TULSIRAMJI GAIKWAD-PATIL College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

(An Autonomous Institute Affiliated to RTM Nagpur University)

DEPARTMENT OF INFORMATION TECHNOLOGY

M.Tech Artificial Intelligence & Machine Learning

As Per NEP 2020

Structure & Curriculum

From

Academic Year 2024-25

II Year/ II Sem

Vision of Institute

To contribute in the enhancement of capabilities of youth to face Information Technology challenges by empowering them with innovative ideas.

Mission of Institute

- To stimulate students to learn effectively and apply the knowledge in the field of Engineering and Technology.
- To undertake industry academic collaboration to enhance competency in graduates.
- To foster innovative ideas amongst students for becoming leaders.
- To create an environment of research culture.
- To impart social and ethical values for inculcating the culture of lifelong learning.

Vision of the Department

To emerge as a learning hub and center of excellence in the domain of Information Technology

Mission of the Department

- To impart quality technical education through effective teaching learning process.
- To provide a platform to address societal issues as well as challenges faced by IT industries.
- To foster a culture of research and impart innovative and entrepreneurial skills in the field of IT.
- To ensure overall development of students and staff by inculcating knowledge and professional ethics as a part of lifelong learning.

Program Education Objectives (PEO)

PEO 1: Demonstrate essential technical skills to identify, analyze and solve problems and design issues in IT Sector.
PEO 2: Apply field knowledge, research and professional practices to meet the requirements of industries.
PEO 3: Imbibe lifelong learning practices and entrepreneurship skills in tune with emerging technologies.
PEO 4: Inculcate professional ethics and managerial skills to satisfy real life problems for serving the needs of society and environment.

Program Specific Outcomes (PSO)

- PSO1: Develop and apply logical and programing skills to solve real-world challenges.
- PSO2: Utilize knowledge of software engineering and network techniques to design and implement efficient solutions.
- PSO3: Leverage computing knowledge to conduct research and adopt emerging technologies in the development of IT systems.

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SCHEME OF INSTRUCTION & SYLLABI

Programme: B.Tech in Information Technology

Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)

Semester- II (w.e.f.: AY 2024-25)

Sr No	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/I A	CA	ESE		
1	II	PCC	IT	MAI21201	Data Analysis	T	4	-	4	**4**	40	-	60	3 Hrs	100
2		PCC	IT	MAI21202	Information & Cyber Security	T	4	-	4	**4**	40	-	60	3 Hrs	100
3		PCC	IT	MAI21203	Laboratory – II	P	-	4	4	**2**	-	25	25	2 Hrs	50
4		PEC	IT	MAI21204-06	Program Elective - III	T	4	-	4	**4**	40	-	60	3 Hrs	100
5		PEC	IT	MAI21207-09	Program Elective - IV	T	4	-	4	**4**	40	-	60	3 Hrs	100
6		RM	ME	MME21204	Literature Review & Research Methodology	T	2	-	2	**2**	-	25	25	2 Hrs	50
Total							**18**	**04**	**22**	**20**	**160**	**50**	**290**	**16 Hrs**	**500**

Course Category	PCC (Programme Core courses)	PEC (Programme Elective courses)	Proj (Project)	OEC (Open Elective Course)
Credits	10	8	-	-
Cumulative Sum	24	16	-	-

PROGRESSIVE TOTAL CREDITS:22+20=42

	Dean Academics (PG) Tulsiramji Gaikwad-Patil College of Engineering and Technology Nagpur (M.S.)	Vice Principal Tulsiramji Gaikwad Patil College of Engineering & Technology, Nagpur	Principal Tulsiramji Gaikwad-Patil College Of Engineering & Technology, Nagpur	August,2024	1.00	Applicable for AY 2024-25 Onwards
Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	

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SCHEME OF INSTRUCTION & SYLLABI

Programme: B.Tech in Information Technology

Scheme of Instructions: M.Tech in AIML (As Per NEP 2020)

