22_cs75/preview
2. Reinforcement Learning Course (Stanford University):
<https://www.youtube.com/watch?v=FgzM3zpZ55o>
3. AI Games with Deep Reinforcement Learning: <https://towardsdatascience.com/how-to-teach-an-ai-to-play-games-deep-reinforcement-learning-28f9b920440a>
4. Deep Reinforcement Learning: <https://www.v7labs.com/blog/deep-reinforcement-learning-guide>
5. TensorFlow Federated documentation: <https://www.tensorflow.org/federated>
6. OpenAI Gym documentation: <https://gym.openai.com>
7. Federated Learning What Is Federated Learning? — IBM
8. Federated Learning <https://blogs.nvidia.com/blog/what-is-federated-learning/>
9. Federated Learning 8 Innovative applications of federated learning across the globe - OpenSistemas



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
AI in Healthcare (22PEAI8012T)		

Prerequisite:

- Knowledge of Machine Learning (Supervised/Unsupervised Learning).
- Understanding of Deep Learning and Neural Networks.
- Familiarity with Data Science tools (Python, TensorFlow/PyTorch).



Course Objective(s):

1. To understand the role of AI in transforming healthcare.
2. To learn how to apply AI techniques such as machine learning, deep learning, and natural language processing (NLP) to healthcare data.
3. To gain hands-on experience in working with real healthcare datasets.
4. To discuss ethical, privacy, and regulatory concerns related to AI in healthcare.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify and evaluate various types of healthcare data (e.g., EHR, medical imaging, genomic data) and assess challenges like data privacy, bias, and regulatory constraints.	L5	Evaluate
CO2	Apply machine learning algorithms (classification, clustering, time-series analysis) for predictive analytics, diagnostics, and clinical decision support systems using healthcare datasets.	L3	Apply
CO3	Apply deep learning architectures (CNNs, RNNs) for medical image classification, segmentation, and time-series health data analysis, enhancing diagnostic accuracy.	L3	Apply
CO4	Use AI tools to aid in drug discovery and optimize personalized medicine approaches by analyzing genomic data and predicting patient responses to treatments.	L3	Apply
CO5	Discuss and address ethical challenges, privacy issues, and the legal framework surrounding the deployment of AI systems in clinical settings.	L2	Understand

AI in Healthcare (22PEAI8012T)

Course Contents



Unit-I

06 Hrs.

Introduction to AI in Healthcare:

Overview of AI in Healthcare: Historical perspective, Types of AI systems in healthcare, Role of AI in healthcare transformation.

Key Healthcare Domains for AI Applications: Medical imaging, Diagnostics, Drug discovery, Personalized medicine.

Challenges in Healthcare Data: Data variability, noise, and incompleteness, Data privacy and security concerns, Regulatory constraints.

Unit-II

08 Hrs.

Machine Learning in Healthcare: Introduction to Healthcare Data: Electronic Health Records (EHR), Medical imaging data (X-rays, MRIs, CT scans), Genomics and clinical trial data. Machine Learning Techniques: Classification and regression for disease prediction, Clustering for patient stratification, Time series analysis for health monitoring. **Use cases:** Predictive analytics, clinical decision support systems.

Unit-III

08 Hrs.

Deep Learning in Healthcare: **Introduction to Deep Learning Architectures:** Convolutional Neural Networks (CNNs) for medical imaging, Recurrent Neural Networks (RNNs) for time-series health data, Auto encoders for anomaly detection.

Applications in Medical Imaging: Image classification, segmentation, and detection in radiology.

Natural Language Processing (NLP) in Healthcare: Information extraction from medical literature and EHRs, NLP applications: Chatbots, virtual assistants, voice recognitions.

Introduction to Federated Learning in Healthcare data

Unit-IV

08 Hrs.

AI in Drug Discovery and Personalized Medicine: **AI-Driven Drug Discovery:** Introduction to computational drug discovery and AI Case studies: AI in accelerating drug development.

AI for Personalized Medicine: AI-based genomic analysis, Predicting patient responses to therapies, Tailoring treatment plans using AI models.

Unit-V

07 Hrs.

AI Ethics, Privacy, and Regulations in Healthcare: Ethical Considerations in AI for Healthcare: Bias in AI models and its implications, AI decision-making in healthcare. Privacy and Security

in Healthcare AI: Handling sensitive healthcare data, Regulations: HIPAA, GDPR, and their implications for AI. **Regulatory Aspects and AI Approval:** AI in clinical trials and FDA approvals.

Unit-VI

05 Hrs.

Emerging Trends of AI in Healthcare: Wearable AI and Remote Monitoring: AI for patient monitoring using IoT and wearables. AI in Robotics and Surgery: AI-assisted surgeries, robotic platforms, and automation. Telemedicine and AI Integration: AI-driven remote consultations and diagnostics.

Text Books:

1. Hui Yang and Eva K. Lee, “Healthcare Analytics: From Data to Knowledge to Healthcare Improvement”, Wiley Publication, 2016.
2. Adam Bohr and Kaveh Memarzadeh, “Artificial Intelligence in Healthcare”, Science Direct, Academic Press, 2020.
3. Zhou, S. K., Greenspan, H., & Shen, D., “Deep learning for medical image analysis”, Academic Press, 2017.

Reference Books:

1. Floridi, L., & Taddeo, M. (Eds.). (2021). Ethics of artificial intelligence in healthcare. Springer / ACM. (Note: The exact editor names may vary slightly depending on the specific volume; Springer publishes multiple editions on AI ethics.)
2. Topol E., “Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again”, New York, NY: Basic Books, 2019.
3. Frangi, A. F., et al., “Medical image analysis”, Elsevier, 2023.

Research Paper:

1. Rieke, N., Hancox, J., Li, W., Milletari, F., Roth, H. R., Albarqouni, S., . . . & Cardoso, M. J. (2020). The future of digital health with federated learning. npj Digital Medicine, 3(119).

Online Resources:

1. <https://ai.stanford.edu/>
2. <https://drerictopol.com/tag/medical-ai/>
3. <https://medicalfuturist.com/>
4. <https://blogs.nvidia.com/blog/tag/healthcare-life-sciences/>
5. <https://www.coursera.org/specializations/ai-for-medicine/>



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Quantum Computing (22PEAI8013T)		

Prerequisite: Statistics for Data Science, and Machine Learning-I.

