Semester: I – I

M.Tech(AI&DS) – R24

24MCST01: Mathematical Foundations of Data Science

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. Gain a comprehensive understanding of analog and discrete signals, including the foundational principles of Shannon theory, wavelet transforms, and their applications in multi-resolution analysis.
2. Acquire knowledge and skills in linear and non-linear approximation methods, signal and image modeling, and advanced compression and denoising strategies.
3. Learn to address inverse problems using regularization techniques, sparsity priors, and iterative algorithms for sparse regularization and deconvolution.
4. Understand the basics and advanced topics in machine learning, including supervised and unsupervised learning, kernel methods, optimization techniques, and empirical risk minimization.
5. Develop proficiency in designing and training deep learning models, such as multi-layer perceptrons and convolutional neural networks, and explore their theoretical and practical implications.

Course Outcomes

At the end of the course, student will be able to

CO1: Analyze the properties of analog and discrete signals and apply Shannon's theorems and wavelet transforms to real-world problems

CO2: Design effective signal compression and denoising systems using both linear and non-linear methods and critically evaluate their performance

CO3: Solve inverse problems in signal processing by applying regularization techniques, demonstrating an ability to tackle ill-posed problems effectively

CO4: Implement machine learning algorithms for signal analysis, optimizing models using gradient descent and other advanced optimization techniques.

CO5: Design, train, and evaluate deep learning architectures, understanding their underlying principles and practical applications.

UNIT – I

Shannon Theory: Analog vs. Discrete Signals, Shannon Sampling Theorem, Shannon Source Coding Theorem

Wavelets: Multi-resolution Approximation Spaces, Multi-resolution Details Spaces, On Bounded Domains, Fast Wavelet Transform, 2-D Wavelets, Wavelet Design

UNIT – II

Linear and Non-linear Approximation: Approximation, Signal and Image Modeling, Efficient approximation, Fourier Linear Approximation of Smooth Functions, Wavelet Approximation of Piecewise Smooth Functions

Compression: Transform Coding, Entropic Coding

Denoising: Noise Modeling, Linear Denoising using Filtering, Non-linear Denoising using Thresholding, Data-dependant Noises

UNIT – III

Inverse Problems: Inverse Problems Regularization, Theoretical Study of Quadratic Regularization, Quadratic Regularization, Non-Quadratic Regularization, Examples of Inverse Problems

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Sparse Regularization: Sparsity Priors, Sparse Regularization of Inverse Problems, Iterative Soft Thresholding Algorithm, Example: Sparse Deconvolution

UNIT – IV

Basics of Machine Learning: Unsupervised Learning, Empirical Risk Minimization, Supervised Learning: Regression, Supervised Learning: Classification, Kernel Methods, Probably approximately correct learning theory.
Optimization & Machine Learning: Smooth Optimization, Motivation in Machine Learning, Basics of Convex Analysis, Derivative and gradient, Gradient Descent Algorithm, Convergence Analysis

UNIT – V

Optimization & Machine Learning: Advanced Topics, Regularization, Stochastic Optimization, Automatic Differentiation
Shallow Learning: Recap on Supervised Learning, Multi-layer Perceptron, Training a MLP, Controlling the Estimation Error, Universality, Approximation Rates
Deep Learning: Deep Architectures, Deep Network Structure, Perceptron and Shallow Models, Convolutional Neural Networks, Advanced Architectures, Scattering Transform

Textbook

1. Peyré, Gabriel. "Mathematical foundations of data sciences." *Rn* 1, no. 2 (2020).

Reference Books

1. Hrycej, Tomas., Bermeitinger, Bernhard., Cetto, Matthias., Handschuh, Siegfried. Mathemati cal Foundations of Data Science. N.p.: Springer International Publishing, 2023.
2. Emmert-Streib, Frank., Moutari, Salissou., Dehmer, Matthias. Mathematical Foundations of Data Science Using R. Austria: De Gruyter, 2022.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H			M		L	H	L	M
CO2		M		L		H	M	H	L
CO3	L		H		M		L	M	H
CO4		H	M			L	H	L	M
CO5		L		H		M	M	H	L

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24MCST02: Advances in Artificial Intelligence

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. Gain a historical perspective of Artificial Intelligence (AI) and its foundations.
2. Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
3. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Experiment with a machine learning model for simulation and analysis.
5. Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes

At the end of the course, student will be able to

CO1: Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.

CO2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.

CO3: Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.

CO4: Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.

CO5: Solve problems with uncertain information using Bayesian approaches.

UNIT – I

Introduction to artificial intelligence: The Foundations of AI, History of AI, The State of the Art, Intelligent Agents and Environments, Good Behavior, The Nature of Environments, The Structure of Agents.

UNIT – II

Solving Problems by Searching: Problem Solving Agents, Example Problems, Searching for solutions, ununiformed search Strategies, Avoiding Repeated States, Searching with Partial Information, Heuristic Search Strategies.

UNIT – III

Ethical Decision Making: Introduction. Ethical Theories, Values, Ethics in Practices, Implementing Ethical Reasoning, Responsible Research and Innovation, the ART of AI, Design of Values.

Can AI Systems be Ethical: Introduction, what is an Ethical Action, Approaches to Ethical Reasoning by AI, Designing Artificial Moral Agents, Implementing Ethical Deliberation, Levels of Ethical Behavior, The Ethical Status of AI Systems.

UNIT – IV

Socially Responsible AI: Introduction, The AI Responsibility Pyramid Socially Responsible AI Algorithms, what could go wrong? Theories in Socially Responsible AI: Fairness, Interpretability, privacy, Distribution Shift.

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UNIT – V

Practices of Socially Responsible AI: Protecting, Informing, Preventing.
Challenges of Socially Responsible AI: Causality and Socially Responsible AI, A Sequential Bias Mitigation approach, A Multidisciplinary Approach for Context Specific Interoperability, The Fairness Utility Trade-off, The Interoperability Utility Trade-off, Trade-offs among Fairness, Interoperability, and privacy.

Textbooks

1. Russell, Stuart Jonathan., Norvig, Peter. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2016.
2. Dignum, Virginia. Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way. Germany: Springer International Publishing, 2019.
3. Cheng, Lu., Liu, Huan. Socially Responsible Ai: Theories And Practices. Singapore: World Scientific Publishing Company, 2023.

Reference Books

1. Rich, Elaine. Artificial Intelligence 3E (Sie). India: Tata McGraw-Hill Publ., 2019.
2. Ertel, Wolfgang. Introduction to Artificial Intelligence. Germany: Springer International Publishing, 2018.
3. Kaushik, Saroj. Artificial Intelligence. India: Cengage Learning India Private Limited, 2011.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	M	-	L	H	M	L
CO2	-	-	M	H	-	L	M	L	H
CO3	-	L	-	H	M	-	H	M	L
CO4	H	-	-	-	M	L	M	H	-
CO5	-	H	-	M	-	L	L	M	H

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24MCST03: Programming for Data Science

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide students with a thorough understanding of the fundamentals of data science, including its methodology, tasks, and the use of Python for data science applications.
2. To teach students the techniques and processes involved in preparing and cleaning data, including handling missing values, standardizing data, and identifying outliers.
3. To equip students with the skills needed to perform exploratory data analysis, including creating visualizations, using statistical methods, and understanding the relationship between variables.
4. To introduce students to various modeling techniques such as decision trees, random forests, Naïve Bayes classification, and neural networks, and how to apply these models to real-world data.
5. To provide an understanding of generalized linear models, including linear regression, logistic regression, and Poisson regression, and to develop skills in data summarization and visualization for better interpretation and communication of results.

Course Outcomes

At the end of the course, student will be able to

CO1: Use Python and its libraries (such as NumPy) to execute commands, manipulate data, create visualizations, and perform basic statistical operations.

CO2: Adept at preparing and cleaning data by performing tasks such as reexpression of categorical data, standardizing numeric fields, and identifying and handling outliers.

CO3: Perform exploratory data analysis using techniques such as bar graphs, contingency tables, and histograms, and understand how to use these tools to gain insights from data.

CO4: Build and evaluate models using decision trees, random forests, Naïve Bayes classifiers, and neural networks, and apply these models to solve classification and regression problems.

CO5: Apply generalized linear models, performing logistic and Poisson regression analyses, and using various data summarization and visualization techniques to effectively communicate their findings.

UNIT – I

Introduction to Data Science: Introduction to Data Science, Data Science Methodology, Data Science tasks

Basics of Python: Using comments in python, Executing Commands in python, importing packages, getting data, saving output, Accessing Records and Variables in Python, setting up graphs in python, python data science Libraries: installing NumPy, Creating NumPy, performing element-wise Operation, using NumPy Statistical Functions.

UNIT – II

Data Preparation: Problem Understanding Phase, Data Preparation Phase Adding Indexed field, changing misleading Values, Re-expression of Categorical data as Numeric, Standardizing the Numeric fields, Identifying Outliers.

Exploratory Data Analysis: EDA vs HT, Bar Graph with Response Overlay, Contingency Tables, Histograms with Response Overlay, Binning Based on Predictive Values.

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UNIT – III

Preparing to model the data: Partitioning the data, validating the Partition, Balancing the training data set, Establishing Baseline Model Performance.

Decision Trees: Introduction, Classification and Regression Trees, The C5.0 algorithm for building Decision trees, Random forest.

UNIT – IV

Naïve Bayes Classification, Bayes Theorem, Neural Networks Structure, Sigmoid Activation Function, Back propagation, Clustering, Dimension Reduction.

UNIT – V

Generalized Linear Models: Linear Regression as a general linear model, Logistic Regression using Python, Poisson Regression, applications.

Data Summarization & Visualization: Building blocks, graphs & Tables for summarizing & organizing, measures of center, variability & Position, Summarization & Visualization of Bivariate Elation ship.

Textbooks

1. Larose, Chantal D., and Daniel T. Larose. Data science using Python and R. John Wiley & Sons, 2019.
2. Vasiliev, Yuli. Python for Data Science: A Hands-on Introduction. No Starch Press, 2022.

Reference Books

1. Massaron, Luca, and John Paul Mueller. Python for data science for dummies. No. PUBDB-2017-146858. Wiley, 2015.
2. Warren, James, and Nathan Marz. Big Data: Principles and best practices of scalable realtime data systems. Simon and Schuster, 2015.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	M	-	L	H	M	L
CO2	-	-	M	H	-	L	M	H	L
CO3	-	L	-	H	-	M	H	L	M
CO4	H	-	L	-	M	L	M	H	-
CO5	-	H	-	M	-	L	L	M	H

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24MCST06: Soft Computing
(Professional Elective – I for CSE & Open Elective – II for ECE, EEE, ME)

Credits – 3 **Sessional Marks: 40**
L:T:P :: 3:0:0 **University Exam Marks:60**

Course Objectives
1. To provide a comprehensive understanding of soft computing, its evolution, types, and applications, with a foundational knowledge of machine learning and neural networks.
2. To explore various neural network architectures, learning methods, and applications, with a focus on backpropagation networks and associative memory networks.
3. To introduce the concepts of unsupervised learning and adaptive resonance theory (ART), including classical ART networks, their features, algorithms, and real-world applications.
4. To provide an understanding of fuzzy sets, fuzzy relations, fuzzy logic, and inference systems, emphasizing their operations, properties, and applications in decision-making processes.
5. To explore the history, principles, and applications of genetic algorithms (GA), including the creation of offspring, genetic modeling, and comparison with traditional algorithms, along with hybrid systems and evolutionary computing.

Course Outcomes
At the end of the course, student will be able to

CO1: Differentiate between soft computing and hard computing, understand the features and applications of soft computing, and have a basic understanding of machine learning principles.

CO2: Understand neural network architectures, learning methods, and the backpropagation algorithm, along with practical applications in various domains.

CO3: Acquire knowledge in unsupervised learning techniques, specifically adaptive resonance theory, and will be able to illustrate and apply ART1 and ART2 models to relevant applications.

CO4: Work with fuzzy sets, fuzzy relations, and fuzzy logic systems, understand their operations and properties, and apply fuzzy inference and decision-making techniques in real-world scenarios.

CO5: Implement genetic algorithms, understand their working principles and genetic modelling techniques, compare GA with traditional methods, and apply hybrid systems and evolutionary computing in solving complex problems.

UNIT – I
Introduction to Soft Computing: soft computing vs. hard computing, evolution of soft computing, features and types of soft computing, applications of soft computing, basics of machine learning. Neural networks: Basic concepts of Neural Networks, Model of Artificial Neuron, Neural Network Architectures, Characteristics of neural networks

UNIT – II
Back Propagation Networks and Associative Memory Networks: Learning Methods, Early neural network architectures, Application domains. Back propagation network (BPN), Back propagation Learning, Applications of BPN, Parameter selection, Variations of Back propagation Algorithms, Auto correlators, hetero correlators: Kosko's discrete Bi-direction associative memory (BAM),Exponential BAM, Application of Character Recognition.