List of Professional Elective Courses

Program Elective- I	Program Elective-II	Program Elective-III	Program Elective- IV
Semester-I	**Semester-I**	**Semester-II**	**Semester-II**
MAI21105- Cloud Computing	**MAI21108-**Robotic Process Automation	**MAI21204-** Pattern Recognition	**MAI21207-** Computer Vision
MAI21106- Agent Based Intelligent Systems	**MAI21109-**Human Computer Interface	**MAI21205-** Reinforcement Learning	**MAI21208-** Data Visualization Techniques
MAI21107- Fundamentals of Data Science	**MAI21110** – Advanced Algorithms and Analysis	**MAI21206-** Optimization Techniques	**MAI21209-** Block Chain Technology

Course Category	PCC (Program Core Course)	PEC (Program Elective Course)	Proj (Project)	OEC (Open Elective)	Semester Wise Credits
Semester-I	**14**	**8**	**-**	**-**	**22**
Semester-II	**10**	**8**	**-**	**-**	**20**
Semester-III	**-**	**3**	**15**	**-**	**18**
Semester-IV	**-**	**-**	**20**	**-**	**20**
Cumulative Sum	**24**	**19**	**35**	**00**	**80**

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Chairperson	Dean-Academics	Vice-Principal	Principal	Date of Release	Version	

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NAAC Accredited (A+ Grade)

First Year (Semester-II) M. Tech. AIML

MAI21201: Data Analysis

Teaching Scheme	
Theory	**4 Hrs/week**
Tutorial	**-**
Total Credits	**4**

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 3Hrs	

Course Objectives:

1.	Identify the need for data analysis.
2.	Recognize the methods of problem solving.
3.	Interpret Modelling in Spreadsheet.
4.	Illustrate data wrangling.
5.	Interpret basic statistical methods.

Course Contents

Unit I	**INTRODUCTION TO DATA ANALYSIS** What is Data Analysis? Why Data Analysis is important? Types of data analysis, Process of Data Analysis, Industry Scenario, Various profiles available, Various tools.
Unit II	**PROBLEM SOLVING METHODS** Define the problem, Explore the data, decision making techniques, designing framework for problem solving, Strategies of overcoming biases, Action Plan.
Unit III	**SPREADSHEET MODELLING & DATA WRANGLING** Excel formula and functions, Data connections in Microsoft Excel, Data summarization using Pivot table, Data Modelling using Power Pivot, Data Preprocessing using Power query.
Unit IV	**DESCRIPTIVE STATISTICS AND INFERENTIAL STATISTICS** Basic of Business Statistics, Fundamentals of Descriptive Statistics, Measures of central tendency, Types of data distribution.
Unit V	**PROBABILITY AND HYPOTHESIS TESTING** Introduction to Probability, Union and Intersection in probability, Confidence Interval, Hypothesis testing- T-Test, Z-Test, One-way ANOVA. **MATHEMATICS FOR DATA ANALYTICS:** Introduction to Regression, Concept of R-Square, Concept of RMSE, Area under curve, Confusion matrix, recall value.

Text Books	
T.1	Data Analytics: Principles, Tools and practice
T.2	Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, Third Edition (Grayscale Indian Edition)- Wes McKinney
Reference Books	
R.1	Data Science and Predictive Analytics: Biomedical and Health Applications Using R- Ivo D. Dinov
R.2	Data Analytics made accessible by Anil Maheshwari
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs45
2	https://onlinecourses-archive.nptel.ac.in/noc17_mg24

CO	Course Outcomes	CL	Class Sessions
MAI21201.1	Interpret the significance of Data Science and use of essential tools for data analysis.	3	9
MAI21201.2	Implement decision-making techniques to identify and prioritize effective solutions.	3	9
MAI21201.3	Identify formals related to spreadsheet and data wrangling.	2	9
MAI21201.4	Differentiate between types of data distributions and their implications for statistical analysis..	4	9
MAI21201.5	Explain the importance of hypothesis testing and fundamentals of mathematics for data analysis.	5	9

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First Year (Semester-II) M. Tech. AIML

MAI21202: Information & Cyber Security

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	4	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

Course Objectives:

1.	Classify different cyber security terminologies.
2.	Analyze cybercrimes and acts in IT.
3.	Categorize the cyber laws.
4.	Identify different types of data and its privacy and security.
5.	Interpret cyber security plans, policies and management.

