Program Structure for Fourth Year Artificial Intelligence and Machine Learning

(With Effect from 2024-2025)

Course Code	Vertical	Course Name	Contact Hrs			Credit Allotted			Total Credits
			Th	Tut	Pr	Th	Tut	Pr	
24AIMLPCC801	PCC	Advanced Artificial Intelligence	3	-	2	3	-	1	4
24AIMLPEC801X	PEC	Department Level Optional Course 5	3	-	2	3	-	1	4
24AIMLPEC802X	PEC	Department Level Optional Course 6	3	-	2	3	-	1	4
24ILOC802X	OE	Institute Level Optional Course 2	3	-	-	3	-	-	3
24AIMLVSE801	VSEC	Industry Certification	-	-	-	-	-	1	1
24AIMLPRJ801	PRJ	Major Project 2 / Internship - III	-	-	10	-	-	5	5
		Total	**12**	**0**	**16**	**12**	**0**	**9**	**21**

Course Code	Vertical	Course Name	Evaluation Scheme					
			IAE 1	IAE 2	ESE	CA	OR/PR	Total
24AIMLPCC801	PCC	Advanced Artificial Intelligence	20	20	60	25	25	150
24AIMLPEC801X	PEC	Department Level Optional Course 5	20	20	60	25	25	150
24AIMLPEC802X	PEC	Department Level Optional Course 6	20	20	60	25	25	150
24ILOC802X	OE	Institute Level Optional Course 2	20	20	60	-	-	100
24AIMLVSE801	VSEC	Industry Certification	-	-	-	-	25	25
24AIMLPRJ801	PRJ	Major Project 2 / Internship - III	-	-	-	75	50	125
		Total	**80**	**80**	**240**	**150**	**150**	**700**

Semester: VIII			Term: Even				Course Code: 24AIMLPCC801					
Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	IAE 1	IAE 2	ESE	CA	Oral/Pract/ Tut.	Total
Th	Tu	Pr	Th	Tu	Pr							
3	-	2	3	-	1	3	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives: The course aims:

1. To relate with the basic concepts of Probabilistic Models.
2. To understand the scope of Generative Networks in the field of AI.
3. To recognize various components of Autoencoder Architecture and Training process.
4. To learn the fundamentals of Transfer Learning.
5. Provide students with a comprehensive understanding of ensemble methods and their applications.
6. To explore the nascent applications of AI.

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

1. Acquire basic knowledge of Probabilistic Models.
2. Analyze the working and architecture for Generative Networks.
3. Interpret various components and various types of Autoencoders.
4. Understand various aspects of Transfer Learning.
5. Apply ensemble learning techniques to real-world problems and demonstrate improved predictive performance.
6. Relate to the nascent technologies in the field of artificial intelligence.

Module		Contents	Hours	COs
I		**Generative and Probabilistic Models**	9	CO1
	1.1	**Introduction:** Overview of generative models and their importance in AI, Fundamentals of Probability theory and generative modelling, Introduction to GANs, VAEs and other generative models. Significance of generative models, Challenges with generative models.		
	1.2	**Probabilistic Models:** Gaussian Mixture Models (GMMs), Hidden Markov Models (HMMs), Bayesian Networks, Markov Random Field (MRFs), Probabilistic Graphical Model.		
		Self-Learning Topics: Study on Energy-Based Models, Diffusion Models and Their Applications		
II		**Generative Adversarial Network**	8	CO2
	2.1	**Basics of GAN:** Generative Adversarial Networks (GANs) architecture, The discriminator model and generator model, Architecture and Training GANs, Vanilla GAN Architecture. GAN variants and improvements (DCGAN, WGAN, Conditional GAN, Cycle GAN), Challenges-		

		Training instability and model collapse, GAN applications in image synthesis and style transfer		
		Self-Learning Topics: GAN Objective Function and Optimization Challenges		
III		**Variational Autoencoders**	8	CO3
	3.1	**Introduction:** Basic components of Variational Autoencoders (VAEs), Architecture and training of VAEs the loss function, Latent space representation and inference, Applications of VAEs in image generation.		
	3.2	**Types of Autoencoders:** Undercomplete autoencoders, Sparse autoencoders, Contractive autoencoders, Denoising autoencoders, Variational Autoencoders (for generative modelling)		
		Self-Learning Topics: Study on Conditional VAEs, Beta-VAE, Discrete VAE,VQ-VAE		
IV		**Transfer Learning**	6	CO4
	4.1	**Introduction to transfer learning** Basic terminologies, Pre-trained model and data sets, Feature extraction and fine tune transfer learning , Recent advancement in transfer learning : self-supervised learning and meta learning.		
		Self-Learning Topics: Understanding of Fine-tuning and Feature Extraction in Transfer Learning		
V		**Ensemble learning**	7	CO5
	5.1	**Ensemble Classifiers:** Introduction to Ensemble Methods. Bagging and random forests, **Boosting algorithms :** AdaBoost Stacking and blending models, Extreme Gradient **Boosting (XGBoost):** XGBoost Regression and classification.		
		Self-Learning Topics: Applications of Ensemble Learning, Sequential Training in Boosting, Study on Light GBM, Cross validation in stacking		
VI		**Nascent Technologies in AI**	7	CO6
	6.1	**Convergence of AI with Augmented / Virtual reality techniques for product and process development** Limitations of 2D Learning Environments, Evolution of virtual worlds and immersive technologies, Definition and concepts of Augmented Reality, Definition and concept of the Metaverse, Characteristics and components of the Metaverse, Challenges and opportunities in the Metaverse ecosystem, AI in the realm of emerging quantum computing paradigms		
		Self-Learning Topics: Explainable AI and Ethical AI, Quantum Machine Learning (QML), Neuromorphic Computing		
		Total	45	