Course Objective(s):

To equip students with foundational and practical knowledge of quantum computing, enabling them to understand quantum principles, analyze quantum algorithms, and apply quantum tools for solving computational problems.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basic principles and mathematical foundations of quantum computing including qubits, superposition, and entanglement.	L2	Understand
CO2	Analyze and construct quantum circuits for various quantum operations.	L4	Analyze
CO3	Demonstrate applications of key quantum algorithms such as Deutsch-Jozsa, Grover's, and Shor's.	L3	Apply
CO4	Apply quantum cryptographic protocols like BB84 and analyze their security features.	L3	Apply
CO5	Evaluate the effects of quantum error correction and noise models in computations.	L5	Evaluate
CO6	Use industry-standard quantum programming platforms (e.g., Qiskit) to design, simulate, and test quantum algorithms.	L3	Apply



Quantum Computing (22PEAI8013T)

Course Contents

Unit-I 06 Hrs.

Mathematical and Physical Foundations:

Linear algebra: vectors, matrices, complex numbers, tensor product,

Probability theory: basics, random variables, Quantum mechanics: states, postulates, Hilbert space formalism, Dirac notation, Superposition, measurements, evolution (unitary operators), The Bloch sphere: geometric representation of qubits.

Quantum time evolution, Schrödinger equation, von Neumann entropy.

Unit-II 07 Hrs.

Qubits and Multi-Qubit Systems:

Single qubit systems: X, Y, Z, Hadamard, Rotation, Phase gates, Multi-qubit systems: tensor products, CNOT, SWAP, Toffoli gates. State representations and matrix forms, No-cloning theorem, Bell states, entanglement, EPR pairs, Schmidt decomposition.

Unit-III 07 Hrs.

Quantum Circuits and Computation: Quantum Boolean circuits, quantum circuit model, Church-Turing hypothesis (quantum extensions), Circuit universality, Solovay-Kitaev theorem, circuit complexity, Bloch sphere operations, circuit optimization.

Unit-IV 08 Hrs.

Quantum Algorithms: Quantum oracles and query models, Deutsch's Algorithm, Deutsch Jozsa Algorithm., Bernstein-Vazirani and Simon's algorithms, Phase estimation, Quantum Fourier Transform.

Applications: order-finding, period-finding, Shor's algorithm (quantum factoring), Grover's Algorithm: unstructured search and amplitude amplification, quantum walks, Optimality proofs for algorithms.

Unit-V 07 Hrs.

Quantum Cryptography and Communication: Quantum key distribution (BB84 protocol), Superdense coding, quantum teleportation, Physical realizations of qubits (superconducting, trapped ions, photonic), Basics of quantum networks and communication.

Unit-VI 07 Hrs.

Complexity, Error Correction, and Advanced Topics: Quantum complexity classes: BQP,

relationship to classical P/NP/EXP, Lower bounds and quantum query complexity (adversary, polynomial methods), Quantum error correction: Shor code, Steane code, syndrome measurement, fault tolerance, NISQ computing, noise models, error mitigation, Variational quantum algorithms (VQE, QAOA), quantum machine learning (introductory topics), Applications: Quantum annealing, optimization, chemistry, and artificial intelligence.

Text Books:

1. Ivan B. Djordjevic, “Quantum Information Processing, Quantum Computing and Quantum Error Correction: An Engineering Approach”, 2nd Edition, Elsevier (Academic Press), 2021.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, “An Introduction to Quantum Computing”, Oxford University Press, 2007.

Reference Books:

1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2000.
2. Parag Lala, “Quantum Computing”, McGraw Hill India, 2020.
3. Eleanor Rieffel, Wolfgang Polak, “Quantum Computing: A Gentle Introduction”, MIT Press, 2011.

Web Links:

1. Web resources:
 - (a) IBM Quantum Learning: <https://quantum.cloud.ibm.com/learning>
 - (b) MIT xPRO Quantum Computing Fundamentals: <https://learn.xpro.mit.edu/quantum-computing>
2. Online Courses: NPTEL / Swayam:
 - (a) Introduction to Quantum Computing course: https://onlinecourses.nptel.ac.in/noc25_cs95/preview
 - (b) Coursera Quantum Computing course: <https://www.coursera.org/learn/quantum-computing>



Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VIII
Reinforcement Learning NPTEL (22PEAI8014T)		

Prerequisite: Basic knowledge of Machine Learning.

Course Objective:

1. To introduce fundamental concepts of Reinforcement Learning and decision-making under uncertainty.
2. To develop an understanding of multi-armed bandit problems and exploration–exploitation trade-offs.
3. To analyze Markov Decision Processes and their solution methods.
4. To apply dynamic programming, temporal difference learning, and function approximation techniques.
5. To explore advanced RL methods such as deep reinforcement learning and hierarchical RL.

Course Outcomes:



CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Define and explain the fundamental concepts of Reinforcement Learning, including multi-armed bandits and exploration–exploitation trade-offs.	L2	Understand
CO2	Apply bandit algorithms such as UCB, PAC, median elimination, and policy gradient methods to solve decision-making problems.	L3	Apply
CO3	Explain and analyze Markov Decision Processes and Bellman optimality principles for policy evaluation and improvement.	L4	Analyze
CO4	Apply and analyze dynamic programming and temporal difference (TD) learning methods for solving reinforcement learning problems.	L4	Analyze
CO5	Analyze advanced reinforcement learning techniques such as function approximation, least squares methods, Deep Q-Networks (DQN), and hierarchical RL.	L4	Analyze



Reinforcement Learning NPTEL (22PEAI8014T)

NPTEL Course Contents

Week 1

Introduction

Week 2

Bandit algorithms – UCB, PAC.

Week 3

Bandit algorithms –Median Elimination, Policy Gradient.

Week 4

Full RL MDPs.



Week 5

Bellman Optimality.

Week 6

Dynamic Programming TD Methods.

Week 7

Eligibility Traces.

Week 8

Function Approximation.

Week 09

Least Squares Methods.

Week 10

Fitted Q, DQN & Policy Gradient for Full RL.

Week 11

Hierarchical RL.