UNIT – III
Unsupervised Learning and Adaptive Resonance Theory: Adaptive Resonance Theory (ART),

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Classical ART Networks, Simplifies ART Architecture, Features, algorithms and Illustration of ART1 and ART2 model, Related Applications.

UNIT – IV

Fuzzy Sets, Fuzzy Relations, Fuzzy Logic And Inference: Fuzzy versus Crisp, Crisp Sets, Fuzzy sets, Membership functions, fuzzy set operations, properties of Fuzzy sets, Crisp Relations, Fuzzy relations – Fuzzy Cartesian product, Operations of Fuzzy Relations. Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Quantifiers, Fuzzy Inference, Fuzzy knowledge and rule-based system, fuzzy decision making, Defuzzification, and application of fuzzy logic

UNIT – V

Genetic Algorithms: History of Genetic Algorithm, Basic concepts, Creation of offspring, working principles, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, crossover, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method, Hybrid systems, evolutionary computing, Genetic Algorithm based on Backpropagation networks - Implementation and comparison on performance of traditional algorithms with Genetic Algorithm

Textbooks

1. Rajasekaran, Sundaramoorthy, and GA Vijayalakshmi Pai. Neural networks, fuzzy systems and evolutionary algorithms: Synthesis and applications. PHI Learning Pvt. Ltd., 2017.
2. Fuzzy Logic With Engineering Applications, 3rd Ed. India: Wiley India Pvt. Limited, 2011.
3. Sivanandam, S. N.Deepa. Principles of Soft Computing, 3rd Ed. India: Wiley India Pvt. Limited, 2018.

Reference Books

1. Jang, Jyh-Shing Roger., Sun, Chuen-Tsai., Mizutani, Eiji. Neuro-fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence. United Kingdom: Prentice Hall, 1997.
2. Kosko, Bart. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence. United States: Prentice Hall, 1992.
3. Klir, George J.., Yuan, Bo. Fuzzy Sets and Fuzzy Logic: Theory and Applications. India: Pearson, 2015.
4. Rich, Elaine. Artificial Intelligence 3E (Sie). India: Tata McGraw-Hill Publ., 2019.
5. Haykin, Simon. Neural networks and learning machines, 3/E. Pearson Education India, 2009.
6. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep learning. MIT press, 2016.

Web References

1. https://onlinecourses.nptel.ac.in/noc20_cs17/preview
2. https://www.coursera.org/learn/cnns-and-rnns
3. https://www.udemy.com/topic/fuzzy-log

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	M	-	L	H	M	L
CO2	-	-	M	H	-	L	H	L	M
CO3	-	-	-	H	M	L	H	M	L
CO4	H	-	-	-	M	L	M	H	L
CO5	-	H	-	M	-	L	L	H	M

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24MCST07: Speech and Natural Language Processing
(Professional Elective – I)

Credits – 3 | **Sessional Marks: 40**
L:T:P :: 3:0:0 | **University Exam Marks: 60**

Course Objectives

1. Introduce students to foundational concepts in natural language processing (NLP), including regular expressions, text normalization, and edit distance.
2. Familiarize students with various language models, including N-gram models, logistic regression, and vector semantics, and their applications in NLP.
3. Educate students on the architecture and training of neural networks and their applications in NLP, including neural language models and sequence labeling.
4. Explore advanced NLP techniques such as RNNs, LSTMs, transformers, and fine-tuning of large language models.
5. Expose students to practical applications of NLP, including question answering, information retrieval, chatbots, dialogue systems, automatic speech recognition, and text-to-speech systems.

Course Outcomes

After completion of the course, students will be able to

CO1: Describe the fundamental concepts and techniques of text processing, including regular expressions, text normalization, and edit distance, as well as their applications in NLP.

CO2: Apply various language models, such as N-gram models, logistic regression, and vector semantics, to solve NLP tasks and evaluate their performance using metrics like perplexity and cross-entropy loss.

CO3: Analyze the architecture and functionality of neural networks, including feedforward networks, RNNs, and LSTMs, and their applications in NLP tasks such as language modeling and sequence labeling.

CO4: Evaluate advanced NLP models, such as transformers and large language models, and their fine-tuning techniques for specific applications like contextual embeddings and masked language models.

CO5: Develop practical NLP systems for question answering, information retrieval, chatbots, dialogue systems, and speech processing, using state-of-the-art techniques and evaluating their performance.

UNIT – I

Introduction, Regular Expressions, Text Normalization, Edit Distance: Regular Expressions, Words, Corpora, Simple Unix Tools for Word Tokenization, Word Tokenization, Word Normalization, Lemmatization and Stemming, Sentence Segmentation, Minimum Edit Distance, N-gram Language Models: N-Grams, Evaluating Language Models: Training and Test Sets, Evaluating Language Models: Perplexity, Sampling sentences from a language model, Generalization and Zeros, Smoothing.

UNIT – II

Logistic Regression: The sigmoid function, Classification with Logistic Regression, Multinomial logistic regression, Learning in Logistic Regression, The cross-entropy loss function, Gradient Descent, Regularization, Learning in Multinomial Logistic Regression, Interpreting models
Vector Semantics and Embeddings: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models, Word2vec, Visualizing

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Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models

UNIT – III

Neural Networks and Neural Language Models: Units, The XOR problem, Feedforward Neural Networks, Feedforward networks for NLP: Classification, Training Neural Nets, Feedforward Neural Language Modeling, Training the neural language model

Sequence Labeling for Parts of Speech and Named Entities: Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition

UNIT – IV

RNNs and LSTMs: Recurrent Neural Networks, RNNs as Language Models, RNNs for other NLP tasks, Stacked and Bidirectional RNN architectures, The LSTM

Transformers and Large Language Models: The Transformer: A Self-Attention Network, Multihead Attention, Transformer Blocks, The Residual Stream view of the Transformer Block

Fine-Tuning and Masked Language Models: Bidirectional Transformer Encoders, Training Bidirectional Encoders, Contextual Embeddings, Fine-Tuning Language Models

UNIT – V

Question Answering and Information Retrieval: Information Retrieval, Information Retrieval with Dense Vectors, Using Neural IR for Question Answering, Evaluating Retrieval-based Question Answering

Chatbots & Dialogue Systems: Properties of Human Conversation, Frame-Based Dialogue Systems, Dialogue Acts and Dialogue State, Chatbots, Dialogue System Design

Automatic Speech Recognition and Text-to-Speech: The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture, CTC, ASR Evaluation: Word Error Rate, TTS, Other Speech Tasks

Textbook

1. Jurafsky, Dan. Speech & Language Processing. India: Pearson Education, 2000.

Reference Books

1. Manning, Christopher., Schutze, Hinrich. Foundations of Statistical Natural Language Processing. Cambridge: MIT Press, 1999.
2. Kamath, Uday., Liu, John., Whitaker, James. Deep Learning for NLP and Speech Recognition. Germany: Springer International Publishing, 2019.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	L	-	-	H	-	M	M	H	-
CO2	-	L	-	-	H	M	M	H	-
CO3	-	-	L	H	-	M	H	M	-
CO4	-	-	H	M	-	L	M	H	-
CO5	-	L	-	-	M	H	H	M	-

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24MCST08: Cognitive Science
(Professional Elective – I)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide an understanding of the foundational concepts of cognitive science, including its interdisciplinary nature, types of representation, and the cognitive approach to artificial intelligence.
2. To delve into cognitive processes such as vision, pattern recognition, and attention, and evaluate different theories and models that explain these processes.
3. To study various types of memory, memory models, visual imagery, and problem-solving techniques, and evaluate their effectiveness in explaining cognitive functions.
4. To introduce the principles and characteristics of artificial neural networks and semantic networks, and evaluate the connectionist approach to cognitive science.
5. To explore the relationship between artificial intelligence and cognitive science, including the history, practical applications, and approaches to designing intelligent agents and reasoning systems.

Course Outcomes

At the end of the course, student will be able to

CO1: Understand cognitive science principles, including different types of representation, the mind-body problem, and the modularity of the mind.

CO2: Analyze and evaluate cognitive processes such as vision, pattern recognition, and attention, and understand various theories and models explaining these processes.

CO3: Explain different types of memory, memory models, and problem-solving techniques, and critically evaluate models like the Modal Model, ACT Model, and SOAR Model.

CO4: Understand the principles and characteristics of artificial neural networks and semantic networks, and be able to evaluate the connectionist approach to cognitive science.

CO5: Acquire knowledge of the relationship between AI and cognitive science, including the history and practical applications of AI, intelligent agent design, and different reasoning approaches, preparing them for advanced study or research in these fields.

UNIT – I

Introduction to Cognitive Science: A Brave New World – Introduction Cognitive Science – Representation: Types of Representation - Interdisciplinary Perspective - Cognitive Approach and Artificial Intelligence Approach - The Mind–Body Problem: Mind as Information Processor - Modularity of Mind - Theories of Vision and Pattern Recognition.

UNIT – II

The Cognitive Approach I: Vision, Pattern Recognition, and Attention: History- the Rise of Cognitive Psychology-The Cognitive Approach: Mind as an Information Processor Modularity of Mind-Evaluating the Modular Approach .Vision: Evaluating the Computational Approach to Vision-Theories of Vision and Pattern. Recognition: How to Recognize Objects -Template Matching Theory-Evaluating Template Matching Theory-Feature Detection Theory- Evaluating Feature Detection Theory- Computational Vision and Pattern- Recognition-Evaluating the Computational Approach to Vision Feature Integration Theory- Attention: How Do We Pay attention-Evaluating the Filter Model-The Multimode Model of Attention.

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UNIT – III

The Cognitive Approach II: Memory, Imagery, and Problem Solving Types of Memory: How Do We Remember-Sensory Memory- Long-Term Memory-Memory Models- The Modal Model-Evaluating the Modal Model-The ACT Model-Evaluating the ACT* Model. The Working Memory Model-Evaluating the Working Memory. Model-Visual Imagery: How to Imagine-Image Structures-Image Processes. Problem Solving: The General Problem Solver Model-Evaluating the General Problem Solver Model- SOAR Model- Evaluating the SOAR Model

UNIT – IV

Network Approach: Principles Underlying Artificial Neural Networks (ANN) Characteristics of ANN - Conceptions of Neural Networks - Back Propagation and Convergent Dynamics - ANN Typologies - Evaluating the Connectionist Approach - Semantic Networks - Characteristics of Semantic Networks - Evaluation of the network approach.

UNIT – V

Artificial Intelligence and Cognitive Science: Definition of AI – History - Practical World of Artificial Intelligence - Approaches to the Design of Intelligent Agents - Machine Representation of Knowledge - Machine Reasoning - Logical Reasoning - Inductive Reasoning - Expert Systems

Textbooks

1. Jay Friedenberg and Gordon Silverman "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York, 2015.
2. Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015.

Reference Books

1. Miller, Paul. An introductory course in computational neuroscience. MIT Press, 2018.
2. Busemeyer, Jerome R., Zheng Wang, James T. Townsend, and Ami Eidels. The Oxford handbook of computational and mathematical psychology. Oxford University Press, 2015.
3. Stillings, Neil A. Cognitive science: An introduction. MIT press, 1995.

Course Outcomes Program Outcomes Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	L	-	M	H	L	M
CO2	-	-	M	H	-	L	M	H	L
CO3	-	M	-	H	-	L	L	M	H
CO4	H	-	-	L	-	M	M	L	H
CO5	-	H	-	M	-	L	L	H	M

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Semester: I – I

M.Tech(AI&DS) – R24

24MCST09: Predictive Analytics and Data Mining
(Professional Elective – II)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. Expose students to the fundamental concepts of data mining, including its processes, types, and algorithms.
2. Familiarize students with association analysis and clustering techniques, and their applications in data mining.
3. Introduce students to model evaluation methods and text mining techniques.
4. Educate students on time series forecasting, anomaly detection, and their practical applications in data analysis.
5. Inform students about feature selection methods and provide hands-on experience with RapidMiner for data mining tasks.

Course Outcomes

After completion of the course, students will be able to

CO1: Describe the key concepts and processes of data mining, including data preparation, modeling, application, and knowledge extraction.

CO2: Apply association rule mining algorithms like Apriori and FP-Growth, as well as clustering techniques such as k-means and DBSCAN, to analyze datasets.

CO3: Evaluate models using techniques such as confusion matrix, ROC curves, and lift curves, and implement text mining methods for clustering and classification.

CO4: Analyze data-driven and model-driven approaches for time series forecasting, and implement anomaly detection methods for identifying outliers in datasets.

CO5: Develop data mining solutions using feature selection methods and RapidMiner tools for data importing, visualization, transformation, and optimization.