Exp.	List of Experiments	COs

No.		
1.	Design and implement a Hidden Markov Models for outcome prediction.	CO1
2.	Design and implement a Bayesian Network for outcome prediction.	CO1
3.	Design and implement a Gaussian Mixture Models for outcome prediction.	CO2
4.	Build and Train a Generative Multi-Layer Network Model using appropriate dataset.	CO3
5.	Build and Train a Deep Convolution Generative Multi-Layer (DCGAN) Network Model for an image based dataset.	CO5
6.	Develop a Conditional GAN (CGAN) Network to direct the image generation process of the generator model.	CO4, 6
7.	Train a variational autoencoder using TensorFlow on Fashion MNIST	CO1, 3
8.	Explore the working of any pre-trained model towards outcome generation.	CO1, 3
9.	Implement and analyze the working of Local Interpretable Model-agnostic Explanations (LIME) supervised model.	CO1, 3
10.	Case-study on the emerging technologies in AI like Metaverse, Augmented reality etc.	CO1 to CO6
11.	Mini Project Report: For any one chosen real world application as per the syllabus of CSC801: Advanced AI.	
12.	Implementation and Presentation of Mini Project.	

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. End Semester Theory Examination (ESE):

End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. Continuous Assessment (CA) :

Continuous Assessment should consist of the following

Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)

Attendance (Theory & Practical): 05 marks

Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

Reference Books:

1. Xiong, J., Hsiang, E.L., He, Z., Zhan, T. and Wu, S.T., 2021. Augmented reality and virtual reality displays: emerging technologies and future perspectives. Light: Science & Applications, 10(1), p.216.
2. Mystakidis, S., 2022. Metaverse. Encyclopedia, 2(1), pp.486-497
3. Gill, S.S., Xu, M., Ottaviani, C., Patros, P., Bahsoon, R., Shaghaghi, A., Golec, M., Stankovski, V., Wu, H., Abraham, A. and Singh, M., 2022. AI for next generation computing: Emerging trends and future directions. Internet of Things, 19, p.100514
4. Mangini, S., Tacchino, F., Gerace, D., Bajoni, D. and Macchiavello, C., 2021. Quantum computing models for artificial neural networks. Europhysics Letters, 134(1), p.10002

Text Books:

1. Foster, D., 2022. Generative deep learning. O'Reilly Media, Inc.
2. Koller, D. and Friedman, N., 2009. Probabilistic graphical models: principles and techniques. MIT press.
3. Goodfellow, I., 2016. Deep Learning-Ian Goodfellow, Yoshua Bengio, Aaron Courville- Google Books
4. Murphy, K.P., 2012. Machine learning: a probabilistic perspective. MIT press.
5. Zhou, Z.H., 2012. Ensemble methods: foundations and algorithms. CRC press.

Useful Links:

1. https://nptel.ac.in/courses/106106201
2. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3. https://machinelearingmastery.com/what-are-generative-adversarial-networks-gans/

Course Title: AI for Financial & Banking Application												
Semester: VIII			Term: Even				Course Code: 24AIMLPEC8011					
Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	IAE 1	IAE 2	ESE	CA	Oral/Pract/ Tut.	Total
Th	Tu	Pr	Th	Tu	Pr							
3	-	2	3	-	1	4	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives: The course aims:

1. To understand the impact of technology and digitization on financial and banking enterprises.
2. To explore blockchain technologies in the financial sector.
3. To examine digital money transfer mechanisms and GIFT cities.
4. To evaluate the benefits of digitization and cloud services in banking.
5. To analyze enterprise software solutions for financial operations.
6. To study the integration of AI in banking processes

Course Outcomes:

1. Gain knowledge of technology's influence on financial and banking enterprises..
2. Understand the applications of blockchain in the financial sector.
3. Recognize digital money transfer mechanisms and its role in digitization.
4. Evaluate the advantages of digitization and cloud services in banking.
5. Analyze enterprise software solutions for financial operations.
6. Explore the integration of AI in banking processes.

Module		Contents	Hours	COs
I		**Information Technology Infrastructure and Digitization of Financial Banking Enterprises**	5	CO1
	1.1	Digital Technology driven processes, Blockchain technologies for Financial – Banking sector, GIFT cities Digital Money transfer Mechanisms. Digitization/ cloud services and solutions in banking and financial services Profiling enterprise software's in financial and banking enterprises. Building Efficiencies, productivity, and infallibility in financial & Banking operations. Detailed study of various processes which shall be transformed by AI integration in banking and financial services. **Self-Learning Topics:** Introduction to business efficiencies, industrial productivity and high degree reliability systems for competitive advantage and carbon neutral enterprises.		
II		**Financial Statistics and The Sharpe Ratio**	8	CO2
	2.1	Probability, Combinatorics, Mathematical Expectation, Sample Mean, Standard Deviation, and Variance, Sample Skewness and Kurtosis ,Sample Covariance and Correlation ,Financial Returns ,Capital Asset Pricing Model ,Sharpe Ratio Formula, Time Periods and Annualizing, Ranking Investment Candidates, The Quantmod Package, Measuring Income Statement Growth, Sharpe Ratios for Income Statement Growth		