Week 12

POMDPs.

Text Books:

1. Richard S. Sutton, Andrew G. Barto, “Reinforcement Learning: An Introduction”, 2nd Edition, MIT Press, 2018.
2. Csaba Szepesvári, “Algorithms for Reinforcement Learning”, Morgan & Claypool Publishers, 2010 (updated reprint editions available).
3. Marco Wiering, Martijn van Otterlo, “Reinforcement Learning: State-of-the-Art”, Springer, 2012.
4. Dimitri P. Bertsekas, “Reinforcement Learning and Optimal Control”, Athena Scientific, 2019.
5. Shangtong Zhang, Richard S. Sutton, “Reinforcement Learning: An Introduction (Draft/Updated Version with Python Examples)”, MIT Press (latest online edition), 2023.

Reference Books:

1. Rafael Ris-Ala, “Fundamentals of Reinforcement Learning”, Springer, 2023.
2. Yves Hilpisch, “Reinforcement Learning for Finance”, O’Reilly Media, 2024.
3. Stefano V. Albrecht, Filippas Christianos, Lukas Schäfer, “Multi-Agent Reinforcement Learning: Foundations and Modern Approaches”, MIT Press, 2023.
4. Stuart Russell, Peter Norvig, “Artificial Intelligence: A Modern Approach”, 4th Edition, Pearson, 2020.
5. Richard S. Sutton, Andrew G. Barto, “Reinforcement Learning: An Introduction”, 2nd Edition, MIT Press, 2018.

Weblinks:

1. Massachusetts Institute of Technology, “Introduction to Reinforcement Learning (OpenCourseWare)”, Available: <https://ocw.mit.edu>
2. Stanford University, “CS234: Reinforcement Learning Course Materials”, Available: <https://cs234.stanford.edu>
3. DeepMind, “Reinforcement Learning Resources and Publications”, Available: <https://deepmind.com>
4. OpenAI, “Spinning Up in Deep Reinforcement Learning”, Available: <https://spinningup.openai.com>
5. Google, “Machine Learning Crash Course – Reinforcement Learning Section”, Available: <https://developers.google.com/machine-learning>



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Responsible AI (22PEAI8021T)		

Prerequisite: Artificial Intelligence, Machine Learning



Course Objective(s):

1. To introduce the fundamental concepts of ethics in AI.
2. To explore the importance of transparency in AI systems, identifying practices that enhance stakeholder understanding and facilitate accountability.
3. To explore and analyze emerging themes in AI governance and policy, such as ethical considerations, workforce impacts, and regulatory challenges, and their implications for the future of AI globally.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the principles of responsible AI development, including fairness, accountability, and transparency.	L2	Understand
CO2	Identify and describe various sources of bias in AI systems, including data collection, feature selection, and model training processes. Analyze real-world examples of bias in AI applications.	L2	Understand
CO3	Evaluate the role of fairness in AI governance. Identify strategies to promote equitable outcomes and mitigate biases in AI systems.	L5	Evaluate
CO4	Analyze the implications of privacy and anonymity for individuals and organizations in the context of data management and usage.	L4	Analyze

Responsible AI (22PEAI8021T)

Course Contents

Unit-I

06 Hrs.

Introduction: Artificial Intelligence Fundamentals, Need for ethics in AI. AI for Society and Humanity, ethics vs law/compliance, Responsible and interpretable AI, Principles for ethical practices, AI and social justice.

Unit-II

08 Hrs.

Bias and Fairness: Sources of Biases, Techniques for detecting, mitigating, and preventing bias in data and models, limitation of a dataset, Preprocessing, in-processing and postprocessing to remove bias, Fairness of classification algorithms: Handling Disparate Treatment/Disparate Impact, Fair Embedding's, Counterfactual fairness.

Unit-III

08 Hrs.

Governance of AI: Role of government, academia, and industry in ethical AI development, Integrity, Transparency, Accountability, Fairness, Control, Sustainability, Democracy, Interoperability, Spread of hate content, Countering hate speech, The future of AI and its impact on humanity.

Unit-IV

07 Hrs.

Transparency and Explainability in AI: Black-box AI vs. transparent AI.

Explainability: methods and challenges, Explainability through causality, Model transparency, interpretability, and documentation in training processes, Model interpretability tools and frameworks (e.g., LIME, SHAP)

Unit-V

06 Hrs.

Data ownership, privacy and anonymity: Understanding the difference between data ownership, data privacy and data anonymity, Idea behind surveillance, data privacy vs. data security, Security concerns in AI system, Differential privacy and federated learning in AI.

Unit-VI

07 Hrs.

AI standards and regulation: National and international strategies on AI- Europe, North America, Asia, Africa, South America, Australia, International AI initiatives, Government Readiness for AI, Emerging Themes, Case studies: Healthcare robots.

Text Books:

1. Mark Coeckelbergh, "AI Ethics", The MIT Press Essential Knowledge series, 2020.



2. Evren Eryurek, Uri Gilad, Valliappa Lakshmanan, “Data Governance: The Definitive Guide - People, Processes, and Tools to Operationalize Data Trustworthiness”, Shroff/O’Reilly, 1st Edition, 2021.
3. Ian Foster, Rayid Ghani, Ron S. Jarmin, Frauke Kreuter, Julia Lane, “Big Data and Social Science: Data Science Methods and Tools for Research and Practic”, Chapman and Hall/CRC, 2nd Edition, 2020.
4. AJ Kelly, “Ethics and Artificial Intelligence: A Comprehensive Guide”, Byte-Sized Press, January 2023.
5. Jonas Tallberg, Eva Erman, Markus Furendal, Johannes Geith, Mark Klamberg, Magnus Lundgren, “The Global Governance of Artificial Intelligence: Next Steps for Empirical and Normative Research”, Oxford University Press (OUP), 2023.
6. Edited by Keith Frankish, “The Cambridge Handbook of Artificial Intelligence”, The Open University, Las Vegas, 2014.