Course Contents

Unit I	**OVERVIEW OF CYBER SECURITY** Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker, Non-state actors, Cyber terrorism.
Unit II	**CYBER CRIMES** An Overview of Cyber Crimes, Indian Evidence Act, Examiner of Electronics Act, Amendments Introduced in Indian Evidence Act, 1872, IT Act as Amended up to 2008, IT (Certifying Authorities) Rules, 2000, Ministerial Order on Blocking of Websites – The IT (Use of Electronics Records and Digital Signatures) Rules 2004
Unit III	**CYBER LAW** Cybercrime and legal landscape around the world, IT Act, 2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Block chain, Dark net and Social media.
Unit IV	**DATA PRIVACY AND INFORMATION SECURITY** Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data Security, Data protection principles.
Unit V	**CYBER SECURITY MANAGEMENT** Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster, Legal Issues, Protecting programs and Data, Information and the law, Rights of Employees and Employers, Emerging Technologies, The Internet of Things, Cyber Warfare.

Text Books	
T.1	Cryptography and Network Security: Principles and Practice by William Stallings
T.2	Computer Security Hardcover – 1 January 2018 by Matt Bishop
Reference Books	
R.1	Cybersecurity and Cyberwar by P.W. Singer and Allan Friedman
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc23_cs127
2	https://onlinecourses.swayam2.ac.in/cec20_cs15

CO	Course Outcomes	CL	Class Sessions
MAI21202.1	Identify the basic terminologies related to cyber security and current cyber security threat landscape.	2	9
MAI21202.2	Interpret the cyber-attacks that target computers, mobiles and persons.	3	9
MAI21202.3	Examine cybercrimes and their associated punishments under various legal frameworks.	4	9
MAI21202.4	Explain the aspects related to personal data privacy and security.	5	9
MAI21202.5	Decide the main components of cyber security plan.	5	9

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First Year (Semester-II) M. Tech. AIML

MAI21203: Data Analysis and Cyber Security(Laboratory-II)

Teaching Scheme		Examination Scheme	
Practical	**2 Hrs/week**	CA	25 Marks
Total Credits	**2**	ESE	25 Marks
		Total	50 Marks

Sr. No	List of Practical	CO
1	Understand Visualization Principles in data analysis.	CO1
2	Analyze a business problem and translate it into a data problem	CO1
3	Build a basic model in Excel using Power Pivot to analyze a scenario.	CO2
4	Visualize data distribution using histograms and box plots.	CO2
5	Implement linear regression on a dataset and interpret R-Square.	CO3
6	Implement the Deffie Hellman-key exchange protocol using virtual Lab	CO3
7	Analyze the legal framework surrounding cybercrimes in India.	CO4
8	Evaluate the legal challenges posed by emerging technologies and their ethical implications.	CO4
9	Implement data protection measures in cyber security.	CO5
10	To explore digital signature schemes function using virtual lab	CO5

Text Books	
1	Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, Third Edition (Grayscale Indian Edition)- Wes McKinney
2	Cryptography and Network Security: Principles and Practice by William Stallings
Reference Books	
1	Data Science and Predictive Analytics: Biomedical and Health Applications Using R- Ivo D. Dinov
2	Cybersecurity and Cyberwar by P.W. Singer and Allan Friedman
Useful Links	
1	https://cse29-iiith.vlabs.ac.in/
2	https://colab.research.google.com/

	Course Outcomes	CL	Lab Sessions
MAI21203.1	Interpret the significance of Data analysis and decision-making skills to translate data insights into effective solutions.	3	4
MAI21203.2	Identify techniques to analyze data distribution effectively.	2	4
MAI21203.3	Classify the cyber security threat landscape, and also explain the importance of hypothesis testing for effective data analysis.	2	4
MAI21203.4	Analyze cyber-attacks devices and determine the legal framework for cybercrimes.	4	4
MAI21203.5	Evaluate the key aspects of data privacy & security, to decide the components necessary for developing a cyber-security plan.	5	4

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First Year (Semester-II) M. Tech. AIML

MAI21204: Pattern Recognition

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	4	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

Course Objectives:

Student shall be able to

1.	Analyze statistical pattern recognition, Parametric Approaches.
2.	Interpret Parametric Discriminate Functions.
3.	Explain Maximum-likelihood parameter estimation in relatively complex probabilistic models Bayesian parameter estimation.
1.	Illustrate Nonparametric Classification, Feature Extraction.
5.	Categorize unsupervised learning and clustering.