UNIT – I

Introduction: What Data Mining Is, What Data Mining Is Not, Types of Data Mining, Data Mining Algorithms

Data Mining Process: Data Preparation, Modeling, Application, Knowledge

Data Exploration: Objectives of Data Exploration, Data Sets, Descriptive Statistics, Data Visualization

UNIT – II

Association Analysis: Concepts of Mining Association Rules, Apriori Algorithm, FP-Growth Algorithm

Clustering: Types of Clustering Techniques, k-Means Clustering, DBSCAN Clustering, Self-Organizing Maps

UNIT – III

Model Evaluation: Confusion Matrix (or Truth Table), Receiver Operator Characteristic (ROC) Curves and Area under the Curve (AUC), Lift Curves, Evaluating the Predictions: Implementation

Text Mining: How Text Mining Works, Implementing Text Mining with Clustering and Classification

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UNIT – IV

Time Series Forecasting: Data-Driven Approaches, Model-Driven Forecasting Methods
Anomaly Detection: Anomaly Detection Concepts, Distance-Based Outlier Detection, Density-Based Outlier Detection, Local Outlier Factor

UNIT – V

Feature Selection: Classifying Feature Selection Methods, Principal Component Analysis, Information Theory-Based Filtering for Numeric Data, Chi-Square-Based Filtering for Categorical Data, Wrapper-Type Feature Selection
Getting Started with RapidMiner: User Interface and Terminology, Data Importing and Exporting Tools, Data Visualization Tools, Data Transformation Tools, Sampling and Missing Value Tools, Optimization Tools

Textbook

1. Kotu, Vijay., Deshpande, Bala., Deshpande, Balachandre. Predictive Analytics and Data Mining: Concepts and Practice with RapidMiner. Germany: Elsevier Science, 2014.

Reference Books

1. Larose, Daniel T.. Data Mining and Predictive Analytics. Germany: Wiley, 2015.
2. Finlay, Steven. Predictive Analytics, Data Mining and Big Data: Myths, Misconceptions and Methods. United Kingdom: Palgrave Macmillan, 2014.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	M	-	-	H	-	L	M	H	-
CO2	-	L	-	-	H	M	H	M	-
CO3	-	-	L	H	-	M	H	-	M
CO4	-	-	H	-	M	L	M	H	-
CO5	M	-	-	L	-	H	H	M	-

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Semester: I – I

M.Tech(AI&DS) – R24

24MCST10: Applied Machine Learning
(Professional Elective – II)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. To provide students with a comprehensive understanding of fundamental classification algorithms such as Nearest Neighbors, Naive Bayes, SVMs, and Random Forests.
2. To introduce students to various clustering techniques including agglomerative and divisive clustering, k-Means algorithm, and clustering using probability models.
3. To equip students with knowledge of regression analysis, including linear regression, least squares, and techniques for visualizing and managing regression models.
4. To familiarize students with sequence models including Hidden Markov Models, Graphical Models, Conditional Random Field Models, and techniques for discriminative learning of CRFs.
5. To teach students about simple image classifiers, convolutional neural networks, and practical applications in classifying images and detecting objects using advanced models like AlexNet, VGGNet, and YOLO.

Course Outcomes

At the end of the course, student will be able to

CO1: Implement and analyze various classification algorithms such as Nearest Neighbors, Naive Bayes, SVMs, and Random Forests, and understand their applications.

CO2: Apply different clustering methods, including agglomerative and divisive clustering, k-Means, and mixture models, to real-world datasets.

CO3: Perform regression analysis using linear regression and least squares, and will be able to visualize and troubleshoot regression models effectively.

CO4: Develop and utilize sequence models like Hidden Markov Models and Conditional Random Fields, and understand their application in dynamic programming and discriminative learning contexts.

CO5: Classify images using convolutional neural networks and detect objects using advanced techniques, demonstrating the ability to work with models like AlexNet, VGGNet, and YOLO.

UNIT – I

Learning to classify: Classification: The Big Ideas, Classifying with Nearest Neighbors, Naive Bayes

SVMs and Random Forests: The Support Vector Machine, Classifying with Random Forests

UNIT – II

Clustering: Agglomerative and divisive clustering, The k-Means algorithm and variants, Describing repetition with vector quantization.

Clustering Using Probability Models: Mixture Models and Clustering, The EM Algorithm

UNIT – III

Regression: Overview, Linear Regression and Least Squares, Visualizing Regressions to Find Problems.

Choosing and Managing Models: Model Selection: Which Model Is Best?, Robust Regression, Generalized Linear Models.

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UNIT – IV

Hidden Markov Models: Markov Chains, Hidden Markov Models and Dynamic Programming, Learning an HMM

Learning Sequence Models Discriminatively: Graphical Models, Conditional Random Field Models for Sequences, Discriminative Learning of CRFs

UNIT – V

Simple Image Classifiers: Image Classification, Pattern Detection by Convolution, Convolutional Layers upon Convolutional Layers, Two Practical Image Classifiers, Example: Classifying MNIST, Example: Classifying CIFAR-10

Classifying Images and Detecting Objects: Image Classification, Object Detection.

Textbook

1. Forsyth, David. Applied Machine Learning. Germany: Springer International Publishing, 2019.

Reference Books

1. Gopal, M.. Applied Machine Learning. United Kingdom: McGraw-Hill Education, 2019.
2. Bhattacharya, Aditya. Applied Machine Learning Explainability Techniques: Make ML Models Explainable and Trustworthy for Practical Applications Using LIME, SHAP, and More. United Kingdom: Packt Publishing, 2022.
3. Giussani, Andrea. Applied Machine Learning with Python. Italy: Bocconi University Press, 2021.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	M	L				H	M	L
CO2	L	H		M			M	L	H
CO3			H		M	L	L	H	M
CO4	M		L	H			H	M	L
CO5				L	H	M	M	L	H

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Semester: I – I

M.Tech(AI&DS) – R24

24MCST11: Building Systems using the Agentic Framework
(Professional Elective – II)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide a comprehensive introduction to agent-based systems, including key concepts, advantages, limitations, and real-world applications.
2. To familiarize students with the Agentic framework, its development environment, and the basics of the Agentic programming language (AgtL), including syntax, data types, and control flow structures.
3. To teach students how to design and develop agents using the BDI architecture, agent communication protocols, and decision-making processes within the Agentic framework.
4. To enable students to represent knowledge and implement reasoning engines and logic programming within Agentic, integrating external knowledge bases as needed.
5. To provide students with the skills to package, deploy, test, and debug agent-based systems, and to evaluate their performance effectively.

Course Outcomes

At the end of the course, student will be able to

CO1: Explain the key concepts of agent-based systems, including agents, environments, interactions, autonomy, and their advantages and limitations.

CO2: Set up the Agentic development environment and use the Agentic programming language to write basic programs, demonstrating understanding of syntax, data types, and control flow structures.

CO3: Design agents using the BDI architecture, implement agent communication protocols, and develop agent behaviors and decision-making processes in the Agentic framework.

CO4: Represent knowledge using beliefs, facts, and rules in Agentic, and implement reasoning engines and logic programming, integrating external knowledge bases when necessary.

CO5: Package and deploy Agentic applications, test and debug agent-based systems, and evaluate their performance using appropriate metrics and techniques.

UNIT – I

Introduction to Agent-Based Systems (ABS): What are ABS?, Key concepts: agents, environments, interaction, autonomy, Advantages and limitations of ABS, Real-world applications of ABS

Introduction to the Agentic Framework: Overview of the Agentic framework, Setting up the Agentic development environment, Introduction to the Agentic programming language (AgtL), Basic syntax, data types, and control flow structures

UNIT – II

Building Agents with Agentic: Designing agents: beliefs, desires, intentions (BDI) architecture, Agent communication protocols (ACLs) in Agentic, Developing agent behaviors and actions, Implementing agent decision-making processes

UNIT – III

Knowledge Representation and Reasoning: Representing knowledge in Agentic (beliefs, facts, rules), Reasoning engines and logic programming in Agentic, Integrating external knowledge bases

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UNIT – IV

Agent Learning in Agentic: Introduction to machine learning for agent-based systems, Implementing learning algorithms within Agentic agents, Reinforcement learning techniques in the Agentic framework

UNIT – V

Deploying and Testing Agent-Based Systems: Packaging and deploying Agentic applications, Testing and debugging agent systems, Performance evaluation of agent-based systems

Textbooks

1. Shoham, Yoav, and Kevin Leyton-Brown. Multiagent systems: Algorithmic, game-theoretic, and logical foundations. Cambridge University Press, 2008.
2. Railsback, Steven F., and Volker Grimm. Agent-based and individual-based modeling: a practical introduction. Princeton university press, 2019.

References

1. Brachman, Ronald, and Hector Levesque. Knowledge representation and reasoning. Morgan Kaufmann, 2004.
2. Wooldridge, Michael, and Nicholas R. Jennings. "Intelligent agents: Theory and practice." The knowledge engineering review 10, no. 2 (1995): 115-152.
3. Rao, Anand S., and Michael P. Georgeff. "BDI agents: from theory to practice." In Icmas, vol. 95, pp. 312-319. 1995.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	L	-	-	H	-	M	H	M	L
CO2	-	-	M	H	-	L	H	L	M
CO3	H	-	-	-	M	L	H	M	L
CO4	H	M	-	-	-	L	M	H	L
CO5	-	H	-	M	-	L	L	H	M

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Semester: I – I

M.Tech(AI&DS) – R24

24MBST01: Research Methodology and IPR

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. To gain familiarity in order to obtain insights into selected area of research.
2. To acquaint procedures and techniques used to find the results of a research problem.
3. To familiarize methods for data analysis and design.
4. To know the steps to collect information about IPR.
5. To implement IPR protection strategies and other facilities provided by R &D in case of new innovation.

Course Outcomes

After completion of the course, students will be able to

CO1: Understand the research problem formulation
CO2: Analyze research related information
CO3: Follow research ethics
CO4: Understand that today's world is controlled by computer, information technology but tomorrow world will be ruled by ideas, concept and creativity.
CO5: Understand that when IPR would take such important place in growth of individuals and nation, it is needless to emphasise the need of information about intellectual property rights to be promoted among students in general and engineering in particular.
CO6: Understand that IPR protection provides an incentive to inventors for further research work and investment in R&D, which leads to creation of new and better products, and intern brings about economic growth and social benefits.

UNIT – I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT – II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT – III

Design and Analysis of Experiments: Introduction to ANOVA with examples; Factorial design: 2n design; Taguchi method: Introduction and application of taguchi method for optimization of process.

UNIT – IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

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UNIT – V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc, Traditional knowledge Case Studies, IPR and IITs.

Textbooks

1. Melville, S., and W. Goddard. "Research Methodology-An Introduction for Science & Engineering Students.I Cape Town: Juta & Co Ltd." (1996).

Reference Books

1. Goddard, Wayne, and Stuart Melville. Research methodology: An introduction. Juta and Company Ltd, 2004.
2. Kumar, Ranjit. "Research methodology: A step-by-step guide for beginners." 2018: 1-528.
3. Halbert, Debora J. Resisting intellectual property. Routledge, 2006.
4. Asimow, Morris. "Introduction to design." 1962.
5. Merges, Robert P., Peter Seth Menell, and Mark A. Lemley. "Intellectual property in the new technological age." 2003.
6. Ramappa, T. "Intellectual Property Rights Under WTO." S. Chand 3 2008: 272-282.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-		M	-	L	H	M	L
CO2	-	-	M	H	-	L	M	L	H
CO3	-	L	H	-	-	M	H	M	L
CO4	-	-	-	L	H	M	M	H	L
CO5	-	H	-	M	-	L	L	M	H
CO6	H	-	-	-	L	H	L	H	M

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24MHMT01 - DISASTER MANAGEMENT

(Common to CSE,ECE,EEE and ME)

Credits – 0
L:T:P::2:0:0

Course Objectives: -

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course Outcomes:

After completion of course, students will be able to :

CO1: Understand the need and significance of studying disaster management
CO2: Understand the different types of disasters and causes for disasters.
CO3: Gain knowledge on the impacts Disasters on environment and society
CO4: Study and assess vulnerability of a geographical area.
CO5: Students will be equipped with various methods of risk reduction measures and risk mitigation.
CO6: Understand the role of Information Technology in Disaster Management

UNIT: I

Introduction
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT: II

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster:
Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT: III

Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT: IV

Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk:Application Of Remote Sensing Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT: V

Risk Assessment

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

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24MHMT02 - VALUE EDUCATION

(Common to CSE,ECE,EEE and ME)

Credits – 0
L:T:P::2:0:0

Course Objectives

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outcomes:

After completion of course, students will be able to

CO1: To learn about philosophy of Life and Individual qualities

CO2: To learn and practice social values and responsibilities

CO3: To learn and practice mind culture, forces acting on the body and causes of diseases and their curing

CO4: To learn more of Engineer as Responsible Experimenter.

CO5: To learn more of Risk and Safety assessment with case studies.

CO6: To learn more of Responsibilities and Rights as Professional and facing Global Challenges

UNIT: I

Values and self-development –Social values and Individual attitudes. Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles, Value judgements .