		Self-Learning Topics: Value at Risk (VaR) and Conditional VaR		
III		**Cluster Analysis**	8	CO3
	3.1	K-Means Clustering, Dissecting the K-Means Algorithm Sparsity and Connectedness of Undirected Graph Covariance and Precision Matrices, Visualizing Covariance, The Wishart distribution Glasso Penalization for Undirected Graphs, Running the Glasso Algorithm, Tracking a Value Stock through the Years Regression on Yearly Sparsity , Regression on Quarterly Sparsity , Regression on Monthly Sparsity **Self-Learning Topics:** Fundamentals of Cluster analysis, types of cluster analysis, Cluster Evaluation metrics, Clustering of high dimensional data		
IV		**Gauging the Market Sentiment**	9	CO6
	4.1	Markov Regime Switching Model, Reading the Market Data, Bayesian Reasoning, The Beta Distribution , Prior and Posterior Distributions , Examining Log Returns for Correlation ,Momentum Graphs ,Simulating Trading Strategies, Foreign Exchange Markets , Chart Analytics Initialization and Finalization, Momentum Indicators, Bayesian Reasoning within Positions, Entries, Exils, Profitability, Short-Term Volatility, The State Machine **Self-Learning Topics:** Market Sentiment, Sentiment's role in decision making, sources of market sentiment, VIX and market Fear Gauges		
V		**Trading algorithms**	8	CO4
	5.1	Vectorized Backtesting, Backtesting an SMA-Based Strategy, Backtesting a Daily DNN-Based Strategy Backtesting an Intraday DNN-Based Strategy , Risk Management : Trading Bot , Vectorized Backtesting Event-Based Backtesting ,Assessing Risk , Backtesting Risk Measures , Stop Loss , Trailing Stop Loss , Take Profit **Self-Learning Topics:** Key components of trading algorithm, types of trading algorithms and strategies, statistical models for trading, Optimization technique, Handling market risks and failures		
VI		**Fraud Analytics**	7	CO5
	6.1	Introduction , The Analytical Fraud Model Life Cycle , Model Representation , Traffic Light Indicator Approach, Decision Tables, Selecting the Sample to Investigate, Fraud Alert and Case Management , Visual Analytics, Backtesting **Analytical Fraud Models :** Backtesting Data Stability, Backtesting Model Stability, Backtesting Mode Calibration, Model Design and Documentation **Self-Learning Topics:** Types of fraud detection techniques, Anomaly Detection techniques, data sources for fraud analytics, fraud prevention and Risk management		
		Total	45	

Exp. No.	List of Experiments	COs
1.	Setting up a Digital Money Transfer System	CO1
2.	Calculating Sharpe Ratios for Investment Portfolios	CO2

3.	Cluster Analysis of Financial Data for Market Segmentation	CO3
4.	Analyzing Market Sentiment using the Markov Regime Switching Model	CO3
5.	Developing and Backtesting a Simple Trading Algorithm	CO3
6.	Implementing Advanced Risk Management Techniques in Trading Algorithms	CO4
7.	Fraud Detection using Machine Learning Algorithms	CO1, 3
8.	Visualizing Fraud Patterns and Analytics	CO1, 3
9.	Designing and Backtesting Complex Trading Strategies	CO1, 6
10.	Evaluating and Enhancing the Performance of Trading Algorithms	CO5
11.	Applying Machine Learning for Predictive Fraud Analytics	CO6

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. End Semester Theory Examination (ESE):
End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. Continuous Assessment (CA) :
Continuous Assessment should consist of the following

Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)
Attendance (Theory & Practical): 05 marks
Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam
Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be held.

Reference Books:

1. Machine Learning for Asset Managers by Marcos López de Prado.
2. Advances in Financial Machine Learning by Marcos López de Prado.

Text Books:

1. Financial Analytics with R Building a Laptop Laboratory for Data Science MARK J. BENNETT University of Chicago DIRK L. HUGEN University of Iowa

2. Artificial Intelligence in Finance A Python-Based Guide, Yves Hilpisch A
3. Fraud Analytics Using Descriptive, Predictive, and Social Network Techniques: A Guide to Data Science for Fraud Detection, Bart Baesens, Veronique Van Vlasselaer, Wouter Verbeke

Useful Links:

1. https://www.eastnets.com/newsroom/digital-transformation-in-the-banking-and-financial-services-sector
2. https://www.techopedia.com/definition/34633/generative-ai

Course Title: Quantum Computing												
Semester: VIII			**Term:** Even				**Course Code:** 24AIMLPEC8012					
Teaching Scheme							**Evaluation Scheme**					
Contact Hrs.			**Credit Allotted**			**Total Credit**	**IAE 1**	**IAE 2**	**ESE**	**CA**	**Oral/Pract/ Tut.**	**Total**
Th	**Tu**	**Pr**	**Th**	**Tu**	**Pr**							
3	-	2	3	-	1	4	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives: The course aims:

1. To understand basics of quantum computing.
2. To understand mathematics required for quantum computing
3. To understand building blocks of quantum computing and design algorithms
4. To understand quantum hardware principles and tools for quantum computing.

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

1. Understand basic concepts of quantum computing
2. Illustrate building blocks of quantum computing through architecture and programming models.
3. Appraise various mathematical models required for quantum computing
4. Discuss various quantum hardware building principles
5. Identify the various quantum algorithms
6. Describe usage of tools for quantum computing.

Module		Contents	Hours	COs
I		**Introduction to Quantum Computing**	8	CO1
	1.1	Motivation for studying Quantum Computing Origin of Quantum Computing Quantum Computer vs. Classical Computer Introduction to Quantum mechanics Overview of major concepts in Quantum Computing		
	1.2	Qubits and multi-qubits states Bloch Sphere representation Quantum Superposition Quantum Entanglement Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)		
		Self-Learning Topics: Quantum computing definition, Quantum states and measurements, Challenges of Quantum Computing, Application of Quantum Computing		
II		**Mathematical Foundations for Quantum Computing**	6	CO2
	2.1	Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors. **Self-Learning Topics:** Application of Complex Numbers in Quantum Mechanics, Linear transformations and Quantum Gates, Case studies of Quantum algorithms and their mathematical foundations		
III		**Building Blocks for Quantum Program**	9	CO3