Course Contents

Unit I	**INTRODUCTION** Machine Perception, An Example, Pattern Recognition Systems, The Design Cycle, Learning and Adaption. Recognition with strings, Grammatical methods, Rule based Methods.
Unit II	**BAYESIAN DECISION THEORY** Introduction, Bayesian Decision Theory-Continuous Features, Minimum-Error-Rate Classification, Classifiers, Discriminant Functions, and Decision Surfaces, The Normal Density, Discriminant Functions for the Normal Density, Error Probabilities and Integrals, Error Bounds for Normal Densities, Bayes Decision Theory-Discrete Features, Missing and Noisy Features, Bayesian Belief Networks, Compound Bayesian Decision Theory and Context.
Unit III	**MAXIMUM-LIKELIHOOD AND BAYESIAN PARAMETER ESTIMATION** Introduction, Maximum-Likelihood Estimation, Bayesian Estimation, Bayesian Parameter Estimation: Gaussian Case, Bayesian Parameter Estimation: General Theory, Sufficient Statistics, Problems of Dimensionality, Component Analysis and Discriminants, Expectation Maximization (EM), Hidden Markov Models.
Unit IV	**NONPARAMETRIC TECHNIQUES** Introduction, Density Estimation, Parzen Windows, Kn – Nearest-Neighbors Estimation, the Nearest-Neighbor Rule, Metrics and Nearest-Neighbor Classification, Fuzzy Classification, Reduced Coulomb Energy Networks, Approximations by Series Expansions.

Unit V	**UNSUPERVISED LEARNING AND CLUSTERING** Introduction, Mixture Densities and Identifiability, Maximum-Likelihood Estimates, Application to Normal Mixtures, Unsupervised Bayesian Learning, Data Description and Clustering, Criterion Functions for Clustering, Iterative Optimization, Hierarchical Clustering, The Problem of Validity, On-line Clustering, Graph-Theoretic Methods, Component Analysis, Low-Dimensional Representations and Multidimensional Scaling (MDS).

Text Books	
T.1	Pattern Classification and Scene Analysis, R. O. Duda, P. E. Hart Wiley, 2001, 2nd edition
T.2	Pattern Classification, PHI,Earl Gose, 2000
Reference Books	
R.1	Pattern Recognition By Konstantinos Koutroumbas
R.2	Pattern Classification" by Richard O. Duda, Peter E. Hart, and David G. Stork
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_ee79
2	https://archive.nptel.ac.in/courses/106/106/106106046

CO	Course Outcomes	CL	Class Sessions
MAI21204.1	Illustrate pattern recognition systems with real-world examples, showcasing their structure and applications.	2	9
MAI21204.2	Identify classification problems probabilistically and estimate classifier performance.	2	9
MAI21204.3	Apply Maximum-likelihood parameter estimation in relatively complex probabilistic models.	3	9
MAI21204.4	Explain Nonparametric Techniques using algorithms.	5	9
MAI21204.5	Evaluate and implement various criterion functions and iterative optimization techniques for clustering.	5	9

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First Year (Semester-II) M. Tech. AIML

MAI21205: Reinforcement Learning

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	4	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

Course Objectives:

Student shall be able to

1.	Understand the basic of probability and linear algebra.
2.	Interpret Markov Decision Processes, policies, value functions, reward models, task types.
3.	Illustrate Fundamental concepts of Reinforcement Learning, focusing on prediction and control problems.
4.	Analyze bootstrapping and the TD (0) algorithm, explore the convergence of Monte Carlo and batch TD (0) algorithms.
5.	Apply advanced reinforcement learning concepts. N-step returns, TD (λ) algorithm, generalization techniques.