UNIT-II

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature,Discipline

UNIT: III

Requirements implementing Value-Education , Elements in implementation of value-education , Special care requirements in implementation and in scaling up . changes are visible in students and teachers . changes are visible in the atmosphere of institution.Does it relate to world problems (Its potential for the world)

UNIT: IV

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking.Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.True friendship.Happiness Vs suffering, love for truth. Aware of self-destructive habits.Association and Cooperation. Doing best for saving nature

UNIT: V

Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation.Equality, Nonviolence, Humility, Role of Women.All religions and same message.Mind your Mind, Self-control.Honesty, Studying effectively

Suggested reading

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

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24MHMT04 - STRESS MANAGEMENT BY YOGA

(Common to CSE,ECE,EEE and ME)

Credits – 0
L:T:P::2:0:0

Course Objectives :

1. To achieve overall health of body and mind
2. To overcome stress

Course Outcomes:

After completion of course, students will be able to

CO1: Develop healthy mind in a healthy body thus improving social health also improve efficiently.
CO2: Learn how to use their bodies in a healthy way. Perform well in sports and academics.
CO3: Will balance, flexibility, and stamina, strengthen muscles and connective tissues enabling good posture.
CO4: Manage stress through breathing, awareness, meditation and healthy movement.
CO5:Build concentration, confidence and positive self-image

UNIT: I

- Definitions of Eight parts of yog. (Ashtanga)

UNIT: II

- Yam and Niyam. Do's and Don't's in life.
- Ahimsa, satya, astheya, bramhacharya and aparigraha
- Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT: III

- Panchakosas and Chittavrithis

UNIT: IV

- Pranayam
- ii) Regularization of breathing techniques and its effects-Types of pranayam

UNIT: V

- Asan : Various yoga poses and their benefits for mind & body

Suggested reading

1. "Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

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24MHMT05 - PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Common to CSE,ECE,EEE and ME)

Credits – 0
L:T:P::2:0:0

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course Outcomes :

After completion of course, students will be able to:

CO 1: Understand their Personality and achieve their highest Goals of Life.

CO2: Learn to build Positive Attitude, Self-Motivation, enhancing Self-Esteem and Emotional Intelligence

CO3: Analyze and Develop Time management, Team management, Work ethics, Good manners and personal and professional Etiquettes.

CO4: Learn the verses of Bhagvadh Githa with respect to Wisdom / Virtue / Professionalism

CO5: Learn to develop coping mechanism to manage and develop a versatile personality

UNIT:I

Introduction to Personality Development: Concept of Personality, Dimensions of Personality, Theories of Personality Development (Freud & Erickson); The Concept of Success and Failure, Factors Responsible for Success, Hurdles in achieving Success and Overcoming Hurdles, Causes of failure; SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats), Individual SWOT.

UNIT: II

Attitude, Motivation and Self-esteem: Conceptual overview of Attitude, Types of Attitudes, Attitude Formation, Advantages and Disadvantages of Positive and Negative Attitude, Ways to Develop Positive Attitude; Concept of Motivation: Definition and Nature of Motivation, Internal and External Motives, Theories of Motivation (Maslow & Herzberg), Importance of SelfMotivation, Factors leading to de-motivation; Self-esteem: Definition and Nature of self-esteem , Do's and Don'ts to develop positive self- esteem, Importance Building positive self image.

UNIT-III

Communication and Emotional Intelligence: Effective Communication, Types of Communication, Types of Etiquette; Decision-making skills, Steps in Decision Making, Conflict Management and Negotiation; Concept of Leadership, Qualities of a successful leader, Character building; Team-work, Time Management, Work ethics; Emotional Quotient, IQ Vs EQ, Dimensions of Emotional Intelligence, Components of Emotional Intelligence.

UNIT-IV

Approach to day to day work and duties.

- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35,
- Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do s)

UNIT: V

Personality of Role model. Shrimad BhagwadGeeta:

- Chapter2- Verses 41, 47,48, 17,
- Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading

1.Hurlock, E.B. Personality Development, 28th Reprint. New Delhi: Tata Mc GrawHill, 2006.

2.Gopinath,RashtrivaSanskritSansthanamP,Bhartrihari"sThreeSatakam,Niti-sringarvairagya, New Delhi, 2010

3.Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

4. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata -Mc-GrawHill.2001 5) Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004)

5 ."Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

6.Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath.

7.Rashtriya Sanskrit Sansthanam, New Delhi.

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24MCSS01: AI Tools Lab
(Skill Enhancement Course)

Credits – 2
L:T:P :: 0:0:4

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. Equip students with practical skills in using various AI tools for data manipulation, machine learning, deep learning, natural language processing, and computer vision tasks.
2. Develop a foundational understanding of how AI is applied in different domains, such as image classification, text analysis, time series forecasting, and chatbot development.
3. Train students in data cleaning techniques, feature engineering practices, and data preparation for effective use in AI models.
4. Introduce students to the concepts of building and evaluating simple machine learning and deep learning models for various tasks.
5. Encourage students to approach problems from an AI perspective, analyze data, and develop solutions using appropriate tools and techniques.

Course Outcomes

At the end of the course, student will be able to

CO1: Use a variety of AI tools for data analysis, model building, and visualization tasks.
CO2: Identify and apply AI techniques to solve problems in different domains relevant to their field of study.
CO3: Critically evaluate the performance of AI models, understand their limitations, and consider ethical implications.
CO4: Communicate their findings and insights gained from AI tools in a clear and concise manner.
CO5: Pursue further learning and exploration of advanced AI concepts and applications.

List of Experiments

Data Exploration and Preprocessing:

- **Experiment 1: Data Cleaning Challenge (Tool: pandas)**
  - Students are given a messy dataset containing missing values, outliers, and inconsistencies.
  - They use pandas library in Python to clean the data by imputing missing values, handling outliers, and correcting inconsistencies.
- **Experiment 2: Feature Engineering Exploration (Tool: Scikit-learn)**
  - Students use Scikit-learn to explore features within a dataset, identify correlations, and potentially create new features for improved model performance.
  - This may involve feature scaling, dimensionality reduction, or creating new features based on existing ones.

Machine Learning:

- **Experiment 3: Image Classification with Pre-trained Models (Tool: TensorFlow Playground or Cloud AutoML)**
  - Beginners can use the interactive TensorFlow Playground to understand image classification with pre-trained models like VGG16.
  - For a more advanced approach, students can experiment with Cloud AutoML to build an image classifier on their own dataset.

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- **Experiment 4: Text Classification with NLP Tools (Tool: spaCy or NLTK)**
  - Students use spaCy or NLTK to classify text data into categories like sentiment analysis or topic modeling.
  - This could involve training a model to identify positive, negative, and neutral sentiment in product reviews, or using topic modeling to discover hidden thematic structures in a large corpus of text.
- **Experiment 5: Time Series Forecasting with AutoML (Tool: Google AutoML)**
  - Students leverage Google AutoML to build a simple model for forecasting future values in a time series dataset.
  - This could involve predicting stock prices, weather patterns, or website traffic.

Deep Learning:

- **Experiment 6: Building a Simple Neural Network (Tool: TensorFlow or PyTorch)**
  - Students delve into deep learning by building a basic neural network with TensorFlow or PyTorch for a specific task like digit classification or image recognition.
  - This allows them to explore the core concepts of neural networks and backpropagation.

Natural Language Processing (NLP):

- **Experiment 7: Text Summarization with NLP Tools (Tool: Gensim or BART)**
  - Students experiment with tools like Gensim or BART to automatically generate summaries of longer text documents.
  - This could involve summarizing news articles, research papers, or product descriptions.
- **Experiment 8: Chatbot Development with Dialogflow (Tool: Google Dialogflow)**
  - Students use Google Dialogflow to build a simple chatbot that can answer basic questions or perform specific tasks based on user input.
  - This introduces them to chatbot development and the concept of natural language interaction.

Computer Vision:

- **Experiment 9: Object Detection with Pre-trained Models (Tool: YOLO model with OpenCV)**
  - Students leverage pre-trained object detection models like YOLO integrated with OpenCV to identify and localize objects within images.
  - This could involve detecting objects in traffic scenes, identifying products on shelves, or counting people in a crowd.

Advanced Machine Learning:

- **Experiment 10: Model Explainability with LIME (Tool: LIME library)**: Students delve into the "black box" nature of some machine learning models. They use libraries like LIME (Local Interpretable Model-Agnostic Explanations) to understand why a model makes specific predictions. This can be applied to previously built models to gain insights into their decision-making process.

Reinforcement Learning:

- **Experiment 11: Training an AI Agent with OpenAI Gym (Tool: OpenAI Gym toolkit)**: Introduce students to the concept of reinforcement learning. They can use OpenAI Gym, a toolkit for developing and comparing reinforcement learning algorithms, to train a simple AI agent to navigate a virtual environment or solve a game using trial and error with rewards and penalties.

Generative AI:

- **Experiment 12: Text Generation with GPT-3 (Tool: OpenAI API)**: Explore the world of generative AI. Students can leverage the capabilities of OpenAI's GPT-3 large language model API to generate creative text formats like poems, code, scripts, or musical pieces. This allows them to experiment with the potential of AI for creative content generation.

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Explainable AI for Computer Vision:

- **Experiment 13: Visualizing Feature Importance with Grad-CAM (Tool: Grad-CAM technique in TensorFlow or PyTorch)**: Focus on Explainable AI (XAI) for computer vision tasks. Students can implement techniques like Grad-CAM (Gradient-weighted Class Activation Mapping) within their chosen deep learning framework to visualize which parts of an image contribute most to a model's prediction.

AI for Anomaly Detection:

- **Experiment 14: Anomaly Detection in Sensor Data with Isolation Forest (Tool: Scikit-learn library)**: Explore the use of AI for anomaly detection. Students can utilize anomaly detection algorithms like Isolation Forest (available in Scikit-learn) to identify unusual patterns in sensor data, potentially useful for fraud detection, system failures, or equipment malfunctions.

AI for Social Good:

- **Experiment 15: Disaster Response with Text Classification (Tool: NLTK or spaCy with disaster-specific datasets)**: Integrate AI for social good. Students can use NLP tools to classify social media messages or news articles related to a disaster event (e.g., floods, earthquakes) into categories like requests for help, damage reports, or volunteering opportunities. This showcases the potential of AI for real-world crisis response.

Reference Books

1. Coeckelbergh, Mark. The political philosophy of AI: an introduction. John Wiley & Sons, 2022.
2. Morales, Miguel. Grokking deep reinforcement learning. Manning Publications, 2020.
3. Bishop, Christopher M. Pattern recognition and machine learning by Christopher M. Bishop. Springer Science+ Business Media, LLC, 2006.
4. Mohaghegh, Shahab D. Artificial Intelligence for Science and Engineering Applications. CRC Press, 2024.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	L	M	-	-	M	H	L
CO2	-	-	M	H	-	L	H	M	-
CO3	-	L	H	M	-	-	L	H	M
CO4	-	H	M	-	-	L	M	L	H
CO5	M	-	H	L	H	-	L	M	H

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Semester: I – I

M.Tech(AI&DS) – R24

24MCSP01: Programming for Data Science Lab

Credits – 2
L:T:P :: 0:0:4

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide a comprehensive introduction to data science concepts, methodologies, and tasks.
2. To develop proficiency in using Python for data manipulation, analysis, and visualization.
3. To equip students with skills to prepare and explore data effectively, identifying patterns and relationships.
4. To introduce various data modeling techniques, including decision trees, Naïve Bayes classification, neural networks, and generalized linear models.
5. To teach students how to summarize and visualize data, making insights accessible and actionable.

Course Outcomes

At the end of the course, student will be able to

CO1: Write Python scripts for data manipulation, analysis, and visualization using libraries like NumPy.

CO2: Clean and prepare data for analysis, including handling outliers and transforming variables.

CO3: Perform exploratory data analysis (EDA) to uncover patterns, relationships, and insights in data.

CO4: Build, train, and evaluate various data models, including decision trees, Naïve Bayes classifiers, neural networks, and regression models.

CO5: Effectively summarize and visualize data, presenting findings in a clear and informative manner.

List of Experiments

1. Write Python scripts to demonstrate the use of comments, executing commands, and importing packages.
2. Install NumPy, create NumPy arrays, perform element-wise operations, and use NumPy statistical functions.
3. Add indexed fields, change misleading values, re-express categorical data as numeric, standardize numeric fields, and identify outliers.
4. Perform EDA using bar graphs, contingency tables, histograms, and binning based on predictive values.
5. Partition data into training and testing sets, validate the partition, balance the training dataset, and establish a baseline model performance.
6. Implement classification and regression trees using the C5.0 algorithm and Random Forest.
7. Implement Naïve Bayes classification and apply Bayes Theorem to a dataset.
8. Implement a simple neural network with sigmoid activation function and backpropagation.
9. Apply clustering techniques and perform dimension reduction on a dataset.
10. Implement linear regression and logistic regression models using Python.
11. Implement Poisson regression and explore its applications.
12. Summarize and visualize data using graphs, tables, measures of center, variability, and position, and analyze bivariate relationships.
13. Read data from various file formats (CSV, Excel, JSON) and write the processed data back to these formats.