	3.1	Architecture of a Quantum Computing platform Details of q-bit system of information representation: Block Sphere Multi-qubits States Quantum superposition of qubits (valid and invalid superposition) Quantum Entanglement Useful states from quantum algorithmic perceptive e.g. Bell State Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit No Cloning Theorem and Teleportation		
	3.2	Programming model for a Quantum Computing Program Steps performed on classical computer Steps performed on Quantum Computer Moving data between bits and qubits.		
		Self-Learning Topics: Potential applications of teleportation in quantum networks, Study resources on error mitigation and quantum measurement in Qiskit or Cirq.		
IV		**Quantum Algorithms and Error correction**		
	4.1	Quantum Algorithms, Shor's Algorithm, Grover's Algorithm. Deutsch's Algorithm, Deutsch -Jozsa Algorithm	6	CO4
	4.2	Quantum error correction using repetition codes 3 qubit codes, Shor's 9 qubit error correction Code		
		Self-Learning Topics: Effects of measurement on quantum states, Analysis of speedup compared to classical algorithms, Need of error correction in quantum computing, Fault Tolerant quantum computing		
V		**Quantum Hardware**		
	5.1	Ion Trap Qubits ,The DiVincenzo Criteria , Lagrangian and Hamiltonian Dynamics in a Nutshell: Dynamics of a Translating Rotor	6	CO5
	5.2	Quantum Mechanics of a Free Rotor: A Poor Person's Atomic		
	5.3	Model: Rotor Dynamics and the Hadamard Gate, Two-Qubit Gates The Cirac-Zoller Mechanism: Quantum Theory of Simple Harmonic Motion, A Phonon-Qubit Pair Hamiltonian, Light- Induced Rotor-Phonon Interactions, Trapped Ion Qubits, Mølmer- Sørenson Coupling ..		
	5.4	Cavity Quantum Electrodynamics (cQED): Eigenstates of the Jaynes-Cummings Hamiltonian Circuit QED (cirQED): Quantum LC Circuits, Artificial Atoms, Superconducting Qubits Quantum computing with spins: Quantum inverter realized with two exchange coupled spins in quantum dots, A 2-qubit spintronic universal quantum gate. **Self-Learning Topics:** Superconducting Qubits, Trapped Ions, Topological Qubits, Cryogenics in Quantum Computing, Benchmarking Quantum Devices		
VI		**OSS Toolkits for implementing Quantum program**		
	6.1	IBM quantum experience Microsoft Q Rigetti PyQuil (QPU/QVM) **Self-Learning Topics:** Importance of OSS in quantum computing, Overview of the Forest platform and QVM (Quantum Virtual Machine), Use cases and scenarios for choosing a toolkit	4	CO6
		Total	45	

Exp. No.	List of Experiments	COs
1.	Building Quantum dice	CO1
2.	Building Quantum Random No. Generation	CO2
3.	Composing simple quantum circuits with q-gates and measuring the output into classical bits.	CO3
4.	Implementation of Shor's Algorithms	CO3
5.	Implementation of Grover's Algorithm	CO3
6.	Implementation of Deutsch's Algorithm	CO4
7.	Implementation of Deutsch-Jozsa's Algorithm	CO4
8.	Quantum Circuits	CO4
9.	Qubit Gates	CO5
10.	Bell Circuit & GHZ Circuit	CO2
11.	Accuracy of Quantum Phase Estimation	CO6
12.	Mini Project such as implementing an API for efficient search using Grover's Algorithms or Integer factorization using Shor's Algorithm.	CO1to CO6

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):

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B. End Semester Theory Examination (ESE):

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C. Continuous Assessment (CA) :

Continuous Assessment should consist of the following

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Attendance (Theory & Practical): 05 marks
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List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

Reference Books:

1. Bernard Zygelman, A First Introduction to Quantum Computing and Information,2018
2. Supriyo Bandopadhyay and Marc Cahy, Introduction to Spintronics, CRC Press, 2008
3. The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
4. La Guardia, Giuliano Gladioli, Quantum Error correction codes, Springer 2021

Text Books:

1. Michael A. Nielsen, Quantum Computation and Quantum Information, Cambridge University Press.
2. David McMahon, Quantum Computing Explained, Wiley, 2008
3. Qiskit textbook https://qiskit.org/textbook-beta/
4. Vladimir Silva, Practical Quantum Computing for Developers, 2018

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview
2. https://www.coursera.org/courses?query=quantum%20computing
3. https://www.cl.cam.ac.uk/teaching/1617/QuantComp/

Course Title: Reinforcement Learning												
Semester: VIII			Term: Even				Course Code: 24AIMLPEC8013					
Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	IAE 1	IAE 2	ESE	CA	Oral/Pract/ Tut.	Total
Th	Tu	Pr	Th	Tu	Pr							
3	-	2	3	-	1	4	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives:

1. Learn about robots as an agent of automation and other Use cases
2. Design and Development of robots based on Direct and Inverse Kinematics
3. Learn the different types of Actuators, Sensors, and degree of freedom of Robots
4. Learn the concepts of Motions, Velocities and Dynamic/ force analysis of Robots
5. Learn algorithms governing Robot movements and Robot Programming
6. Learn about integration of electronics and communication devices for multimodal functions
7. Learn about integration of AI in robotics and self-configuring Robots

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

1. Understand different types of robots, specifications of Robots its characteristics and applications.
2. Understanding Direct – Inverse kinematics of robotic manipulator.
3. Identify actuators, sensors, and control of a robot for different applications
4. Developing the differential relationships of motion, velocities and dynamic analysis of force
5. Developing perspectives on AI and Robotics
6. Developing footprints of algorithms, programming associated with Robots and conceptualizing self-configuring Robots and use of Robots in different applications

Module		Contents	Hours	COs
I		**Introduction and Fundamentals of Robotics and Automation**	5	CO1
	1.1	Automation and its types, definition of Robotics and a Robot, History of Robotics, Advantages and Disadvantages of Robot, Robotic Manipulators, Robot Motions, Robot Anatomy, Links and Joints, Classification of Robots, Specification of Robot, Applications of Robots **Self-Learning Topics:** Current Trends in Robotics and Automation Technologies, Differences and Overlaps Between Robotics and Automation		
II		**Direct and Inverse Kinematics**	8	CO2
	2.1	Direct (Forward) Kinematics: Homogeneous coordinates, Link coordinates, Coordinate frame, coordinate transform, Arm equations, An example – Four Axis SCARA.		
	2.2	Inverse Kinematics: Inverse kinematics problem, Tool Configuration, An example – Four Axis SCARA. **Self-Learning Topics:** Distinction Between Direct (Forward) and Inverse Kinematics, Applications of Kinematics		
III		**Actuators and Sensors**	8	CO3