Course Contents

Unit I	**BASIC OF PROBABILITY AND LINEAR ALGEBRA** Basics of probability, linear algebra, Definition of a stochastic multi-armed bandit, Definition of regret, Achieving sublinear regret, UCB algorithm, KL-UCB, Thompson Sampling.
Unit II	**INTRODUCTION TO MARKOV DECISION PROCESSES** Markov Decision Problem, policy, and value function, Reward models (infinite discounted, total, finite horizon, and average), Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration.
Unit III	**FUNDAMENTAL CONCEPTS OF REINFORCEMENT LEARNING** The Reinforcement Learning problem, prediction and control problems, Model-based algorithm, Monte Carlo methods for prediction, and Online implementation of Monte Carlo policy evaluation.
Unit IV	**MODEL-FREE REINFORCEMENT LEARNING** Bootstrapping, TD (0) algorithm; Convergence of Monte Carlo and batch TD (0) algorithms; Model-free control: Q-learning, Sarsa, and Expected Sarsa.

Unit V	**ADVANCED REINFORCEMENT LEARNING TECHNIQUES** N-step returns, TD (λ) Algorithm, Need for generalization in practice; Linear function approximation and geometric view; Linear TD (λ). Tile coding; Control with function approximation; Policy search; Policy gradient methods; Experience replay; Fitted Q Iteration; Case studies.
Text Books	
T.1	"Reinforcement learning: An introduction," First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020.
T.2	"Statistical reinforcement learning: modern machine learning approaches," First Edition, Sugiyama, Masashi. CRC Press 2015.
Reference Books	

R.1	Sayon Dutta, Reinforcement Learning with Tensor Flow: A beginner's guide, Packt Publications, 2018.
R.2	"Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.
Useful Links	
1	https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs71
2	https://onlinecourses.nptel.ac.in/noc21_cs25

	Course Outcomes	CL	Class Sessions
MAI21205.1	Interpret the basic of probability and linear algebra, UCB algorithm, KL-UCB, Thompson sampling.	3	9
MAI21205.2	Apply Bellman's optimality operator to solve problems and derive optimal policies.	3	9
MAI21205.3	Differentiate between model-based and model-free approaches to reinforcement learning and their respective applications.	4	9
MAI21205.4	Evaluate the TD (0) algorithm, sarsa maximization bias and double learning.	5	9
MAI21205.5	Evaluate the application of advanced reinforcement learning methods	5	9

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First Year (Semester-II) M. Tech.

MAI21206: Optimization Techniques

Teaching Scheme	
Theory	**4 Hrs/week**
Tutorial	**-**
Total Credits	**4**

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 3Hrs	

Course Objectives:

1.	Interpret Classical optimization techniques, linear programming, and geometry of linear programming problems.
2.	Identify initial basic feasible solution by north, west corner rule, least cost method.
3.	Categorize constrained and unconstrained optimization techniques.
4.	Develop techniques in multivariable nonlinear unconstrained optimization, focusing on direct search methods.
5.	Analyze dynamic programming, including multistage decision processes, types and sub-optimization.

Course Contents

Unit I	**INTRODUCTION AND CLASSICAL OPTIMIZATION TECHNIQUES** Statement of an Optimization problem design vector, design constraints, constraint surface, objective function, objective function surface, classification of Optimization problems. **LINEAR PROGRAMMING** Standard form of a linear programming problem, geometry of linear programming problems, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation to the simplex method simplex algorithm.
Unit II	**TRANSPORTATION PROBLEM** Finding initial basic feasible solution by north, west corner rule, least cost method and Vogel's approximation method, testing for optimality of balanced transportation problems. Degeneracy. **ASSIGNMENT PROBLEM** Formulation, Optimal solution, Variants of Assignment Problem; Traveling Salesman problem.
Unit III	**CLASSICAL OPTIMIZATION TECHNIQUES** Single variable Optimization, multi variable Optimization without constraints, necessary and sufficient conditions for minimum/maximum, multivariable Optimization with equality constraints: Solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints: Kuhn, Tucker conditions. Single Variable Nonlinear Unconstrained Optimization: Elimination methods: Uni Model function-its importance, Fibonacci method & Golden section method.