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14. Identify and handle missing values in a dataset using techniques like imputation, deletion, and interpolation.
15. Create new features from existing data to improve model performance.
16. Apply data transformation techniques like normalization, standardization, and log transformation.
17. Evaluate model performance using various metrics like accuracy, precision, recall, F1 score, ROC curve, and AUC.
18. Implement and train advanced neural network architectures like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs).
19. Apply K-Means clustering to a dataset and analyze the results.
20. Perform time series analysis and forecasting using models like ARIMA and Prophet.
21. Apply Principal Component Analysis (PCA) and t-Distributed Stochastic Neighbor Embedding (t-SNE) for dimensionality reduction and visualization.
22. Build and train SVM models for classification tasks.
23. Implement ensemble methods like Bagging, Boosting, and Stacking to improve model performance.
24. Apply Gradient Boosting algorithms like XGBoost, LightGBM, and CatBoost for classification and regression tasks.

Textbooks

1. Larose, Chantal D., and Daniel T. Larose. Data science using Python and R. John Wiley & Sons, 2019.
2. Vasiliev, Yuli. Python for Data Science: A Hands-on Introduction. No Starch Press, 2022.

Reference Books

1. Massaron, Luca, and John Paul Mueller. Python for data science for dummies. No. PUBDB 2017-146858. Wiley, 2015.
2. Warren, James, and Nathan Marz. Big Data: Principles and best practices of scalable realtime data systems. Simon and Schuster, 2015.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	L	-	-	H	M	-	H	M	L
CO2	-	-	M	H	-	L	H	L	M
CO3	H	-	M	-	-	L	H	M	L
CO4	H	M	-	-	-	L	M	H	L
CO5	-	H	-	M	-	L	-	H	M

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BoS Chairman

24MCST04: Deep Learning

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide a comprehensive introduction to deep learning, including its principles, motivations, and how deep learning models work, along with the challenges involved.
2. To explore both supervised and unsupervised deep learning architectures, including CNNs, LeNet-5, AlexNet, ResNet, DenseNet, RBMs, and DBNs, and understand their evolution and applications.
3. To understand the application of deep learning techniques in specific areas such as fingerprint recognition and character recognition, and learn about performance improvement techniques like transfer learning.
4. To introduce the principles and applications of autoencoders, including denoising autoencoders and variational autoencoders, and their implementation using Keras.
5. To provide an overview of generative models like GANs and their variants, and introduce the principles and applications of deep reinforcement learning, including Q-Learning and DQNs.

Course Outcomes

After completion of the course, students will be able to

CO1: Understand deep learning principles, the architecture of convolutional neural networks, and the training and optimization of deep networks.

CO2: Implement and differentiate between various supervised and unsupervised deep learning architectures, understanding their specific use cases and performance characteristics.

CO3: Develop the ability to apply deep learning techniques to recognition systems, such as fingerprint and character recognition, and evaluate the performance of different architectures in these domains.

CO4: Acquire the skills to build and utilize autoencoders and VAEs for various applications, including data denoising, colorization, and generating new data representations.

CO5: Implement and experiment generative models like GANs and understand the principles of deep reinforcement learning, being able to apply these techniques to practical problems and research scenarios.

UNIT – I

Introduction to Deep Learning, Why to Use Deep Learning. How Deep Learning Works, Deep Learning Challenges. Basics of Supervised Deep Learning, Convolutional Neural Network (ConvNet/CNN), Evolution of Convolutional Neural Network Models. Convolution Operation, Architecture of CNN, Convolution Layer, Activation Function (ReLU), Pooling Layer, Fully Connected Layer, Training Supervised Deep Learning Network Training Convolution Neural Networks, Loss Functions and Softmax Classifier, Gradient Descent-Based Optimization Techniques, Challenges in Training Deep Networks.

UNIT – II

Supervised Deep Learning Architectures: LeNet-5, AlexNet, ZFNet, VGGNet, GoogleNet, ResNet, Densely Connected Convolutional Network (DenseNet), Capsule Network.
Unsupervised Deep Learning Architectures: Restricted Boltzmann Machine (RBM), Variants of Restricted Boltzmann Machine, Deep Belief Network, Variants of Deep Belief Network.

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UNIT – III

Supervised Deep Learning in Fingerprint Recognition Fingerprint Features, Automatic Fingerprint Identification System (AFIS), Feature Extraction Stage, Minutia Matching Stage, Deep Learning Architectures for Fingerprint Recognition, Deep Learning for Fingerprint Segmentation, Deep Learning for Fingerprint Classification, Model Improvement Using Transfer Learning
Unsupervised Deep Learning in Character Recognition Datasets of Handwritten Digits, Deep Learning Architectures for Character Recognition Performance Comparison of Deep Learning Architectures.

UNIT – IV

Autoencoders Principles of autoencoders Building autoencoders using Keras Denoising autoencoder (DAE) Automatic colorization autoencoder, Variational Autoencoders (VAEs) Principles of VAES,Variational inference,Core equation,Optimization,Reparameterization trick,Decoder testing,VAEs in Keras,Using CNNs for VAES,Conditional VAE (CVAE) VAE with disentangled latent representations

UNIT – V

Generative Adversarial Networks (GANs) An overview of GANS,Principles of GANS,GAN implementation in Keras, Conditional GAN, Improved GANs: Wasserstein GAN, Least-squares GAN, Auxiliary classifier GAN, Disentangled Representation of GANs: Disentangled Representations, Info GAN, Stacked GAN.
Deep Reinforcement Learning Principles of reinforcement learning (RL), The Q value, Q-Learning example, Q-Learning in Python, Deep Q-Network (DQN), DQN on Keras, Double Q-Learning (DDQN)

Textbooks

1. Wani, M. Arif, Farooq Ahmad Bhat, Saduf Afzal, and Asif Iqbal Khan. Advances in deep learning. Springer, 2020.
2. Atienza, Rowel. Advanced Deep Learning with Keras: Apply deep learning techniques, autoencoders, GANs, variational autoencoders, deep reinforcement learning, policy gradients, and more. Packt Publishing Ltd, 2018.

Reference Books

1. Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. Vol. 1. Cambridge, MA, USA: MIT press, 2017.
2. Chollet, Francois. Deep learning with Python. Simon and Schuster, 2021.

Web References

1. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2. http://deeplearning.net/reading-list/
3. https://project.inria.fr/deeplearning/files/2016/05/deepLearning.pdf

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	M	-	L	H	M	L
CO2	-	-	M	H	-	L	M	L	H
CO3	-	-	-	H	M	L	H	M	L
CO4	H	-	-	L	-	M	M	H	L
CO5	-	H	-	M	-	L	L	H	M

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24MCST05: Prompt Engineering
(Professional Core for CSE & Open Elective – I for ECE, EEE, ME)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To introduce students to the fundamental concepts and architecture of Large Language Models (LLM) and the functionality of LLM prompts, including their components and types.
2. To provide a comprehensive understanding of prompt engineering, emphasizing its importance in AI communications and exploring techniques to enhance prompt effectiveness.
3. To delve into advanced topics and best practices in prompt engineering, including template-based forms, language nuances, and iterative refinement for improved performance.
4. To demonstrate the practical applications of AI, particularly ChatGPT, in creating and promoting content such as podcasts and educational materials.
5. To equip students with the knowledge and skills to effectively use ChatGPT and its APIs, understanding their functionalities, customizable parameters, and practical use cases.

Course Outcomes

At the end of the course, student will be able to

CO1: Understand and create effective LLM prompts, utilizing few-shot learning models and defining personality in prompts to enhance their effectiveness.

CO2: Craft and refine prompts, leveraging effective verbs, tone nuances, and progressive experimentation to achieve high-quality AI communications.

CO3: Apply advanced prompt engineering techniques, including template-based forms and iterative testing, while addressing ethical considerations and common challenges.

CO4: Use AI tools like ChatGPT to create and promote content, such as podcasts and educational materials, and generating strategic questions for client engagements.

CO5: Master the use of ChatGPT APIs, understand key parameters, interaction methods, and limitations, enabling them to integrate and utilize these APIs effectively in various applications.

UNIT – I

Introducing LLM Prompts, how LLM Prompt works, Architecture, LLM Training, Types of LLM Prompts, Components of an LLM Prompts, Few shot learning training models wit example prompts, Finding your voice-defining personality in prompts, Using patterns to enhance prompt effectiveness, Mix and Match –Strategic combinations for enhanced prompts, Exploring LLM parameters, The challenges and limitations of using LLM prompts.

UNIT – II

Introduction to Prompt Engineering: Definition of Prompt Engineering, Importance of Prompt Engineering in AI Communications, Overview of the Different Types of Prompts, Understanding the Foundation of Prompt Engineering, Power Up Your Prompts With Effective Verbs, Elevate Your Prompts with Nuances of Tone, Progressive Experimentation for Refining Prompts, Key attributes Goo prompt writing.

Unit – III

Advanced topics in Prompt Engineering: Deep dive into advanced topics, Template based forms. Best Practices Prompt Engineering: Understanding of nuances of Language & tone, Testing & Iterating Prompts or improved performance, incorporating feedback form AI models to refine prompts, Enhancing reliability of responses.

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Challenges in Prompt Engineering: Addressing common challenges and pitfalls, Strategies for improving the Prompt Effectiveness, Ethical Considerations in Prompt Engineering

Unit – IV

Creating and Promoting a Podcast Using ChatGPT and Other Practical Examples: Crafting podcast questions for celebrity guests, Preparing podcast questions with everyday guests, Identify topics, ideas, and potential guest speakers for your podcast, Using AI to promote a podcast, Identifying insightful interview questions, Sharpening interview skills with AI-generated responses, Generating strategic questions for client engagements with AI

Applications of LLM in Education: Creating course materials with ChatGPT, Creating handouts and other materials, creating quizzes, Creating rubrics, Creating cloze comprehension tests

Unit – V

Introduction to ChatGPT: What Is ChatGPT, Output Formats, Generated By ChatGPT, Use Cases for ChatGPT, Differences between ChatGPT and Web Search

Practical guide to CHATGPT API's: API's and their functionalities, API interaction methods, Key customizable API parameters, Impact of temperature & Max tokens, API Limitations & Considerations, Mastering ChatGPT API's

Textbooks

1. Mizrahi, Gilbert. Unlocking the Secrets of Prompt Engineering: Master the Art of Creative Language Generation to Accelerate Your Journey from Novice to Pro. United Kingdom: Packt Publishing, 2024.
2. Bhat, Harish. Demystifying Prompt Engineering: AI Prompts at Your Fingertips: A Step-By-Step Guide. United States: Harish Bhat, 2023.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	M	-	L	H	L	M
CO2	-	-	M	H	-	L	M	H	L
CO3	-	M	-	H	-	L	H	L	M
CO4	H	-	-	L	M	L	M	H	-
CO5	-	H	-	M	-	L	L	M	H

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24MCST12: Computer Vision
(Professional Elective – III)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide a comprehensive understanding of image processing techniques, including classical filtering operations, edge detection, and texture analysis.
2. To teach students how to perform binary shape analysis, object labeling, distance functions, deformable shape analysis, and shape recognition techniques.
3. To enable students to understand and implement various object recognition techniques such as Hough Transform, RANSAC, and generalized Hough Transform for detecting lines, circles, ellipses, and other objects.
4. To introduce students to methods for 3D vision, including shape from shading, photometric stereo, and 3D object recognition, as well as techniques for motion analysis and 3D reconstruction.
5. To provide hands-on experience in applying image processing, object recognition, and 3D vision techniques to real-world applications such as photo albums, face recognition, surveillance, and in-vehicle vision systems.

Course Outcomes

At the end of the course, student will be able to

CO1: Explain fundamental image processing techniques, including filtering operations, edge detection, and texture analysis.

CO2: Analyze binary shapes, perform object labeling and counting, and describe shapes using boundary descriptors, Fourier descriptors, and region descriptors.

CO3: Implement object recognition techniques such as Hough Transform and RANSAC, and evaluate their effectiveness in detecting various objects.

CO4: Apply methods for 3D vision and motion analysis, including shape from shading, 3D reconstruction, and optical flow, to create accurate 3D representations and analyze motion.

CO5: Develop and evaluate applications that utilize image processing and vision techniques, such as face detection and recognition, surveillance systems, and in-vehicle vision systems, demonstrating practical problem-solving skills.

UNIT – I

Image Processing Foundations: Review of image processing techniques classical filtering operations thresholding techniques edge detection techniques corner and interest point detection mathematical morphology texture.

UNIT – II

Shapes and Regions: Binary shape analysis connectedness object labeling and counting size filtering distance functions skeletons and thinning deformable shape analysis boundary tracking procedures active contours shape models and shape recognition centroidal profiles handling occlusion boundary length measures boundary descriptors chain codes Fourier descriptors region descriptors moments.