Reference Books:

1. Michael Negnevitsky, “Artificial Intelligence: A Guide to Intelligent Systems”, 2001.
2. Markus Dubber, Frank Pasquale, Sunit Das, “OXFORD HANDBOOK OF ETHICS OF AI”, 2021.
3. Michael Kearns and Aaron Roth, “The Ethical Algorithm: The Science of Socially Aware Algorithm Design”, 2019.
4. Solon Barocas, Moritz Hardt, and Arvind Narayanan, “Fairness and Machine Learning: Limitations and Opportunities”, 2023.
5. Christoph Stückelberger, Pavan Duggal, “Data Ethics: Building Trust: How Digital Technologies Can Serve Humanity”, Globethics Publications, 1st Edition, 2023.
6. Gry Hasselbalch & Pernille Tranberg, “Data Ethics”, PubliShare, 1st Edition, 2016.
7. Evren Eryurek, Uri Gilad, Valliappa Lakshmanan, “Data Governance: The Definitive Guide - People, Processes, and Tools to Operationalize Data Trustworthiness”, Shroff/O’Reilly, 1st Edition, 2021.

Web links:

1. <https://standards.ieee.org/initiatives/autonomous-intelligence-systems/>
2. <https://partnershiponai.org/>
3. <https://aiethicslab.com/>



4. <https://www.oxford-aiethics.ox.ac.uk/>

5. <https://www.media.mit.edu/groups/ethics-and-governance/overview/>

6. <https://artificialintelligenceact.eu/the-act/>



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Image Generative AI (22PEAI8022T)		

Prerequisite: Deep Learning, Large Language Models

Course Objective(s):

1. To provide students with a thorough grasp of image generative AI, including its historical context, key technologies, and applications across various industries.
2. To Equip students with hands-on experience in image generation techniques, manipulation, and evaluation methods.
3. Enable students to explore and analyze the diverse applications of image generative AI in fields such as art, healthcare, and entertainment.
4. Foster an understanding of the ethical considerations and societal impacts of image generation technologies, preparing students to address potential challenges and biases in the field.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the principles of Image Generation and applications of Image Generation.	L2	Understand
CO2	Analyze and contrast various generative models, including GANs and VAEs, and apply their architectures to real-world problems.	L4	Analyze
CO3	Demonstrate proficiency in using diffusion models and vision transformers in generating images and utilize vision language models.	L3	Apply
CO4	Apply techniques for video generation.	L3	Apply



Image Generative AI (22PEAI8022T)

Course Contents

Unit-I

07 Hrs.

Introduction and Applications of Image Generation: Overview of Image Generation, Historical Context and Evolution, Challenges, Types of Image Generation Techniques, Applications in Various Industries: Art and Design, Image-to-Image Translation, Super-Resolution, Face Generation, Deepfakes, 3D Image Generation, Overview of Generative Model Families: Likelihood based, Implicit, Diffusion, and Energy-based models, Evaluation Metrics for Generated Images : FID, PSNR, SSIM

Unit-II

07 Hrs.

Generative Adversarial Networks (GANs) and Variants: Architecture of GANs: Generator and Discriminator, Adversarial Training, Variants of GANs (e.g., DCGAN, StyleGAN), BigGAN, Pix2Pix, GauGAN

Unit-III

07 Hrs.

Generative and Representation Learning Architectures for Images: Introduction to Variational Autoencoders (VAEs), -Variational inference and reparameterization trick. Conditional VAEs (CVAE), Vector Quantized VAE (VQ-VAE, VQ-VAE-2). **Representation Learning Architectures:** Neural Style Transfer (NST), Siamese Networks and UNET Architecture.

Unit-IV

08 Hrs.

Diffusion Models and Modern Image Generation: Introduction to Diffusion Models, Concepts and architecture overview, De-noising Diffusion Probabilistic Model, Stochastic Differential Equation (SDE), Diffusion Probabilistic Models: Concept & Architecture (DALL-E, Stable Diffusion, Imagen), Comparison: GANs vs VAEs vs Diffusion Models, Hybrid Diffusion Techniques: Latent Diffusion, VQ-Diffusion. Flow based models, ControlNet.

Unit-V

07 Hrs.

Vision Language Models and Image Generation: Introduction to Vision Language Models (VLMs), Transformer-Based Captioning Models: Contrastive Language Image Pairs (CLIP), Vision-and Language Transformer (ViLT), DeepSeek-VL2, Gemma 3.

Unit-VI

06 Hrs.

Video Generation Models: Video GAN (VGAN), MoCoGAN: Decomposing Motion and Content for Video Generation, Video Diffusion Models: TATS (Text-to-Video via Diffusion) model, Video LDM (High-Resolution Video Synthesis with Latent Diffusion Models)

Text Books:

1. Denis Rothman, “Transformers for Natural Language Processing- Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more”, 2nd Edition, Packt Publishing, 2023.
2. Zonunfeli Ralte, Indrajit Kar, “Learn Python Generative AI: Journey from autoencoders to transformers to large language models”, 1st Edition 2024, ISBN: 978-93-55518-972.
3. Soon Yau Cheong, “Hands-On Image Generation with TensorFlow: A practical guide to generating images and videos using deep learning”, Packt Publishing, 2020.
4. David Foster, “Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play”, O’Reilly Media, Inc. June 2019, ISBN: 9781492041948.

Reference Books:

1. Martin Yanev, “Building AI Applications with OpenAI APIs: Leverage ChatGPT, Whisper, and DALL-E APIs to build 10 innovative AI projects”, 2nd Edition, Packt Publishing, 2024.
2. Amita Kapoor, Antonio Gulli, Sujit Pal, “Deep Learning with TensorFlow and Keras – 3rd Edition: Build and deploy supervised, unsupervised, deep, and reinforcement learning models”, 3rd Edition, Packt Publishing, 2022.
3. V. Kishore Ayyadevara, Yeshwanth Reddy, “Modern Computer Vision with PyTorch: Explore deep learning concepts and implement over 50 real-world image applications”, Packt Publishing, 2020.
4. Martinez, “TensorFlow 2.0 Computer Vision Cookbook: Implement machine learning solutions to overcome various computer vision challenges”, 1st Edition, Packt Publishing, 2021.