	3.1	Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Devices, Pneumatic Devices, Electric Motors, Magneto strictive Actuators		
	3.2	Sensor Characteristics, Position Sensors, Velocity Sensors, Acceleration Sensors, Force and Pressure Sensors, Torque Sensors, Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors, Sniff Sensors, Vision Systems, Voice Synthesizer **Self-Learning Topics:** Importance in Robotic Systems, Advanced Control Systems		
IV		**Motions, velocities and dynamic analysis of force**	8	CO4
	4.1	Differential relationship, Jacobian, Differential motions of a frame and robot, Inverse Jacobian, Lagrangian mechanics, Moments of Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames **Self-Learning Topics:** Importance of Motion Analysis, Workspace Analysis		
V		**Self-configuring Robots and AI integration**	9	CO5
	5.1	Historical perspective of AI in Robotics, Uncertainty in Robotics Reinforcement Learning: Basic overview, examples, elements, Tabular Solution Methods - Multiarmed bandits, Finite Markov decision process, Dynamic programming (Policy Evaluation, Policy Iteration, Value Iteration), Monte Carlo Methods. **Self-Learning Topics:** Decision-Making in Dynamic Environments, Predictive Maintenance with AI		
VI		**Applications of Robotics for Automation**	7	CO6
	6.1	Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading Processing - spot and continuous arc welding & spray painting – Assembly Inspection, Selected Embedded System based Applications: Database Applications (smart cards), Process-Control (Fuzzy logic), Robot application in Medical, Industrial Automation, Security **Self-Learning Topics:** Cobots in Assembly, Pick-and-Place Robots		
		Total	45	

Exp. No.	List of Experiments	COs
1.	Implementing a simple grid-world environment and training an agent using basic Q-learning	CO1
2.	Implementing a multi-armed bandit problem and comparing different exploration strategies like epsilon-greedy and UCB.	CO2
3.	Implementing a basic grid-world environment as an MDP and applying policy iteration and value iteration algorithms to find optimal policies.	CO3
4.	Applying dynamic programming algorithms, such as policy evaluation and policy	CO4

	improvement, to solve a small-scale MDP problem.	
5.	Implementing Monte Carlo control and Temporal Difference (TD) learning algorithms to train an agent in a grid-world environment.	CO4
6.	Exploration vs. Exploitation Trade-off: Experimenting with different exploration strategies and analyzing their impact on the learning performance of an agent in a bandit problem.	CO4
7.	Function Approximation in Reinforcement Learning: Using function approximation techniques, such as linear regression or neural networks, to approximate value functions in reinforcement learning problems.	CO4
8.	Deep Reinforcement Learning: Implementing a deep Q-network (DQN) to train an agent to play a popular Atari game, such as Pong or Space Invaders.	CO4
9.	Transfer Learning and Multi-Task Reinforcement Learning: Investigating transfer learning in reinforcement learning by training an agent in one environment and transferring its knowledge to a different but related environment	CO5
10.	Policy Gradient Methods: Implementing policy gradient methods, such as REINFORCE or Proximal Policy Optimization (PPO), to train an agent in a continuous control environment.	CO5
*11.	Applications and Case Studies: Applying reinforcement learning techniques to solve a real-world problem, such as training a self-driving car to navigate a simulated road environment.	CO6

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. End Semester Theory Examination (ESE):
End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. Continuous Assessment (CA) :
Continuous Assessment should consist of the following

Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)
Attendance (Theory & Practical): 05 marks
Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit

6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

Reference Books:

1. John J. Craig, "Introduction to Robotics: Mechanics & Control", 3rd Edition, Pearson Education, India, 2009
2. Mark W. Spong & M. Vidyasagar, "Robot Dynamics & Control", 2nd Wiley India Pvt. Ltd., 2004
3. Principles of Robot Motion – Theory, Algorithms and Implementation by Howie Choset, Lynch, PHI.

Text Books:

1. Robert Shilling, "Fundamentals of Robotics-Analysis and control", PHI, 2003.
2. Saeed B. Niku, "Introduction to Robotics Analysis, Systems, Applications", 3rd Edition, Wiley, 2019.
3. Saha, S.K., "Introduction to Robotics", 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
4. Staughard, Robotics and AI, Prentice Hall of India
5. Ashitava Ghoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, Sixth impression, 2010.
6. Mukherjee S., "Robotics Process Automation", 1st Edition, Khanna Publishing House, New Delhi, 2020.

Useful Links:

1. https://swayam.gov.in/nc_details/NPTEL
2. https://www.udemy.com/course/robotics-course/
3. https://www.learndatasci.com/out/coursera-machine-learning/
4. https://www.coursera.org/courses?query=robotics

Course Title: Graph Data Science												
Semester: VIII			Term: Even				Course Code: 24AIMLPEC8021					
Teaching Scheme							Evaluation Scheme					
Contact Hrs.			Credit Allotted			Total Credit	IAE 1	IAE 2	ESE	CA	Oral/Pract/ Tut.	Total
Th	Tu	Pr	Th	Tu	Pr							
3	-	2	3	-	1	4	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives: The course aims:

1. To Understand the basics of graphs, including definitions, connectivity, and properties.
2. To Explore the use of graphs in solving puzzles and optimization problems.
3. To Learn about the advantages of graph databases over relational and NoSQL databases.
4. To Gain knowledge of data modelling with graphs, including the labeled property graph model.
5. To Develop skills in building graph database applications, including data modelling and testing.
6. To Explore real-world use cases and understand non-functional characteristics of graph databases.