Unit IV	**MULTI VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION** Direct search methods, Univariant method, Pattern search methods, Powell's, Hooke - Jeeves, Rosenbrock's search methods. Gradient methods: Gradient of function & its importance, Steepest descent method, Conjugate direction methods: Fletcher Reeves method & variable metric method.
Unit V	**DYNAMIC PROGRAMMING** Dynamic programming multistage decision processes, types, concept of sub optimization and the principle of optimality, computational procedure in dynamic programming, examples illustrating the calculus method of solution, examples illustrating the tabular method of solution.

Text Books

T.1	Optimization Techniques & Applications by S.S.Rao, New Age International.

Reference Books

R.1	George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in Operations Research 3rd edition, 2003.

Useful Links

1	https://archive.nptel.ac.in/courses/111/105/111105039

	Course Outcomes	CL	Class Sessions
MAI21206.1	Categorize optimization techniques using linear Programming.	4	9
MAI21206.2	Simplify initial basic feasible solution by north, west corner rule, least cost method and Formulation, Optimal solution, Variants of Assignment Problem.	4	9
MAI21206.3	Apply Single variable Optimization, multi variable Optimization without constraints, Single Variable Nonlinear Unconstrained Optimization.	3	9
MAI21206.4	Interpret Direct search methods, Univariant method, Pattern search methods, Powell's, Hooke Jeeves, Rosenbrock's search methods.	5	9
MAI21206.5	Explain dynamic programming, including multistage decision processes, types, sub-optimization, the principle of optimality, and computational procedure.	5	9

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First Year (Semester-II) M. Tech. AIML

MAI21207:Computer Vision

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	4	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

Course Objectives:

Student shall be able to

1.	Analyze the Fundamental Concepts Related to sources, shadows and shading.
2.	Interpret the Linear Filters and Convolution, Edge Detection-Noise, Estimating Derivatives, Detecting edges.
3.	Interpret the geometry of multiple views, stereopsis and segmentation by clustering.
4.	Explores segmentation and fitting using probabilistic methods, tracking with linear dynamic models.
5.	Explain a geometric camera models, calibration techniques, and model-based vision.

Course Contents

Unit I	**CAMERAS:** Pinhole Cameras **RADIOMETRY – MEASURING LIGHT:** Light in Space, Light Surfaces, Important Special Cases **Sources, Shadows, And Shading:** Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Inter reflections: Global Shading Models **COLOR:** The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.
Unit II	**LINEAR FILTERS:** Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates. **EDGE DETECTIOIN:** Noise, Estimating Derivatives, Detecting Edges **TEXTURE:** Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.
Unit III	**THE GEOMETRY OF MULTIPLE VIEWS:** Two Views **STEREOPSIS:** Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras **SEGMENTATION BY CLUSTERING:** What Is Segmentation?, Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

Unit IV	**SEGMENTATION BY FITTING A MODEL:** The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness **SEGMENTATION AND FITTING USING PROBABILISTIC METHODS:** Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice **TRACKING WITH LINEAR DYNAMIC MODELS:** Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and eg
Unit V	**GEOMETRIC CAMERA MODELS:** Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations **GEOMETRIC CAMERA CALIBRATION:** Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, Case study: Mobile Robot Localization **MODEL- BASED VISION:** Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration In Medical Imaging Systems, Curved Surfaces

Text Books	
T.1	David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.
T.2	Computer Vision: Algorithms and Applications- Richard Szeliski-Springer- 1st Edition, 2010
Reference Books	
R.1	E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
R.2	R. C. Gonzalez and R. E. Woods “Digital Image Processing” Addison Wesley 2008.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs101