Web links:

1. https://www.tensorflow.org/tutorials/generative/style_transfer
2. <https://www.coursera.org/specializations/deep-learning>
3. <https://medium.com/@zhonghong9998/neural-style-transfer-creating-artistic-images-with-deep-learning-803409fc64c0>
4. <https://medium.com/@outerrencedl/a-simple-autoencoder-and-latent-space-visualization-with-pytorch-568e4cd2112a>
5. <https://pyimagesearch.com/2020/03/30/autoencoders-for-content-based-image-retrieval-with-keras-and-tensorflow/>





6. <https://realpython.com/generative-adversarial-networks/>
7. <https://towardsdatascience.com/reparameterization-trick-126062cfd3c3>
8. <https://shashank7-iitd.medium.com/understanding-vector-quantized-variational-autoencoders-vq-vae-323d710a888a>

Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Social Network Analysis (22PEAI8023T)		

Prerequisite: Probability and Statistics, Machine Learning

Course Objective(s):

The analysis of massive networks which provide many computational, algorithmic, modeling challenges and research on the structure and analysis of such large networks.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a social network using various visualization tools.	L4	Analyze
CO2	Illustrate large-scale network data and mechanisms used for network growth models.	L4	Analyze
CO3	Examine social networks analysis and prediction using case studies.	L3	Apply
CO4	Apply appropriate anomaly detection and graph representation method on a network.	L3	Apply



Social Network Analysis (22PEAI8023T)

Course Contents

Unit-I 07 Hrs.

Society & Network: Introduction, Use of social networks, defining a network, types of network (link-centric, node and link centric, local view, temporal view, generalization, real-world network), levels of social network analysis, graph visualization tools (web-based and standalone), applications.

Network Measures: Network basics, node centrality, assortativity, transitivity and reciprocity, similarity, degeneracy.

Unit-II 08 Hrs.

Network Growth Models: Properties of real world networks, Random Network Model: Degree Distribution of Random Network, Binomial to Poisson Distribution, Evolution of a Random Network, Average Path Length, Clustering Coefficient, Random Network vs. Real-world Network, Ring Lattice Network Model, Watts-Strogatz Model: Network Formation, Preferential Attachment Model: Network Formation, Degree Dynamics, Limitations of BA Model.

Unit-III 07 Hrs.

Link Analysis: Application of link analysis, Signed networks: Balance Theory of Undirected Signed Networks, Status Theory of Signed Networks, Triad Balance vs Status, Strong and Weak Ties: Strength of a Tie, Triadic Closure, Dunbar Number, Local Bridges and Importance of Weak Ties, PageRank, Personalised PageRank, DivRank, SimRank, PathSim.

Unit-IV 08 Hrs.

Community Detection: Application of community detection, types of communities, community detection methods, Disjoint Community Detection: Node-centric community detection, modularity and community detection, Overlapping Community Detection: Clique Dynamics, Local Community Detection.

Link Prediction: Applications of link prediction, Evaluating Link Prediction methods, Heuristic models, Probabilistic models, Supervised Random Walk.

Unit-V 05 Hrs.

Cascade Behaviours & Network Effects: Preliminaries and Important Terminologies, Cascade Models, Probabilistic Cascades, Epidemic Models, Independent Cascade Models, Cascade Prediction.

Unit-VI 07 Hrs.

Anomaly Detection in Networks: Anomaly in Static Networks: Plain and attributed networks,

relational learning, Anomaly in Dynamic Networks: Preliminaries, feature and decomposition-based approaches.

Graphical Representation Learning: Criterion of graph representation learning, pipeline, representation learning methods.



Text Books:

1. Tanmoy Chakraborty, “Social Network Analysis”, 1st Edition, Wiley, 2021.
2. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, “Analyzing Social Networks”, Sage Publications Ltd, 2nd Edition, 2018.

Reference Books:

1. Xiaoming Fu, Jar-Der Luo, Margarete Boos, “Social Network Analysis Interdisciplinary Approaches and Case Studies”, 1st Edition, CRC Press, 2020.
2. Dr. Krishna Raj P.M., Mr. Ankith Mohan, Dr. Srinivasa K.G, “Practical Social Network Analysis with Python (Computer Communications and Networks)”, 1st Edition, Springer, 2019.
3. John Scott, “Social Network Analysis”, 4th Edition, SAGE Publications Ltd, 2017.
4. Song Yang, Franziska Barbara Keller, Lu Zheng, “Social Network Analysis: Methods and Examples”, 1st Edition, SAGE Publications, 2016.

Web Links:

1. A course on Social Network Analysis: https://onlinecourses.nptel.ac.in/noc22_cs117/preview
2. A comprehensive guide to Social Network Analysis: <https://towardsdatascience.com/how-to-get-started-with-social-network-analysis-6d527685d374>
3. Social Network Analysis 101: Ultimate Guide Comprehensive Introduction for Beginners: <https://visiblenetworklabs.com/guides/social-network-analysis-101/>

Program: Artificial Intelligence and Machine Learning	Final Year B.Tech	Semester: VIII
Social Networks NPTEL (22PEAI8024T)		

Prerequisite: Probability and Statistics, Machine Learning.

Course Objective:

1. To understand, model, analyze, and simulate real-world social and complex networks using graph theory and computational tools to study connectivity, diffusion, link analysis, community structure, and viral phenomena.

Course Outcomes:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain fundamental concepts of social and complex networks including graph theory, connectedness, homophily, weak ties, and small-world phenomenon.	L2	Understand
CO2	Apply Python-based tools such as NetworkX and Gephi to construct, visualize, and analyze real-world network datasets.	L3	Apply
CO3	Apply structural properties of networks such as clustering coefficient, centrality measures, PageRank, community detection, and structural balance.	L3	Apply
CO4	Analyze diffusion models, cascading behaviors, and epidemic spreading models (SIR/SIS) in social and web networks.	L4	Analyze
CO5	Analyze network models such as Barabási–Albert model, Erdős–Rényi model, Schelling model, and cascading models for understanding real-world phenomena.	L4	Analyze



Social Networks NPTEL (22PEAI8023T)

NPTEL Course Contents

Week 1: Introduction

Introduction, Introduction to Python, Introduction to Networkx, Social Networks: The Challenge, Google Page Rank, Searching in a Network, Link Prediction, The Contagions, Importance of Acquaintances, Marketing on Social Networks.