Course Outcomes: Learner will be able to

1. Demonstrate a solid understanding of graph concepts and properties.
2. Apply graph algorithms to solve puzzles and optimization problems.
3. Compare graph databases with relational and NoSQL databases.
4. Model data using the labeled property graph model and avoid common pitfalls.
5. Build graph database applications with proper data modeling and testing.
6. Analyze and implement graph database solutions for real-world use cases, considering non-functional characteristics

Module		Contents	Hours	COs
I		**Introduction to Graph**	5	CO1
	1.1	Definitions and examples, Three puzzles, Paths and cycles, Connectivity, Eulerian graphs, Hamiltonian graphs, shortest path, Chinese postman problem, traveling salesman problem, trees, properties of trees **Self-Learning Topics:** Graph-Based Learning, Graph Neural Networks (GNNs)		
II		**Introduction Graph databases**	8	CO2
	2.1	A High-Level View of the Graph Space, Graph Databases, Graph Compute Engines, The Power of Graph Databases, Performance, Flexibility, Agility, Options for Storing Connected Data, Relational Databases Lack Relationships, NOSQL Databases also Lack Relationships, Graph databases embraces relationship **Self-Learning Topics:** Native Graph Databases, Non-Native or Multi-Model Databases		
III		**Data Modelling with Graphs**	8	CO3
	3.1	Models and Goals, The Labelled Property Graph Mode Querying Graphs, A Comparison of Relational and Graph Modelling, Cross-Domain Models, Common Modelling Pitfalls, Identifying Nodes and Relationships, Avoiding Anti-Patterns **Self-Learning Topics:** Entity-Relationship (ER) Model Translation, Modeling Complex Relationships		
IV		**Building a Graph Database Application**	8	CO4

	4.1	Data Modelling, Application Architecture, Testing, Capacity Planning, Importing and Bulk Loading Data **Self-Learning Topics:** Data Migration from Relational Databases, Batch Loading Technique		
V		**Graphs in the Real World**	8	CO5
	5.1	Organizations Choose Graph Databases, Common Use Cases, Real-World Examples, Authorization and Access Control, Geospatial and Logistics, Graph Database Internals, Native Graph Processing, Native Graph Storage Programmatic APIs, Kernel API, Core API, Traversa Framework, Non-functional Characteristics **Self-Learning Topics:** Modeling Social Networks, Influencer Analysis		
VI		**Case study**	8	CO6
	6.1	Neo4j - About, Neo4j – Installation, Neo4j - Browser Neo4j - Query Language (Cypher), Neo4j - Create a Node Neo4j - Create a Relationship, Neo4j - Create an Index Neo4j - Create a Constraint, Neo4j - Select Data with MATCH, Neo4j - Import Data from CSV, Neo4j - Drop an Index, Neo4j - Drop a Constraint, Neo4j - Delete a Node, Neo4j - Delete a Relationship **Self-Learning Topics:** Case study based on real-time examples		
		Total	45	

Exp. No.	**List of Experiments**	**COs**
1.	**Graph Database Fundamentals:** • Install and set up a graph database system (e.g., Neo4j) on a local machine. • Familiarize yourself with the graph database environment, including the cquery language (Cypher) and browser interface.	CO1
2.	**Data Modeling with Graphs:** • Design a data model using the labeled property graph model for a specific domain (e.g., social network, e-commerce). • Implement the data model in the graph database and populate it with sample data	CO2
3.	**Basic Graph Queries:** • Perform basic graph queries using Cypher to retrieve nodes, relationships, and their properties. • Explore different query patterns, such as finding paths, filtering nodes, and ordering results.	CO3
4.	**Advanced Graph Queries:** • Extend your query knowledge by performing more complex graph queries, including subgraph matching, aggregation, and conditional filtering. • Optimize query performance by understanding and utilizing indexes.	CO4

5.	**Graph Database Administration:** • Learn and practice essential administrative tasks, such as managing users, roles, and access control. • Perform backup and restore operations to ensure data integrity	CO4
6.	**Importing and Exporting Data:** • Import data from external sources (e.g., CSV files) into the graph database. • Export graph data to different formats for analysis or sharing.	CO4
7.	**Graph Algorithms and Analytics:** • Explore the built-in graph algorithms provided by the graph database system (e.g., centrality, community detection). • Apply graph algorithms to analyze and extract insights from your graph data	CO4
8.	**Graph Visualization and Exploration:** • Utilize visualization tools and libraries to visualize your graph data. • Explore and navigate the graph visually to gain a better understanding of its structure and relationships.	CO4
9.	**Performance Optimization:** • Identify and address performance bottlenecks in your graph database application. • Optimize queries, indexes, and data modeling to improve overall system performance.	CO5
10.	**Scaling and Replication:** • Learn techniques for scaling and replicating a graph database to handle larger datasets and higher workloads. • Implement and test replication strategies to ensure data availability and fault tolerance.	CO5
*11.	**Real-World Use Cases:** • Choose a specific real-world use case (e.g., recommendation systems, fraud detection) and apply graph database techniques to solve the problem. • Design and implement a graph database application that addresses the unique requirements of the chosen use case.	CO1 to CO6

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. End Semester Theory Examination (ESE):

End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. Continuous Assessment (CA) :

Continuous Assessment should consist of the following

Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)

Attendance (Theory & Practical): 05 marks

Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

Reference Books:

1. Graph Databases: New Opportunities for Connected Data by Ian Robinson, Jim Webber, and Emil Eifrém.
2. Neo4j in Action by Aleksa Vukotic, Nicki Watt, and Tareq Abedrabbo.
3. Graph Databases for Beginners by Mark Needham and Amy E. Hodler.
4. Practical Neo4j by Gregory Jordan.
5. Learning Neo4j by Rik Van Bruggen.
6. Graph Database Applications and Concepts with Neo4j by Dionysios Synodinos.

Text Books:

1. Introduction to Graph Theory Fourth edition, Robin J. Wilson
2. Daphne Koller and Nir Friedman, "Probabilistic Graphical Models: Principles and Techniques",
3. Graph databases, Ian Robinson, Jim Webber & Emil Eifrem

Useful Links:

1. https://web4.ensiie.fr/~stefania.dumbrava/OReilly_Graph_Databases.pdf
2. https://www.quackit.com/neo4j/tutorial/

Course Title: Recommendation Systems												
Semester: VIII			**Term:** Even				**Course Code:** 24AIMLPEC8022					
Teaching Scheme							**Evaluation Scheme**					
Contact Hrs.			**Credit Allotted**			**Total Credit**	**IAE 1**	**IAE 2**	**ESE**	**CA**	**Oral/Pract/ Tut.**	**Total**
Th	**Tu**	**Pr**	**Th**	**Tu**	**Pr**							
3	-	2	3	-	1	4	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives: The course aims:

1. To introduce Recommendation systems and its basic concepts.
2. To understand design and working of Collaborative Filtering based recommendation.
3. To analyze design and working of Content-based recommendation.
4. To understand design and working of Knowledge based recommendation.
5. To understand design and working of Ensembled- Based and Hybrid Recommendation Systems.
6. To identify the methods for evaluation of recommendation systems.