	Course Outcomes	**CL**	**Class Sessions**
MAI21207.1	Explain the concepts of radiometry, including the measurement of light and its behavior in space and on surfaces.	2	9
MAI21207.2	Analyze shift-invariant linear systems and their role in signal processing and image filtering.	4	9
MAI21207.3	Interpret geometry of multiple views, stereopsis and segmentation by clustering.Human Vision, Grouping and Getstalt.	5	9
MAI21207.4	Implement the Expectation-Maximization (EM) algorithm for fitting and segmentation tasks, demonstrating its practical applications.	5	9
MAI21207.5	Evaluate geometric camera calibration techniques using least-squares parameter estimation and linear approaches for camera c	5	9

Head of Dept. (Information Technology)
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Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited (A+ Grade)

First Year (Semester-II) M. Tech. AIML

MAI21208: Data Visualization Techniques

Teaching Scheme	
Theory	4 Hrs/week
Tutorial	-
Total Credits	4

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 3Hrs	

Course Objectives:

Student shall be able to

1.	Interpret the basics of data visualization, its relationship with other fields.
2.	Analyze the stages of visualization, the semiology of graphical symbols, eight visual variables and historical perspectives.
3.	Categorize spatial, geospatial, and multivariate data through various dimensional techniques.
4.	Determine text and document visualization techniques, including text representations.
5.	Classify the steps in designing effective visualizations, addressing challenges in data, cognition and perception.

Course Contents

Unit I	**INTRODUCTION AND DATA FOUNDATION** Basics, Relationship between Visualization and Other Fields, The Visualization Process, Pseudo code Conventions, The Scatter plot. Data Foundation, Types of Data, Structure within and between Records, Data Preprocessing, Data Sets
Unit II	**FOUNDATIONS FOR VISUALIZATION** The Visualization stages, Semiology of Graphical Symbols, The Eight Visual Variables, Historical Perspective, Taxonomies, Experimental Semiotics based on Perception Gibson‘s Affordance theory, A Model of Perceptual Processing.
Unit III	**VISUALIZATION TECHNIQUES** Spatial Data: One-Dimensional Data, Two-Dimensional Data, Three Dimensional Data, Dynamic Data, Combining Techniques. Geospatial Data: Visualizing Spatial Data, Visualization of Point Data, Visualization of Line Data, Visualization of Area Data, Other Issues in Geospatial Data Visualization Multivariate Data: Point-Based Techniques, Line-Based Techniques, Region-Based Techniques, Combinations of Techniques, Trees Displaying Hierarchical Structures, Graphics and Networks, Displaying Arbitrary Graphs/Networks.

Unit IV	**INTERACTION CONCEPTS AND TECHNIQUES** Text and Document Visualization: Introduction, Levels of Text Representations, The Vector Space Model, Single Document Visualizations, Document Collection Visualizations, Extended Text Visualizations Interaction Concepts: Interaction Operators, Interaction Operands and Spaces, A Unified Framework. Interaction Techniques: Screen Space, Object Space, Data Space, Attribute Space, Data Structure Space, Visualization Structure, Animating Transformations, Interaction Control.
Unit V	**RESEARCH DIRECTIONS IN VIRTUALIZATIONS** Steps in designing Virtualizations, Problems in designing effective Virtualizations, Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications.

Text Books	
T.1	Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010
T.2	Colin Ware, “Information Visualization Perception for Design”, 2nd edition, Margon Kaufmann Publishers, 2004.

Reference Books	
R.1	Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007.
R.2	Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.
Useful Links	
1	https://elearn.nptel.ac.in/shop/iit-workshops/completed/data-visualization-with-r/?v=c86ee0d9d7ed
2	https://onlinecourses.nptel.ac.in/noc24_ma30

CO	Course Outcomes	CL	Class Sessions
MAI21208.1	Analyze the Relationship between Visualization and Other Fields, The Visualization Process, Pseudo code Conventions.	4	9
MAI21208.2	Interpret Semiology of Graphical Symbols, The Eight Visual Variables, Historical Perspective, Taxonomies, and Experimental Semiotics.	5	9
MAI21208.3	Determine spatial, geospatial, and multivariate data and techniques for visualizing point, line, and area data.	3	9
MAI21208.4	Explain Levels of Text Representations, The Vector Space Model, Single Document Visualizations, and Document Collection Visualizations.	5	9
MAI21208.5	Design the Steps in designing Virtualizations, Problems in designing effective Virtualizations, Issues of Data, Issues of Cognition, Perception, and Reasoning.	5	9