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UNIT – III

Object Recognition: Line detection Hough Transform (HT) for line detection foot-of-normal method line localization line fitting RANSAC for straight line detection HT based circular object detection accurate centre location speed problem ellipse detection Case study: Human Iris location hole detection generalized Hough Transform (GHT) spatial matched filtering GHT for ellipse detection object location GHT for feature collation.

UNIT – IV

3D Vision and Motion: Methods for 3D vision projection schemes shape from shading photometric stereo shape from texture shape from focus active range finding surface representations point-based representation volumetric representations 3D object recognition 3D reconstruction introduction to motion triangulation bundle adjustment translational alignment parametric motion spline based motion optical flow layered motion.

UNIT – V

Applications: Application: Photo album Face detection Face recognition Eigen faces Active appearance and 3D shape models of faces Application: Surveillance foreground-background separation particle filters Chamfer matching, tracking, and occlusion combining views from multiple cameras human gait analysis Application: In-vehicle vision system: locating roadway road markings identifying road signs locating pedestrians.

Textbooks

1. Baggio, Daniel Lelis. Mastering OpenCV with practical computer vision projects. Packt Publishing Ltd, 2012.
2. Solem, Jan. Programming Computer Vision with Python: Tools and algorithms for analyzing images. " O'Reilly Media, Inc.", 2012.
3. Nixon, Mark., Aguado, Alberto S.. Feature Extraction and Image Processing. United Kingdom: Elsevier Science, 2013.

Reference books

1. Szeliski, Richard. Computer vision: algorithms and applications. Springer Nature, 2022.
2. Prince, Simon JD. Computer vision: models, learning, and inference. Cambridge University Press, 2012.

Web References

1. https://nptel.ac.in/courses/106/105/106105216

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	M	L	-	-	H	M	L
CO2	-	-	H	M	-	L	M	H	-
CO3	-	L	M	H	-	-	H	-	M
CO4	-	M	-	H	L	-	M	L	H
CO5	M	H	L	-	H	-	L	M	H

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24MCST13: Medical Image Processing
(Professional Elective – III)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. Expose students to the fundamental concepts of imaging systems and the applications of digital image processing.
2. Familiarize students with various medical imaging modalities using ionizing and non-ionizing radiation, and their associated risks and benefits.
3. Introduce students to techniques for image enhancement in both the spatial and frequency domains.
4. Educate students on image restoration, morphological image processing, and segmentation methods.
5. Inform students about feature recognition, classification techniques, three-dimensional visualization, and the medical applications of imaging technologies.

Course Outcomes

After completion of the course, students will be able to

CO1: Describe the fundamental concepts and components of imaging systems, digital image processing, and various medical imaging modalities, both ionizing and non-ionizing.

CO2: Analyze and compare different techniques for image enhancement and restoration in the spatial and frequency domains, and their effectiveness in various applications.

CO3: Apply mathematical and algorithmic methods for morphological image processing and image segmentation to improve image analysis.

CO4: Evaluate the effectiveness of feature recognition and classification methods, as well as three-dimensional visualization techniques in medical image analysis.

CO5: Develop and implement comprehensive image processing solutions that integrate enhancement, restoration, segmentation, and classification techniques for practical medical applications.

UNIT – 1

Introduction: Imaging systems, Objects and images, the digital image processing system, Applications of digital image processing

Imaging systems: The human visual pathway, Photographic film, other sensors, digitizing an image, the quality of a digital image, Color images

UNIT – II

Medical images obtained with ionizing radiation: Medical imaging modalities, Images from x-rays, Images from γ-rays, Dose and risk

Medical images obtained with non-ionizing radiation: Ultrasound imaging, Magnetic resonance imaging, Picture archiving and communication systems (PACS)

UNIT – III

Image enhancement in the spatial domain: Algebraic operations, Logical (Boolean) operations, Geometric operations, Convolution-based operations

Image enhancement in the frequency domain: The Fourier domain, The Fourier transform, Properties of the Fourier transform, Sampling, Cross-correlation and autocorrelation, Imaging systems – point spread function and optical transfer function, Frequency domain filters, Tomographic reconstruction

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UNIT – IV

Image restoration: Image degradation, Noise, Noise-reduction filters, Blurring, Modeling image degradation, Geometric degradations

Morphological image processing: Mathematical morphology, Morphological operators, Extension to grayscale images

Image segmentation: What is segmentation?, Thresholding, Region-based methods, Boundary-based methods

UNIT – V

Feature recognition and classification: Object recognition and classification, connected components labelling, Features, Object recognition and classification, Statistical classification, Structural/syntactic classification, Applications in medical image analysis

Three-dimensional visualization: Image visualization, Surface rendering, Volume rendering, Virtual reality

Medical applications of imaging: Computer-aided diagnosis in mammography, Tumor imaging and treatment, Angiography, Bone strength and osteoporosis, Tortuosity

Textbook

1. Dougherty, Geoff. *Digital image processing for medical applications*. Cambridge University Press, 2009.

Reference Books

1. Sinha, G. R., and Bhagwati Charan Patel. *Medical image processing*. PHI Learning Pvt. Ltd., 2014.
2. Medical Image Processing for Improved Clinical Diagnosis. United States: IGI Global, 2018.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	L	-	-	H	-	M	H	M	-
CO2	-	L	-	-	H	M	H	M	-
CO3	-	-	L	M	-	H	M	H	-
CO4	-	-	H	M	-	L	H	M	M
CO5	-	-	H	-	M	L	H	M	M

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Semester: I – II

M.Tech(AI&DS) – R24

24MCST14: Reinforcement Learning
(Professional Elective – III)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide a thorough introduction to reinforcement learning concepts, including elements, finite Markov decision processes, and dynamic programming.
2. To teach students the principles and applications of Monte Carlo methods and temporal-difference learning for prediction and control tasks in reinforcement learning.
3. To enable students to understand and implement n-step bootstrapping techniques and planning methods, including Dyna, prioritized sweeping, and Monte Carlo Tree Search.
4. To introduce various function approximation techniques for on-policy prediction and control, including linear methods, artificial neural networks, and kernel-based methods.
5. To provide students with the knowledge and skills to apply policy gradient methods, including the policy gradient theorem, REINFORCE algorithms, and actor-critic methods for continuous action spaces.

Course Outcomes

At the end of the course, student will be able to

CO1: Explain the fundamental concepts of reinforcement learning, including the agent-environment interface, policies, value functions, and dynamic programming.

CO2: Apply Monte Carlo methods and temporal-difference learning techniques for prediction and control tasks in reinforcement learning scenarios.

CO3: Implement n-step bootstrapping methods and planning techniques such as Dyna, prioritized sweeping, and Monte Carlo Tree Search for effective learning and decision-making.

CO4: Analyze and implement various function approximation techniques, including linear methods, artificial neural networks, and kernel-based methods, for reinforcement learning tasks.

CO5: Develop and evaluate policy gradient algorithms, including REINFORCE and actor-critic methods, to solve reinforcement learning problems with continuous action spaces and achieve optimal control.

UNIT – I

Introduction: Reinforcement Learning, Examples, Elements of Reinforcement Learning, An Extended Example: Tic-Tac-Toe

Finite Markov Decision Processes: The agent-environment interface, goals and rewards, returns and episodes, unified notation for episodic and continuing tasks, policies and value functions, optimal policies and optimal value functions, optimality and approximation.

Dynamic Programming: Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, asynchronous dynamic programming, generalized policy iteration, efficiency of dynamic programming.

UNIT – II

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo estimation of action values, monte Carlo control, Monte Carlo control without exploring starts, off-policy prediction via importance sampling, incremental implementation, off-policy Monte Carlo Control

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Temporal-Difference Learning: TD Prediction, advantages of TD prediction methods, optimality of TD(0), Sarsa: on-policy TD Control, Q-Learning: Off-policy TD control, Expected Sarsa, Maximization Bias and Double Learning

UNIT – III

n-step Bootstrapping: n-step TD prediction, n-step Sarsa, n-step Off-policy learning, off-policy learning without importance sampling: the n-step tree backup algorithm
Planning and learning with tabular methods: Models and Planning, Dyna: Integrated Planning, acting, and learning, when the model is wrong?, prioritized sweeping, expected vs. sample updates, trajectory sampling, real-time dynamic programming, planning at decision time, heuristic search, rollout algorithms, Monte Carlo Tree search

UNIT – IV

On-Policy prediction with approximation: value-function approximation, the prediction objective, stochastic-gradient and semi-gradient methods, linear methods, feature construction for linear methods – polynomials, Fourier basis, Coarse coding, tile coding, radial basis functions, selecting step-size parameters manually, nonlinear function approximation: artificial neural networks, least-squares TD, memory based function approximation, kernel-based function approximation

UNIT – V

On-policy Control with Approximation: Episodic Semi-gradient control, semo-gradient n-step Sarsa, average reward: a new problem setting for continuing tasks, deprecating the discounted setting, differential semi-gradient n-step Sarsa.
Policy Gradient Methods: Policy approximation and its advantages, the policy gradient theorem, Reinforce: Monte Carlo Policy Gradient, REINFORCE with Baseline, Actor-Critic Methods, Policy Gradient for continuing problems, policy parameterization for continuous actions.

Textbook

1. Sutton, Richard S.., Barto, Andrew G.. Reinforcement Learning: An Introduction. United States: MIT Press, 2018.

Reference Books

1. Ris-Ala, Rafael. Fundamentals of Reinforcement Learning. Germany: Springer Nature Switzerland, 2023.
2. Ravichandiran, Sudharsan. Hands-On Reinforcement Learning with Python: Master Reinforcement and Deep Reinforcement Learning Using OpenAI Gym and TensorFlow. Germany: Packt Publishing, 2018.
3. D., Phil Winder Ph.. Reinforcement Learning. United States: O'Reilly Media, 2020.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	L	M	-	-	H	L	M
CO2	-	-	H	M	-	L	M	H	-
CO3	-	L	-	H	M	-	H	-	M
CO4	-	M	H	-	-	L	M	H	-
CO5	M	H	L	-	H	-	L	M	H

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Semester: I – II

M.Tech(AI&DS) – R24

24MCST15: Bio-Inspired Artificial Intelligence
(Professional Elective – IV)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. Expose students to the fundamental principles of evolutionary theory, including genetic representations, fitness functions, selection mechanisms, and types of evolutionary algorithms.
2. Familiarize students with the applications and techniques of evolutionary electronics, focusing on both analog and digital circuit design, and the role of abstraction in these processes.
3. Introduce students to the structure and function of biological nervous systems and their artificial counterparts, including neuron models, neural architectures, and hybrid neural systems.
4. Educate students on the principles and potential advantages of developmental systems, including the synthesis and evolution of developmental programs and processes.
5. Inform students about the mechanisms and algorithms of biological and artificial immune systems, including the Negative Selection Algorithm and Clonal Selection Algorithm, and their practical applications.

Course Outcomes

After completion of the course, students will be able to

CO1: Describe the key elements of evolutionary theory, including genetic operators, fitness functions, and types of evolutionary algorithms.

CO2: Design and implement evolutionary digital and analog circuits, applying lessons from evolutionary electronics and addressing multiple objectives and constraints.

CO3: Compare and contrast biological and artificial neural networks, discussing the evolution of neural systems, signal encoding, and neural hardware.

CO4: Develop artificial evolutionary developmental systems using rewriting systems and evolutionary developmental processes, synthesizing concepts from biology and computer science.

CO5: Assess the effectiveness and applications of artificial immune system algorithms, demonstrating a deep understanding of the lessons learned from biological immune systems.

UNIT – I

Evolutionary Systems 1: Pillars of Evolutionary Theory, the Genotype, Artificial Evolution, Genetic Representations, Initial Population, Fitness Functions, Selection and Reproduction, Genetic Operators, Evolutionary Measures, Types of Evolutionary Algorithms, Schema Theory, Human-Competitive Evolution

UNIT – II

Evolutionary Systems 2: Evolutionary Electronics, Lessons from Evolutionary Electronics, the Role of Abstraction, Analog and Digital Circuits, Extrinsic and Intrinsic Evolution, Digital Design, Evolutionary Digital Design, Analog Design, Evolutionary Analog Design, Multiple Objectives and Constraints, Design Verification

UNIT – III

Neural Systems: Biological Nervous Systems, Artificial Neural Networks, Neuron Models, Architecture, Signal Encoding, Evolution of Neural Networks, Neural Hardware, Hybrid Neural Systems

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UNIT – IV

Developmental Systems: Potential Advantages of a Developmental Representation, Rewriting Systems, Synthesis of Developmental Systems, Evolution and Development, Defining Artificial Evolutionary Developmental Systems, Evolutionary Rewriting Systems, Evolutionary Developmental Programs, Evolutionary Developmental Processes

UNIT – V

Immune Systems: How Biological Immune Systems Work, The Constituents of Biological Immune Systems, Lessons for Artificial Immune Systems, Algorithms and Applications, Shape Space, Negative Selection Algorithm, Clonal Selection Algorithm, Examples

Textbook

1. Floreano, Dario, and Claudio Mattiussi. Bio-inspired artificial intelligence: theories, methods, and technologies. MIT press, 2008.