Course Outcomes: Learner will be able to

1. To have a broad understanding of the field of Recommendation Systems.
2. In-depth Knowledge of the architecture and models for Collaborative Filtering.
3. Understanding the architecture and working of Content based recommendation systems.
4. Understanding the architecture and basics of Knowledge based recommendation systems.
5. Analyzing hybrid and ensembles recommendation systems.
6. Evaluation of recommendation systems by selecting right evaluation parameter.

Module		Contents	Hours	COs
I		**Introduction to Recommendation System**	7	CO1
	1.1	History of recommendation system, Eliciting Ratings and other Feedback Contributions, Implicit and Implicit Ratings, Recommender system functions.		
	1.2	Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system. **Self-Learning Topics:** Matrix Factorization Techniques, Advantages and challenges of collaborative filtering method		
II		**Collaborative Filtering**	7	CO2
	2.1	Architecture of Collaborative Filtering, User-based nearest neighbour recommendation, Item-based nearest neighbour recommendation, Model based and pre-processing based approaches, Clustering for recommendation system, Attacks on collaborative recommender systems, Advantages and drawbacks of Collaborative Filtering. **Self-Learning Topics:** Advantages and challenges of collaborative filtering methods, Item-Based Collaborative Filtering		
III		**Synchronization**	8	CO3
	3.1	Architecture of content-based systems, Content representation and content similarity, Item profiles, Discovering features of documents,		

		Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, The Role of User Generated Content in the Recommendation Process		
	3.2	Bayes classifier for recommendation, Regression based recommendation system. Advantages and drawbacks of content-based filtering **Self-Learning Topics:** Synchronization in Multi-Core System, Quantum Synchronization		
IV		**Knowledge based recommendation**	7	CO4
	4.1	Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders, Persistent Personalization in Knowledge-Based Systems, Conversational Recommendation. Search based recommendation, Navigation-based recommendation **Self-Learning Topics:** Collaborative Knowledge-Based Methods, Cold Start Problem		
V		**Ensembled- Based and Hybrid Recommendation System**	7	CO5
	5.1	Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies **Self-Learning Topics:** Advantages on pipelined hybridization design		
VI		**Evaluating Recommendation System**	9	CO6
	6.1	Characteristics and properties of evaluation research, Evaluation design goals- Accuracy, Coverage, Confidence and Trust, Novelty, Serendipity, Diversity, Robustness, Stability and Scalability.		
	6.2	Comparison between evaluation design of classification model and recommendation system, Error metrics, Decision-Support metrics, User-Centred metrics. Comparative analysis between different types of recommendation systems. **Self-Learning Topics:** Advantages on decision-support metrics, advantages of user-centred metrics		
		Total	45	

Exp. No.	List of Experiments	COs
1.	Implementation of Matrix operations and data representation towards understanding mathematics for recommendation system	CO1
2.	Experiment on the role of clustering methods with respect to recommendation systems	CO2
3.	Feature engineering and pre-processing of data for recommendation systems.	CO3
4.	Implementation of Bayes classifier for recommendation.	CO4
5.	Implement User-based Nearest neighbour recommendation.	CO4
6.	Implement Item-based Nearest neighbour recommendation	CO4
7.	Implement Content-based recommendation system.	CO4
8.	Implement Knowledge-based recommendation system.	CO4

9.	Implementation of a recommendation system using Hybrid approach.	CO5
10.	Implementation of a recommendation system using Ensembled approach.	CO5
11.	Implementation of a Regression based recommendation system.	CO6
12.	Analyze results on the basis of different evaluation parameters and graphical representations for recommendation systems.	
13.	Mini Project Report: For any one chosen real world Recommendation systems application.	
14	Implementation and Presentation of Mini Project	

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):
Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. End Semester Theory Examination (ESE):
End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. Continuous Assessment (CA) :
Continuous Assessment should consist of the following

Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)
Attendance (Theory & Practical): 05 marks
Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems
5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam
Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

Reference Books:

1. Aggarwal, C. C. (2016). Recommender systems (Vol. 1). Cham: Springer International Publishing.

Text Books:

1. Jannach, D., Zanker, M., Felfernig, A., & Friedrich, G. (2010). Recommender systems: an introduction. Cambridge University Press
2. Ricci, F., Rokach, L., & Shapira, B. (2011). Introduction to Recommender Systems Handbook. Springer, Boston, MA

Useful Links:

1. http://www.iem.iitkgp.ac.in/eco/Recommender_Systems/
2. https://www.coursera.org/specializations/recommender-systems
3. https://www.udemy.com/course/recommender-systems/
4. https://www.analyticsvidhya.com/blog/2021/08/developing-a-course-recommender-system-using-python/

Course Title: Social Media Analytics												
Semester: VIII			**Term:** Even				**Course Code:** 24AIMLPEC8023					
Teaching Scheme							**Evaluation Scheme**					
Contact Hrs.			**Credit Allotted**			**Total Credit**	**IAE 1**	**IAE 2**	**ESE**	**CA**	**Oral/Pract/ Tut.**	**Total**
Th	**Tu**	**Pr**	**Th**	**Tu**	**Pr**							
3	-	2	3	-	1	4	20	20	60	25	25	150

IAE: Internal Assessment Examination
ESE: End Semester Examination
CA: Continuous Assessment, TW: Term Work

Course Objectives: Learner will be able to

1. Familiarize the learners with the concept of social media.
2. Familiarize the learners with the concept of social media analytics and understand its significance.
3. Enable the learners to develop skills required for analyzing the effectiveness of social media.
4. Familiarize the learners with different tools of social media analytics.
5. Familiarize the learner with different visualization techniques for Social media analytics.
6. Examine the ethical and legal implications of leveraging social media data.