Tulsiramji Gaikwad-Patil College of Engineering and Technology

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First Year (Semester-II) M. Tech. AIML

MAI21209: Block Chain Technology

Teaching Scheme		Examination Scheme	
Theory	4 Hrs/week	CT-I	15 Marks
Tutorial	-	CT-II	15 Marks
Total Credits	4	CA	10 Marks
		ESE	60 Marks
		Total	100 Marks
		Duration of ESE: 3Hrs	

Course Objectives:

Student shall be able to

1.	Interpret the concepts and technologies behind ledgers, databases, distributed systems, and block chain.
2.	Explain Bitcoin's block chain and scripting fundamentals, exploring its use cases in micropayments and escrow.
3.	Analyze ethereum and smart contracts, principles and applications of lightweight wallets, hierarchical deterministic wallets.
4.	Illustrate the Hyper ledger Fabric block chain network, covering its infrastructure, participant roles.
5.	Understand privacy and security challenges in block chain, including anonymity vs. pseudo-anonymity, Zcash and Zk-SNARKS.

Course Contents

Unit I	**FOUNDATIONS** Ledgers - Databases - Distributed systems - Hash-linked chains, distributed ledger, Block chain as new form of trust, distributed consensus, Double- Spending Problem, GHOST protocol.
Unit II	**BITCOIN BLOCK CHAIN** Bitcoin Block chain and scripts, Use cases of Bitcoin Block chain scripting language in micro-payment, escrow etc. Downside of Bitcoin – mining, UTXO Model, Transactions, The Merkle Root, Signing and Validating Transactions, The Coin-base Transaction, Wallets.
Unit III	**ETHEREUM BLOCKCHAIN** Ethereum and Smart contracts, Lightweight wallets, Hierarchical deterministic wallets, Extended public keys, Deriving hardened private keys, Public key math, Public key multiplication, Public key encoding, Merkle trees, Security of lightweight wallets, NFTs and ERC-721 Tokens Stable coins and other ERC-20 Tokens Decentralized Finance (DeFi), Layer 2& Payment Channel Network
Unit IV	**HYPERLEDGER BLOCKCHAIN** Fabric network: Infrastructure, Participants In Hyper ledger Block chain Network, Chain code, Types Of Peers, Transaction Life-Cycle Of Hyper ledger Fabric.

Unit V	**PRIVACY, SECURITY ISSUES IN BLOCKCHAIN** Pseudo anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Block chains such as Sybil attacks, selfish mining, 51% attacks - - advent of algorand, and Sharding based consensus algorithms, User Addresses and Privacy Security issues in Block chain: Anonymity, Sybil Attacks, Selfish Mining, 51/49 ratio Attacks.
Text Books	
T.1	Andreas M. Antonopoulos, Gavin Wood, Dr. Gavin Wood, "Mastering Ethereum: Building Smart Contracts and DApps", O'Reilly Media, Incorporated, 2018
T.2	Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications Imran Bashir-Packt Publishing-2nd Edition, 2020
Reference Books	
R.1	M. Swan, "Blockchain: Blueprint for a New Economy", OReilly, 2015
R.2	Blockchain Applications: A Hands-On Approach Arshdeep Bahga, Vijay Madisetti-VPT-1st Edition, 2018
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_cs44
2	https://onlinecourses.nptel.ac.in/noc20_cs01

	Course Outcomes	CL	Class Sessions
MAI21209.1	Explain hash-linked chains and distributed ledgers, highlighting blockchain as a new form of trust.	2	9
MAI21209.2	Classify Bitcoin wallet management and the role of wallets in securing Bitcoin transactions.	2	9
MAI21209.3	Analyze Ethereum's use of Merkle trees, NFTs, ERC-721 tokens, and ERC-20 tokens for decentralized finance (DeFi) applications.	4	9
MAI21209.4	Examine the transaction lifecycle in Hyperledger Fabric and its application in enterprise blockchain solutions.	4	9
MAI21209.5	Evaluate security issues of block chain and smart contracts.	5	9

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