Reference Books

1. Arana-Daniel, Nancy., Lopez-Franco, Carlos., Y Alanis, Alma. Bio-inspired Algorithms for Engineering. Netherlands: Elsevier Science, 2018.
2. Bio Inspired Computing: Fundamentals and Applications for Biological Inspiration in the Digital World. N.p.: One Billion Knowledgeable, 2023.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	L	-	-	H	-	M	H	M	-
CO2	-	-	-	M	H	L	H	M	-
CO3	-	-	H	M	-	L	H	M	-
CO4	-	-	H	-	M	L	M	-	M
CO5	-		H	M	-	L	H	-	M

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24MCST16: Edge Intelligence
(Professional Elective – IV)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. Expose students to the foundational concepts of edge computing and edge intelligence, including their evolution, benefits, and applications.
2. Familiarize students with various architectures and performance indicators for edge intelligence model training, including centralized, decentralized, and hybrid models.
3. Introduce students to federated meta-learning techniques and their applications in achieving real-time edge intelligence.
4. Educate students on edge-cloud collaborative learning, hierarchical mobile-edge-cloud model training, and edge intelligence via model inference.
5. Inform students about advanced techniques for accelerating deep neural network inference via edge computing and the future directions and applications of edge intelligence.

Course Outcomes

After completion of the course, students will be able to

CO1: Describe the evolution and benefits of edge computing and edge intelligence, including key enabling technologies and their practical applications.

CO2: Analyze different architectures for edge intelligence model training, including centralized, decentralized, and hybrid models, and evaluate their performance using key indicators such as training loss, convergence, and energy efficiency.

CO3: Apply federated meta-learning techniques to achieve real-time edge intelligence, and evaluate the performance and robustness of these methods.

CO4: Evaluate collaborative learning techniques, such as distributionally robust optimization and hierarchical mobile-edge-cloud model training, for their effectiveness in edge-cloud synergy and policy scheduling.

CO5: Develop advanced edge computing systems for accelerating deep neural network inference, and assess their applications in various marketplaces and future directions of edge intelligence.

UNIT – I

Introduction to Edge Intelligence: Edge Computing: Evolution of Edge Computing, Benefits of Edge Computing, Edge Intelligence: Motivation and Benefits of Edge Intelligence, Scope and Rating of Edge Intelligence

Edge Intelligence via Model Training: Architectures: Centralized, Decentralized, Hybrid, Key Performance Indicators: Training Loss, Convergence, Privacy, Communication Cost, Latency, Energy Efficiency, Enabling Technologies: Federated Learning, Aggregation Frequency Control, Gradient Compression, DNN Splitting, Knowledge Transfer Learning, Gossip Training, Hardware Acceleration, Knowledge Distillation for Edge-Cloud Collaboration, Meta-Learning

UNIT – II

Edge Intelligence via Federated Meta-Learning: Introduction, Related Work, Preliminaries on Meta-Learning, Federated Meta-Learning for Achieving Real-Time Edge Intelligence: Problem Formulation, Federated Meta-Learning (FedML), Performance Analysis of FedML: Convergence Analysis, Performance Evaluation of Fast Adaptation, Robust Federated Meta-Learning (FedML): Robust Federated Meta-Learning, Wasserstein Distance-Based Robust Federated Meta-Learning,

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Robust Meta-Training across Edge Nodes, Convergence Analysis, Experiments: Experimental Setting, Evaluation of Federated Meta-Learning, Evaluation of Robust Federated Meta-Learning

UNIT – III

Edge-Cloud Collaborative Learning via Distributionally Robust Optimization: Introduction, Basic Setting for Collaborating Learning toward Edge Intelligence, Collaborative Learning Based on Edge-Cloud Synergy of Distribution Uncertainty Sets, Collaborative Learning Based on Knowledge Transfer of Conditional Prior Distribution

UNIT – IV

Hierarchical Mobile-Edge-Cloud Model Training with Hybrid Parallelism: Introduction, Background and Motivation, HierTrain Framework, Problem Statement of Policy Scheduling, Optimization of Policy Scheduling, Performance Evaluation

Edge Intelligence via Model Inference: Architectures, Key Performance Indicators, Enabling Technologies

UNIT – V

On-Demand Accelerating Deep Neural Network Inference via Edge Computing: Introduction, Background and Motivation, Framework and Design, Performance Evaluation

Applications, Marketplaces, and Future Directions of Edge Intelligence: Applications of Edge Intelligence, Marketplace of Edge Intelligence, Future Directions on Edge Intelligence

Textbook

1. Lin, Sen., Zhou, Zhi., Zhang, Zhaofeng., Chen, Xu., Zhang, Junshan. Edge Intelligence in the Making: Optimization, Deep Learning, and Applications. Switzerland: Springer International Publishing, 2022.

Reference Books

1. Taheri, Javid., Dustdar, Schahram., Zomaya, Albert., Deng, Shuiguang. Edge Intelligence: From Theory to Practice. N.p.: Springer International Publishing, 2023.
2. Benedict, Shajulin. Edge Intelligence: Deep Learning-Enabled Edge Computing. N.p.: Institute of Physics Publishing, 2024.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	L	-	-	H	-	M	H	M	-
CO2	-	L	-	M	H	-	H	-	M
CO3	-	-	L	H	-	M	M	H	-
CO4	-	-	H	-	M	L	M	-	H
CO5	L	-	-	-	M	H	H	M	-

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24MCST17: Augmented Reality and Virtual Reality
(Professional Elective – IV)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide an in-depth understanding of augmented reality (AR), including its history, concepts, and how it works.
2. To familiarize students with the major hardware and software components of AR systems and the software used to create AR content.
3. To introduce key concepts in computer graphics and geometric modeling, including 3D space, perspective projection, shading algorithms, and geometric transformations.
4. To provide a comprehensive overview of virtual reality (VR), its origins, systems, and user interaction techniques.
5. To explore the application of VR in different fields, understand what makes a good VR application, and identify recent trends in VR development.

Course Outcomes

At the end of the course, student will be able to

CO1: Explain the fundamental concepts of augmented reality, its relationship with other technologies, and how AR works.

CO2: Identify and describe the major hardware and software components used in AR systems and the tools used to create AR content.

CO3: Apply computer graphics techniques, including perspective projection, shading algorithms, and geometric transformations, to create 3D models and virtual environments.

CO4: Analyze different VR systems, understand user interaction techniques, and explain the paradigms and collaboration methods in VR.

CO5: Evaluate the suitability of various applications for VR, identify promising application fields, and design VR applications that demonstrate the benefits of virtual reality.

UNIT – I

What Is Augmented Reality? Introduction, Where Did Augmented Reality Come from?, Augmented Reality, The Relationship between Augmented Reality and Other Technologies, Augmented Reality Concepts, How Does Augmented Reality Work?

UNIT – II

Augmented Reality Hardware & Software: Introduction, Major Hardware Components for Augmented Reality Systems, Major Software Components for Augmented Reality Systems, Software Used to Create Content for the Augmented Reality Application, Mobile Augmented Reality, Augmented Reality Applications, The Future of Augmented Reality

UNIT – III

Computer Graphics and Geometric Modelling: The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Colour theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

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UNIT – IV

Introduction to Virtual Reality: What is virtual reality?, The beginnings of VR, VR paradigms, Collaboration, Virtual reality systems, Representation, User interaction.

UNIT – V

Applying Virtual Reality: Virtual reality: the medium, Form and genre, What makes an application a good candidate for VR, Promising application fields, Demonstrated benefits of virtual reality, More recent trends in virtual reality application development

Textbooks

1. Craig, Alan B. Understanding Augmented Reality: Concepts and Applications. Netherlands: Elsevier Science, 2013.
2. Vince, John. Virtual Reality Systems. India: Pearson Education, 1995.
1. Craig, Alan B.., Sherman, William R.., Will, Jeffrey D.. Developing Virtual Reality Applications: Foundations of Effective Design. Netherlands: Elsevier Science, 2009.

Reference Books

1. Schmalstieg, Dieter., Hollerer, Tobias. Augmented Reality: Principles and Practice. United Kingdom: Pearson Education, 2016.
2. Norman, Kent, and Jurek Kirakowski, eds. The Wiley handbook of human computer interaction set. John Wiley & Sons, 2017.
3. LaViola Jr, Joseph J., Ernst Kruijff, Ryan P. McMahan, Doug Bowman, and Ivan P. Poupyrev. 3D user interfaces: theory and practice. Addison-Wesley Professional, 2017.
4. Coiffet, Philippe. Virtual reality technology. J. Wiley-Interscience, 2003.

Web References

1. https://nptel.ac.in/courses/121106013
2. https://www.youtube.com/watch?v=zLMgdYI82IE
3. NPTEL Special Lecture Series, https://www.youtube.com/watch?v=MGuSTAqlZ9Q

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	L	M	-	-	M	L	H
CO2	-	-	H	M	-	L	L	H	M
CO3	-	M	-	H	-	L	H	M	-
CO4	-	L	M	-	H	-	M	-	H
CO5	M	H	-	-	L	-	H	M	L

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24MECT20: ADVANCED EMBEDDED SYSTEMS

Credits: 3
L: T: P: 3: 0 :0

Sessional Marks: 40
University Exam. Marks: 60

Course Objectives

Students completing this course will be well positioned to

1. Familiarize about the basic functions of embedded systems.
2. Inculcate the basic architecture of general purpose processors and its applications.
3. Gain interface between analog and digital blocks, also Software aspects of embedded systems.
4. Develop different State Machine and Concurrent Process Models.
5. Learn Evolution of complication and synthesis, Verification and reuse of intellectual property cores.

Course Outcomes

At the end of this course students will demonstrate the ability to

CO1. To understand the embedded system concepts and technologies of embedded systems.
CO2. To analyze the general process of embedded system development.
CO3. To apply Interfacing between analog and digital blocks and apply Software aspects of embedded systems.
CO4. To create finite state machine and analyze Communication and Synchronization among processes.

UNIT I

Introduction The concept of embedded systems design, Examples of embedded systems Design challenge, Processor technology, IC technology, Design technology. RT-Level combinational logic, Sequential logic (RT-Level), Custom single purpose processor design (RT-Level), Optimizing custom single purpose processors.

UNIT II

General Purpose Processors Basic architecture, Development environment, Application specific system depth, Set processors (ASIPs). Embedded Memories.

UNIT III

Technoligical aspects of embeddes systems Interfacing between analog and digital blocks, signal conditioning, digital signal processing. System interfacing, interfacing with external systems, user interfacing. Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

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UNIT IV

State Machine and Concurrent Process Models Introduction, Models Vs languages, Finite State Machine with Data path model (FSMD), using State Mahines, Program State Machine (PSM), Concurrent Process Model, Concurrent Processes, Communication among processors, Synchronization among processes, Implementation, Data flow model.

UNIT V

Introduction Automation The parallel evolution of complication and synthesis, Logic, RT, Behavioral synthesis, System synthesis and hardware/software code sign, Verification of hardware/software co-simulation, Reuse of intellectual property cores, Embedded microcontroller cores.

Text Books

1. Embedded Systems Design – A unified Hardware/Software introduction by Frank Vahid, Tony, D. Givargis, John Wiley & Sons. Inc. 2002.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole,2000.

Reference books

1. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
2. V.K.Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
3. David Simon, "An Embedded Sostware Primer", Addison Wesley,2000.

Course Outcomes-Program Outcomes – Program Specific Outcomes – (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H		L			
CO2	L	M	H	M	L	
CO3				M	H	
CO4		L	M	H		
CO5			M	L		H

PSO1	PSO2	PSO3
H		
	M	H
L	M	H
	L	H
L	H	M

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24MEET12: NEURAL NETWORK AND FUZZY LOGIC
(PROFESSIONAL ELECTIVE –III)

Credits - 3 | **Sessional Marks: 40**
L: T: P:: 3:0:0 | **University Exam Marks: 60**

Course Objectives:

1. To know the Importance of AI techniques in engineering applications
2. To familiarize with the concepts of Artificial Neural networks and Biological Neural Network.
3. To study the ANN approach in various Electrical Engineering problems.
4. To impart knowledge on Fuzzy Logic and Its use in various Electrical Engineering Applications

Course Outcomes:

At the end of this course, students will be able to

CO1. Discuss the concepts of Artificial Neural networks
CO2. Acquire the adequate knowledge about feedback networks.
CO3. Explain the learning rules and control applications of Neural Networks.
CO4. Understand the concept of fuzziness, fuzzy set theory and gain the comprehensive Knowledge of fuzzy logic control and adaptive fuzzy logic
CO5. Design of fuzzy systems for real time applications

UNIT I

Biological neuron Vs artificial neuron, structure and activation functions – Neural network architectures –learning methods, stability and convergence .Single layer networks –Mcculloh–pitts neuron model, Perceptron training and algorithm, delta learning, Windrow-Hoff learning rules, limitations, Adeline and modification.