Week 2: Handling Real-world Network Datasets

Introduction to Datasets, Ingredients Network, Synonymy Network, Web Graph, Social Network Datasets, Datasets: Different Formats, Datasets : How to Download?, Datasets: Analysing Using Networkx, Datasets: Analysing Using Gephi, Introduction : Emergence of Connectedness, Advanced Material : Emergence of Connectedness, Programming Illustration : Emergence of Connectedness, Summary to Datasets.

Week 3: Strength of Weak Ties

Introduction, Granovetter's Strength of weak ties; Triads, clustering coefficient and neighborhood overlap; Structure of weak ties, bridges, and local bridges; Validation of Granovetter's experiment using cell phone data; Embeddedness; Structural Holes; Social Capital; Finding Communities in a graph (Brute Force Method); Community Detection Using Girvan Newman Algorithm; Visualising Communities using Gephi; Tie Strength, Social Media and Passive Engagement; Betweenness Measures and Graph Partitioning; Strong and Weak Relationship – Summary.

Week 4: Strong and Weak Relationships (Continued) & Homophily

Introduction to Homophily - Should you watch your company ?, Selection and Social Influence, Interplay between Selection and Social Influence, Homophily - Definition and measurement, Foci Closure and Membership Closure, Introduction to Fatman Evolutionary model, Fatman Evolutionary Model- The Base Code (Adding people), Fatman Evolutionary Model- The Base Code (Adding Social Foci), Fatman Evolutionary Model- Implementing Homophily, Quantifying the Effect of Triadic Closure, Fatman Evolutionary Model- Implementing Closures, Fatman Evolutionary Model- Implementing Social Influence, Fatman Evolutionary Model- Storing and analyzing longitudinal data.

Week 5: Homophily Continued and Ve / -Ve Relationships

Spatial Segregation: An Introduction, Spatial Segregation: An Introduction, Spatial Segregation: Simulation of the Schelling Model, Spatial Segregation: Conclusion, Schelling Model Implementation-1(Introduction), Schelling Model Implementation-2 (Base Code), Schelling Model Implementation-3 (Visualization and Getting a list of boundary and internal nodes), Schelling Model Implementation-4 (Getting a list of unsatisfied nodes), Schelling Model Implementation-5 (Shifting the unsatisfied nodes

and visualizing the final graph).

Positive and Negative Relationships (Introduction): Structural Balance, Enemy's Enemy is a friend, characterizing the structure of balanced networks, Balance Theorem, proof of balance theorem, Introduction to positive and negative edges, Outline of implementation, Creating graph, displaying it and counting unstable triangles, Moving a network from an unstable to stable state, Forming two coalitions, visualizing coalitions and the evolution.

Week 6: Link Analysis

The Web Graph, Collecting the Web Graph, Equal Coin Distribution, Random Coin Dropping, Google Page Ranking Using Web Graph, Implementing PageRank Using Points Distribution Method-1, Implementing PageRank Using Points Distribution Method-2, Implementing PageRank Using Points Distribution Method-3, Implementing PageRank Using Points Distribution Method-4, Implementing PageRank Using Random Walk Method -1, Implementing PageRank Using Random Walk Method -2, DegreeRank versus PageRank.

Week 7: Cascading Behavior in Networks

We Follow, Why do we Follow?, Diffusion in Networks, Modeling Diffusion, Impact of Communities on Diffusion, Cascade and Clusters, Knowledge, Thresholds and the Collective Action, An Introduction to the Programming Screencast (Coding 4 major ideas), The Base Code, Coding the First Big Idea - Increasing the Payoff, Coding the Second Big Idea - Key People, Coding the Third Big Idea- Impact of Communities on Cascades, Coding the Fourth Big Idea - Cascades and Clusters.

Week 8: Link Analysis (Continued)

Introduction to Hubs and Authorities (A Story), Principle of Repeated Improvement (A story), Principle of Repeated Improvement (An example), Hubs and Authorities, PageRank Revisited - An example, PageRank Revisited - Convergence in the Example, PageRank Revisited - Conservation and Convergence, PageRank, conservation and convergence - Another example, Matrix Multiplication (Pre-requisite 1), Convergence in Repeated Matrix Multiplication (Pre-requisite 1), Addition of Two Vectors (Pre-requisite 2), Convergence in Repeated Matrix Multiplication- The Details, PageRank as a Matrix Operation, PageRank Explained.

Week 09 - Rich Get Richer Phenomenon

Introduction to Powerlaw, Why do Normal Distributions Appear?, Power Law emerges in WWW graphs, Detecting the Presence of Powerlaw, Rich Get Richer Phenomenon, Summary So Far, Implementing Rich-getting-richer Phenomenon (Barabasi-Albert Model)-1, Implementing Rich-getting-richer Phenomenon (Barabasi-Albert Model)-2, Implementing a Random Graph (Erdos- Renyi Model)-1, Implementing a Random Graph (Erdos- Renyi Model)-2, Forced Versus Random Removal of Nodes (Attack Survivability).

Week 10 - Rich Get Richer Phenomenon - 2

Rich Get Richer - A Possible Reason, Rich Get Richer - The Long Tail, Epidemics- An Introduction, Introduction to epidemics (contd..), Simple Branching Process for Modeling Epidemics, Simple Branching Process for Modeling Epidemics (contd..), Basic Reproductive Number, Modeling epidemics on complex networks, SIR and SIS spreading models, Comparison between SIR and SIS spreading models, Basic Reproductive Number Revisited for Complex Networks, Percolation model, Analysis of basic reproductive number in branching model (The problem statement), Analyzing basic reproductive number 2, Analyzing basic reproductive number 3, Analyzing basic reproductive number 4, Analyzing basic reproductive number 5.

Week 11 - The Small World Effect

Small World Effect - An Introduction, Milgram's Experiment, The Reason, The Generative Model, Decentralized Search – I, Decentralized Search – II, Decentralized Search – III.

Week 12 - How to go Viral on Web

Programming illustration- Small world networks : Introduction, Base code, Making homophily based edges, Adding weak ties, Plotting change in diameter, Programming illustration- Myopic Search : Introduction, Myopic Search, Myopic Search comparison to optimal search, Time Taken by Myopic Search, PseudoCores : Introduction, How to be Viral, Who are the right key nodes?, finding the right key nodes (the core), Coding K-Shell Decomposition, Coding cascading Model, Coding the importance of core nodes in cascading, Pseudo core.

