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	
							Continuous Assessment (CA)							
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2)	ESE			
							[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

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Director

R. C. Patel Institute of Technology Shirpur

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: €-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.

Unit-VI 07 Hrs.

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, 2^{nd} Edition, 2020.
5. Laura Graesser Wah Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson Education, 1^{st} 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, 1^{st} Edition, 2025.
3. George Jeno, "Federated Learning with Python: Design and implement a federated learning system and develop applications using existing frameworks", Packt Publishing, 1^{st} Edition, 2022.
4. Phil Winder, "Reinforcement Learning Industrial Applications of Intelligent Agents", O'Reilly, 1^{st} Edition, 2020.
5. Csaba Szepesvari, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 1^{st} Edition, 2019.
6. Enes Bilgin, "Mastering Reinforcement Learning with Python", Packt publication, 1^{st} 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", 2^{nd} 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, Filippos 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.e
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.g 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 Ediiton, 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; Embededness; 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 longitudnal 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 comparision 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 Skills Gained/Enhanced (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 Skills Gained/Enhanced (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) A logbook (as per Table 6) of the work done must be maintained by each group.

   (b) 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 manger'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.)