Course Outcomes: Learner will be able to

1. Understand the concept of Social media
2. Understand the concept of social media Analytics and its significance.
3. Learners will be able to analyze the effectiveness of social media.
4. Learners will be able to use different Social media analytics tools effectively and efficiently.
5. Learners will be able to use different effective Visualization techniques to represent social media analytics.
6. Acquire the fundamental perspectives and hands-on skills needed to work with social media data.

Module		**Contents**	**Hours**	**COs**
I		**Social Media Analytics: An Overview**	7	CO1
	1.1	Core Characteristics of Social Media, Types of Social Media, Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations. Purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools **Self-Learning Topics:** Social media analytics cycle		
II		**Social Network Structure, Measures & Visualization**	7	CO2
	2.1	Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph Layout, Visualizing Network features, Scale Issues. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks, Common Network Terminologies, Network Analytics Tools. **Self-Learning Topics:** Visualizing Network Features, Advanced Audience Segmentation in Social Media		
III		**Social Media Text, Action & Hyperlink Analytics**	9	CO3

	3.1	Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools **Self-Learning Topics:** Advanced NLP Techniques in Social Media Text Analytics, Text Analytics for Spam and Bot Detection		
IV		**Social Media Location & Search Engine Analytics**	7	CO4
	4.1	Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools **Self-Learning Topics:** Geospatial Data Types and Quality Analysis, Ethical and Regulatory Frameworks in Location Analytics ,Content Gap Analysis and Competitor Benchmarking		
V		**Social Information Filtering**	7	CO5
	5.1	Social Information Filtering - Social Sharing and filtering , Automated Recommendation systems, Traditional Vs social Recommendation Systems Understanding Social Media and Business Alignment, Social Media KPI, Formulating a Social Media Strategy, Managing Social Media Risks **Self-Learning Topics:** Collaborative Filtering Techniques in Social Media ,.Risk Assessment and Crisis Management in Social Media		
VI		**Social Media Analytics Applications and Privacy**	8	CO6
	6.1	Social media in public sector - Analyzing public sector social media, analysing individual users, case study. Business use of Social Media - Measuring success, Interaction and monitoring, case study. Privacy - Privacy policies, data ownership and maintaining privacy Online **Self-Learning Topics:** Crisis Communication and Emergency Management on Social Media, Public Sentiment Analysis and Policy Feedback		
		Total	45	

Exp. No.	**List of Experiments**	**COs**
1.	Study various – 1. Social Media platforms (Facebook, twitter, YouTube etc.) 2. Social Media analytics tools (Facebook insights, google analytics, etc.) 3. Social Media Analytics techniques and engagement metrics (page level, post level, member level)	CO1

	4. Applications of Social media analytics for business. e.g. Google Analytics https://marketingplatform.google.com/about/analytics/ https://netlytic.org/	
2.	Data Collection-Select the social media platforms of your choice (Twitter, Facebook, LinkedIn, YouTube, Web blogs etc) ,connect to and capture social media data for business (scraping, crawling, parsing)	CO2
3.	Data Cleaning and Storage- Preprocess, filter and store social media data for business (Using Python, MongoDB, R, etc).	CO3
4.	Exploratory Data Analysis and visualization of Social Media Data for business.	CO4
5.	Develop Content (text, emoticons, image, audio, video) based social media analytics model for business. (e.g. Content Based Analysis :Topic , Issue ,Trend, sentiment/opinion analysis, audio, video, image analytics.)	CO4
6.	Develop Structure based social media analytics model for any business. (e.g. Structure Based Models -community detection, influence analysis)	CO4
7.	Develop a dashboard and reporting tool based on real time social media data.	CO4
8.	Design the creative content for promotion of your business on social media platform.	CO4
9.	Analyze competitor activities using social media data.	CO5
10.	Develop social media text analytics models for improving existing product/ service by analyzing customer's reviews/comments.	CO5

Evaluation and Assessment Scheme:

A. Internal Assessment Examination (IAE):

Assessment consists of two class tests, each 20 marks. The IAE 1 will cover any three Course Outcomes (COs) and IAE 2 will cover the remaining three Course Outcomes (COs). Each test will have a duration of one hour.

B. End Semester Theory Examination (ESE):

End Semester exam of 60 Marks will be conducted based on entire syllabus.

C. Continuous Assessment (CA) :

Continuous Assessment should consist of the following

Experiments / Tutorials (8 to 10): 10 marks (All COs / LOs should be covered)
Attendance (Theory & Practical): 05 marks
Teacher Assessment Examination (TAE): 10 Marks

List of Teacher Assessment Examination (TAE):

1. Assignment
2. Case Study
3. Debate
4. Solution for Social Problems

5. Field Visit
6. Group Project
7. Flip Classroom
8. Topic Review
9. Quiz
10. Mind Mapping
11. Any other

Note: Number of activities to be conducted under TAE would be as per the subject need.

D. Oral & Practical Exam

Based on the entire syllabus, oral (10 marks) & practical/implementation (15 marks) examination will be conducted.

Reference Books:

1. Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, Avinash Kohirkar, IBM Pres
2. Social Media Analytics Strategy_ Using Data to Optimize Business Performance, Alex Gonçalves, A Press Business Team.
3. Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulus (2019), Wiley, ISBN 978-1-118-82485-6

Text Books:

1. Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan (ISBN-10: 1507823207)
2. Analyzing the Social Web 1st Edition by Jennifer Golbeck
3. Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites, Matthew A Russell, O'Reilly
4. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 201

Useful Links:

1. https://cse.iitkgp.ac.in/~pawang/courses/SC16.html
2. https://onlinecourses.nptel.ac.in/noc20_cs78/preview
3. https://nptel.ac.in/courses/106106146
4. https://7layersanalytics.com/