Text Books:

1. Barabási, Albert-László, "Network Science", 1st Edition, Cambridge University Press, 2016 (online updated edition continues).
2. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets (3rd Edition)", Cambridge University Press, 2020.
3. Guillaume, Jean-Laurent; Latapy, Matthieu, "Graph Theory and Complex Networks: An Introduction to Statistical Physics", 1st Edition, ISTE Press – Elsevier, 2021.
4. Peter G. Doyle, Fan Chung-Yau; Linyuan Lü, "Handbook of Graph Theory and Network Applications", 1st Edition, CRC Press, 2022.
5. Anna Nagurney, "Networks Against Time: Supply Chain Analytics for Perishable Products" (focus on network modeling and diffusion), 2nd Edition, Springer, 2023.

Reference Books:



1. David Easley, Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, 1st Edition, Cambridge University Press, 2010 (latest continuing reference in network theory).
2. Reinhard Diestel, “Graph Theory (Graduate Texts in Mathematics)”, 6th Edition, Springer, 2020.
3. Ted G. Lewis, “Network Science: Theory and Practice”, 2nd Edition, Wiley, 2021.
4. Ulrik Brandes, Thomas Erlebach (Eds.), “Network Analysis: Methodological Foundations”, 2nd Edition, Springer, 2021.
5. Michele Coscia, Vito Latora, Kevin B. Wood, “Analyzing Networks and Health Systems: A Guide for Practitioners”, 1st Edition, Oxford University Press, 2024.

Weblinks:

1. <https://networksciencebook.com/> – Network Science (Barabási) — foundational and actively updated.
2. <https://networkx.org/documentation/stable/> – NetworkX Python Library (latest docs & examples).
3. <https://gephi.org/users/> – Gephi Visualization Tutorials & Latest Updates.
4. <https://snap.stanford.edu/data/> – Stanford Network Datasets for research and practice.
5. <https://www.coursera.org/learn/social-network-analysis> – Social Network Analysis course with recent methodologies.



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Internship (22INTAI8030L)		

Course Objective(s):

- To expose technical students for the industrial environment, allowing them to gain real-world experience and develop into competent professionals.
- To provide opportunities to learn and enhance the practical technical skills required for professional roles.
- To familiarize students with current technological developments relevant to their field of study.
- To develop technical writing skills for reports and projects.
- To introduce students to the responsibilities and ethics of the engineering profession.
- To develop an understanding of employee psychology, habits, attitudes, and problem-solving approaches.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply theoretical knowledge to real-world engineering problems through hands-on experience in industry or field settings.	L3	Apply
CO2	Apply technical knowledge and problem-solving approaches to address complex engineering problems in an industrial environment.	L3	Apply
CO3	Analyze organizational structures, workflows, and technologies to understand industry practices and operational challenges.	L4	Analyze
CO4	Develop technical documentation, reports, and presentations reflecting experiential learning and problem-solving approaches.	L6	Create
CO5	Discuss career goals and identify areas for personal and professional development based on internship exposure.	L2	Understand



Internships offer valuable educational and career development opportunities by providing students with practical experience in their field of study. In Semester–VIII, students have two options for their internship: Industry Internship and In-house Internship.

1. Industry Internship

Industry Internship Guidelines:

- The Training and Placement (T&P) cell of the institute will arrange internships for students in industries/organizations after the seventh semester.
- Students are expected to accept internship offers regardless of the company, job profile, location, or stipend offered.
- Alternatively, students can individually apply by submitting “Student Internship Program Application” (available on Institute Website) for industry internships, adhering to the prescribed guidelines as follows:
 1. Only T&P department granted internship will be considered.
 2. The internship duration should be of minimum 12 Weeks.
 3. Each student needs to take prior permission from T&P department before proceeding for any internship opportunity on his/her own.
 4. Each student will be monitored twice (virtually/through online meetings) during the internship period in the presence of an industry mentor and the departmental faculty mentor and the concerned TPC.
 5. If any student wants to withdraw from the Internship, he/she can only be allowed within two weeks of joining the same. Such students will have to continue the semester VIII academic activities regularly along with In-house internship.

Expected Activity in Industry Internship:

- Students may choose to work on innovation or entrepreneurial activities resulting in start-ups or undergo internships with Industry/NGO/ Government organizations/Micro/ Small/ Medium enterprises to prepare for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him/her. The evaluation of these activities will be done twice (virtually/through online meetings) during the internship period by the committee constituted by the Head of the Department which shall include Industry mentor, faculty mentor and Department T&P Co-ordinator (TPC). The assessment criteria for continuous assessment is as per Table 4.
- The ESE will be jointly evaluated by an industry mentor, faculty member and department T&P coordinator (TPC). The evaluation criteria is as per Table 5.

Table 1: Continuous Assessment for Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Gained/Enhanced (30 Marks)	Ex-Skills (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

Table 2: Evaluation Criteria of Industry Internship

Internship Objectives and Goals (30 Marks)	Internship Experience Gained/Enhanced (30 Marks)	Ex-Skills (30 Marks)	Professional Development and Growth (30 Marks)	Internship Report (30 Marks)	Presentation (30 Marks)

Industry Internship Report:

- Upon completion of the internship, students should prepare a comprehensive report that reflects their observations and learnings during the internship period. Students can consult their Industrial Supervisor, Faculty Mentor, or T&P Co-ordinator/Officer for guidance on selecting special topics and problems for the report.
- The internship report will be evaluated based on the following criteria:
 - i. Adequacy and purposeful write-up.
 - ii. Variety and relevance of learning experience.
 - iii. Practical applications and connections with the fundamental theories and concepts covered in the course (Semester I to VII).



2. In-house Internship

The in-house internship provides students with research-oriented opportunities to cultivate a research mindset. It serves as an extension of the project completed in VI and VII semesters (Project Stage-I & II) or offers new objectives provided by the department or research guide.

1. The in-house internship can be pursued individually or as a group activity.
2. If extending a project from Stage II, at least one student in the group must have participated in Stage I & II.
3. If working on the topic offered by the department or in-house mentor, a group of fresh students can form a team.
4. The maximum group size is limited to four students.
5. In case of extension of project stage II, the outcomes should be in the form of product development/technology transfer along with patent and copyright / one research publication (UGC

care listed journal/conference). Students can work jointly with any government funding agency or industry. In such cases, a detailed project report shall be submitted after verification by the in-house mentor and industry/funding agency mentor/authority. In case of standalone/non-sponsored activity, i.e. without any funding agency/industry collaboration, the detailed project report shall be submitted after verification by the in-house mentor.

6. If pursuing a Topic offered by the department or in-house mentor, the outcome of the in-house internship should include the publication of a research paper, preferably in an SCI/Scopus/UGC care listed/indexed Journal/Conference. The detailed project report must be submitted and verified by the in-house mentor.

7. All the designated work shall be submitted to the department in the form of a report in hard-bound as well as soft copy.

8. Evaluation Scheme:

I. Continuous Assessment:

- A logbook (as per Table 6) of the work done must be maintained by each group.
- Each in-house internship activity will be reviewed twice in the semester. In the first review (as per Table 7), at least 40% work shall be completed including the topic identification / introduction/ scope of the work, literature survey, problem definition and objectives. The remaining 60% of work shall be completed in the second review (as per Table 8) including implementations, key findings, publications &/ patenting &/ copyright &/ product development etc.

II. End Semester Examination:

End semester examination (as per Table 9) will be jointly evaluated by the faculty mentor and an external examiner appointed by the HOD in consultation with the COE.

9. Assessment Formats:

Table 3: Log Book Format

Sr	Week (Start Date: End Date)	Work Done	Sign of In-house mentor	Sign of Coordinator
1				

Table 4: First Review

Topic Identification & Validation (20 Marks)	Literature Survey (20 Marks)	Problem Definition (20 Marks)	Objectives (15 Marks)



Table 5: Second Review

Implementation (20 Marks)	Publications (20 Marks)	Report (20 Marks)	Presentation (15 Marks)

Table 6: End Semester Examination

Topic Identification & Validation (30 Marks)	Literature Survey & Problem Definition (30 Marks)	Objectives & Implementation or Product Development (30 Marks)	Presentation (30 Marks)	Report, Publications/Patent/IPR Documents (30 Marks)



Program: Artificial Intelligence and Machine Learning	Final Year B. Tech	Semester: VIII
Disaster Management and Preparedness (22MCAI8040T)		

Course Objective(s):

1. To provide basic understanding of hazards, disasters and various types and categories of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand roles and responsibilities of individual and various organizations during and after disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

Course Outcomes: On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Apply disaster management principles & guidelines.	L3	Apply
CO2	Conduct risk assessments.	L3	Apply
CO3	Develop community awareness & participation.	L6	Create
CO4	Utilize Science & Technology tools (GIS, GPS).	L3	Apply
CO5	Prepare disaster management plans.	L6	Create



Disaster Management and Preparedness (22MCAI8040T) Course Contents

Unit-I

06 Hrs.

Understanding Disasters & Hazards:

- Definition and types of disasters: Natural, Man-made and hybrid disasters, Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc. Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy,
- Hazard & Vulnerability profiles of India (seismic zones, flood-prone areas).
- Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.
- India's vulnerability to disasters, and the impact of disasters on National development.

Unit-II

06 Hrs.

Disaster Risk Reduction (DRR) & Mitigation:

- Disaster Management Cycle: Prevention, Mitigation, Preparedness, Response, Recovery. Need for disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction.
- Risk Assessment & Vulnerability Analysis.
- Science & Technology: Use of information management, Geo informatics like RS, GIS, GPS and remote sensing mitigation measure.

Unit-III

04 Hrs.

Disaster Preparedness & Response:

- Preparedness Planning, Early Warning Systems (EWS), & Communication.
- Emergency Response: Search & Rescue, Logistics, Medical Aid.
- Psychological Response & Management (Trauma, Stress).
- Role of IT, Media, Govt., NGOs, & Community.



Unit-IV

04 Hrs.

Recovery, Rehabilitation & Reconstruction:

- Post-disaster damage assessment.
- Rehabilitation, Reconstruction, & Livelihood Restoration.
- Sanitation, Hygiene, & Waste Management.



Unit-V

04 Hrs.

Policy, Governance & Capacity Building:

- National Disaster Management Authority (NDMA) & Legislation.
- Institutional Mechanisms & Community Mobilization. Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.

Unit-VI

04 Hrs.

Case studies on disaster (National /International):

- Case study discussion of National Disasters: Tsunami (2004), Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, 26th July 2005 Mumbai flood
- Case study discussion of International Disasters: Hiroshima – Nagasaki (Japan), Cyclone Phailin (2013), Fukushima, Daiichi nuclear disaster (2011), Chernobyl meltdown

Reference Books:

1. Harsh K. Gupta, “Disaster Management”, Universities Press Publications, 2003.
2. O. S. Dagur, “Disaster Management: An Appraisal of Institutional Mechanisms in India”, published by Centre for land warfare studies, New Delhi, 2011.
3. Damon Copolla, Butterworth Heinemann, “Introduction to International Disaster Management”, Elsevier Publications, 2015.
4. Jack Pinkowski, CRC Press, “Disaster Management Handbook”, Taylor and Francis group, 2008.
5. Rajdeep Dasgupta, “Disaster management & rehabilitation”, Mittal Publications, New Delhi, 2007.
6. R B Singh, “Natural Hazards and Disaster Management, Vulnerability and Mitigation”, Rawat Publications, 2006.
7. C. P. Lo Albert, K.W. Yonng, “Concepts and Techniques of GIS”, Prentice Hall (India) Publications, 2006.

8. Claudia G. Flores Gonzales, “Risk management of natural disasters”, KIT Scientific Publishing, 2010.
 9. W. Nick Carter, “Disaster Management – a disaster manager’s handbook”, Asian Development Bank, 2008.
 10. R. K. Srivastava, “Disaster Management in India”, Ministry of Home Affairs, GoI, New Delhi, 2011.
 11. Wil Mara, “The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy”, Marshall Cavendish Corporation, New York, 2011.
 12. Ronald Eisler, “The Fukushima 2011 Disaster”, Taylor & Francis, Florida, 2013.
- (Learners are expected to refer reports published at national and international level and updated information available on authentic web sites.)