UNIT II

Multilayer networks, architectures and modeling, BP algorithm, radial basis functions. Unsupervised Learning-Winner take all learning, out star learning, Counter propagation networks, self-organizing networks-Kohonen.

UNIT III

Grossberg, Hamming NET, MAXNET, Hopfield networks, recurrent and associative memory, BAM and ART architectures Fuzzy sets and systems – geometry of fuzzy sets – theorems – fuzzy and neural function estimators

UNIT IV

Measures of Fuzziness – Classical measures of uncertainty – measures of Dissonance –confession specificity – knowledge base defuzzification.

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UNIT-V

Application to load forecasting, load flow, fault detection-unit commitments. LF control – economic dispatch, Neuro-Fuzzy controllers.

Text Books:

1. Jacek M Jurada, "Introduction to artificial Neural Systems". Jaico Publications.
2. S.Rajashekaran , G.A.VijayaLakshmiPai,"Neural Networks. Fuzzy Logic and Genetic Algorithm Synthesis and applications".PHI,2013.

Reference Books:

1. Hans-JurgenZimmermann,"Fuzzy Set TheoryanditsApplications" .4th.Kluwer AcademicPublishers,2006.
2. S.N. Sivanandam& S.N. Deepa ."Principles of soft Computing". 3rd Edition.Wiley India Pvt.Ltd,2018.

Course Outcomes-Program outcomes- Program specific outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	L	M	-	H	-	-
CO2	H	-	-	L	M	-	H	-	-
CO3	H	-	-	L	M	-	H	-	-
C04	H	-	-	L	M	-	H	-	-
C05	-	H	-	L	M	-	-	H	-

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24MMET19: INDUSTRIAL ROBOTICS

Credits: 3
L: T: P: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

To expose the students to the following

1. To introduce students to Robotics Engineering as a discipline and expose them to the multifaceted world of robots.

2. To apply the principles and concepts learned in the course to design a robotic system

3. To build and test a fully functional robotic system that meets the specific requirements

4. To study the various kinematics and inverse kinematics of robots.

5. To present their projects in the fields of robotics.

Course Outcomes

After successful completion of course the student should be able to

CO1. Gain knowledge of basic mechanical designing, electrical wiring, robotic sensors and actuators. PCB design and communication protocols.

CO2. Gain an understanding of the theoretical background necessary to understand advanced robotic technologies and their specific applications.

CO3. Demonstrate proficiency in design, construction, and operation of robotic systems.

CO4. Develop problem-solving skills by applying principles of robotics engineering to real-world problems

CO5. Communicate effectively about robotics engineering technologies, their workings and potential applications.

UNIT I

Introduction to Robotics: Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, Overview of robot subsystems, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

UNIT II

Rigid-body motions and twists, Rotations and angular velocities, Homogenous transformation matrices and its Twists.

UNIT III

UNIT III

Robot subsystems: Sensors and Actuators; Image Processing and Computer Vision , Robotic Control Systems.

UNIT IV

Introduction to Robo Analyzer : DH Parameters Visualization , Forward Kinematics; Inverse Kinematics; Forward Dynamics; Inverse Dynamics ,Building Virtual Robot Module.

UNIT V

Robotics Applications : The advanced robotics applications, including automation systems, robotic arm design and control, robot-vehicle interaction, and collaborative robots, robotic inspection and safety considerations.

TEXT BOOKS:

1. S. K. Saha, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd., New Delhi.

2. R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata McGraw-Hill Publishing Company Ltd.

3. J. J. Graig, "Introduction to Robotics – Mechanics and Control", 2nd edition, Pearson Education, Inc.

4. K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, "ROBOTICS – Control, Sensing, Vision, and Intelligence", McGraw-Hill Book Company.

REFERENCES:

1. Saeed Niku, "Introduction to Robotics – Analysis, Control, Applications", John Wiley & Sons. 2. Mohsen Shahin poor, Harper and Row, "A Robot Engineering Textbook", New York

3. Roboert J. Schilling, "Fundamentals of Robotics – Analysis & Control", Prentice-Hall of India Pvt. Ltd.

4. S. R. Deb and S. Deb, "Robotics Technology and Flexible Automation", Second Edition, Tata McGraw Hill Education Pvt, Ltd., New Delhi

Course Outcomes - Program Outcomes - Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H				M			M	M	M
CO2	M	H							M	
CO3		M	M					M	M	L
CO4	M	M	H	H	H					
CO5			H		H					M

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24MBST02: English for Research Paper Writing
(Open Elective – I)

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. To develop students' ability to plan and structure their academic writing, ensuring clarity, coherence, and conciseness.
2. To enhance students' skills in avoiding ambiguity, redundancy, and plagiarism while effectively paraphrasing and citing sources.
3. To guide students through the process of writing key sections of a research paper, including the abstract, introduction, literature review, methods, results, discussion, and conclusion.
4. To equip students with the necessary skills to write clear, concise, and impactful titles, abstracts, and introductions for academic papers.
5. To provide students with practical strategies and useful phrases to ensure their academic writing is well-organized, properly structured, and meets the standards for first-time submission.

Course Outcomes

At the end of the course, student will be able to

CO1: Apply effective planning and structuring techniques in academic writing to produce clear, concise, and coherent sentences and paragraphs.

CO2: Identify and eliminate ambiguity, redundancy, and plagiarism in academic writing, ensuring clarity and originality in their work.

CO3: Demonstrate proficiency in writing key sections of a research paper, including the abstract, introduction, literature review, methods, results, discussion, and conclusion.

CO4: Develop well-crafted titles, abstracts, and introductions that accurately represent the content and significance of their research.

CO5: Utilize useful phrases and strategies to enhance the quality of their academic writing, ensuring it meets the standards for first-time submission.

UNIT – 1

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT – 2

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction.

UNIT – 3

Review of the Literature, Methods, Results, Discussion, Conclusions and the Final Check.

UNIT – 4

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

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UNIT – 5

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Reference Books

1. Goldbort, Robert. Writing for science. Yale university press, 2006.
2. Day, Robert A., and Bárbara Gastel. "How to Write and Publish a Scientific Paper: Cambridge University Press. ISBN: 978-1-107-67074-7." (2012).
3. Highman, N. "Handbook of Writing for the Mathematical Sciences, SIAM." Highman's book (1998).
4. Wallwork, Adrian. English for writing research papers. Springer, 2016.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	M	L	-	-	-	-	L
CO2	M	H	-	-	-	L	L	-	-
CO3	-	M	H	L	-	-	-	L	-
CO4	L	-	M	-	H	-	M	-	-
CO5	-	L	-	H	M	-	-	M	-

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Semester: I – II

M.Tech(AI&DS) – R24

24MHMT06: Entrepreneurship Development

Credits – 3
L:T:P :: 3:0:0

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To grasp the essential characteristics, functions, types, ethics, and social responsibilities of an entrepreneur, and the importance and role of entrepreneurship in economic development, as well as the impact of the MSMED Act 2006.
2. To explore India's start-up revolution, trends, imperatives, benefits, key players in the ecosystem, and examples of business incubators, rural entrepreneurship, social entrepreneurship, and women entrepreneurship through case studies of prominent Indian entrepreneurs.
3. To identify opportunities, conduct market surveys, create business plans, assess financial viability, manage bookkeeping, accounting, costing, pricing, and working capital, and apply management principles in business.
4. To comprehend different company structures, job roles, negotiation skills, financial risk assessment, and business plan preparation.
5. To design effective business models by understanding customer segmentation, value proposition, channels, customer relationships, key partners, activities, revenue streams, cost structures, and social business models.

Course Outcomes

At the end of the course, student will be able to

CO1: Explain the key characteristics, functions, and types of entrepreneurship and the significance of ethics and social responsibilities in entrepreneurial ventures.
CO2: Analyze the various Indian models of entrepreneurship and evaluate the contributions of key Indian entrepreneurs to economic development
CO3: Develop comprehensive business plans by identifying opportunities, conducting market surveys, and assessing financial viability and working capital management.
CO4: Evaluate company structures and job roles, and demonstrate negotiation skills, financial risk assessment, and business plan preparation
CO5: Create innovative business models that address customer segmentation, value propositions, and social business considerations, and optimize revenue streams and cost structures.

UNIT – I

Entrepreneur and Entrepreneurship: Characteristics, Functions, Types, Ethics and Social Responsibilities of an Entrepreneur. Entrepreneurship: Importance, Growth and Role of Entrepreneurship in Economic Development, EDPs in India. MSMED Act 2006.

UNIT – II

Indian Models in entrepreneurship: Overview of entrepreneurship. India's start up revolution, Trends, imperatives, benefits; the players involved in the ecosystem, Business incubators, Rural entrepreneurship. Social entrepreneurship, women entrepreneurship, Cases of Tata, Birla, Kirloskar and many large and small entrepreneurs of India.

UNIT – III

Soft skills for entrepreneurs, Planning, Whom to approach, Opportunity identification, Market survey, Production programme, Business plan, Financial of project report, Assessing financial viability, Bookkeeping and Accounting and financial statements, Costing and Pricing of Produce,

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Working Capital Management, Marketing, Management, Applied management in Business, Learning from Existing Business, Legal requirements

UNIT – IV

Company Structure and Job roles, Understanding company structure, understanding job role, Developing negotiations skill, Add Wizard & Market makers skill, Financial Risk assessment, Business plan preparation.

UNIT – V

Designing and configuration Business Models, Introduction to business models, Designing/Understanding customer segmentation and value preposition, choosing channels, Customer relationship to serve customer, key partners and key activities of the business model, choosing revenue streams and cost structures, social business model.

Textbooks

1. Vasant Desai: The Dynamics of Entrepreneurial Development and Management (Himalaya Publishing House)
2. Dr. S.S.Khanka: Entrepreneurial Development (S.Chaned)
3. K. Nagarajan: Project Management (New Age international Publishers)
4. Poornima M. Charantimath: Entrepreneurship Development (Tata McGraw Hill)

Web References

1. http://eagri.org/eagri50/ARM402/index.html
2. http://pioneerinstitute.net/activities/6188-entrepreneurship.development-cell.html
3. http://www.sreewarangal.ac.in/centre-for-entrepreneurship.php
4. http://fredericodeigh.wrodpress.com/2012/10/12/introduction-to-entrepreneurship-developement/
5. http://ncert.nic.ic/ncerts/l/lebs213.pdf

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	L	-	M	H	M	L
CO2	L	H	-	-	M	-	M	H	L
CO3	-	L	H	-	-	M	L	M	H
CO4	-	-	M	H	-	L	H	L	M
CO5	M	-	-	-	H	L	M	H	L

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24MCSP02: Deep Learning Lab

Credits – 2
L:T:P :: 0:0:4

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. To provide a foundational understanding of deep learning principles, including the structure and function of neural networks, convolutional neural networks (CNNs), and various deep learning architectures.
2. To develop practical skills in implementing, training, and optimizing deep learning models using popular frameworks like Keras and TensorFlow.
3. To explore advanced deep learning architectures such as autoencoders, variational autoencoders (VAEs), generative adversarial networks (GANs), and reinforcement learning models.
4. To apply deep learning techniques to specific applications such as fingerprint recognition, character recognition, and image generation, emphasizing real-world problem-solving.
5. To encourage experimentation and innovation in deep learning, preparing students for research and development roles by understanding state-of-the-art techniques and their applications.

Course Outcomes

At the end of the course, student will be able to

CO1: Design, implement, and train various deep learning models, including CNNs, autoencoders, VAEs, GANs, and reinforcement learning algorithms.

CO2: Optimize deep learning models using different optimization techniques and evaluating their performance on various tasks.

CO3: Apply deep learning techniques to solve application-specific problems, such as fingerprint and character recognition, demonstrating practical implementation skills.

CO4: Experiment with and innovate in the design of deep learning models, understanding advanced architectures and their applications.

CO5: Understand and implement state-of-the-art techniques and contribute to advancements in the field.

List of Experiments

1. Build and train a simple CNN for image classification (e.g., MNIST digit classification) using Keras.
2. Implement different activation functions (ReLU, sigmoid, tanh) and pooling layers (max pooling, average pooling) in a CNN.
3. Train a CNN using different optimization techniques like SGD, Adam, and RMSprop, and compare their performance.
4. Build and train the LeNet-5 and AlexNet architectures on image datasets.
5. Implement VGGNet and ResNet architectures and analyze their performance on image classification tasks.
6. Build and train an RBM for unsupervised learning tasks.
7. Implement a deep learning model for fingerprint feature extraction and minutia matching.
8. Improve a fingerprint recognition model using transfer learning techniques.
9. Implement and compare different deep learning architectures for handwritten digit recognition.
10. Implement basic autoencoders and denoising autoencoders using Keras.
11. Build and train a VAE, understand variational inference, and apply the reparameterization trick.
12. Build and train a basic GAN using Keras for image generation.

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Textbooks

1. Lewis, Nigel Da Costa. Deep Learning Step by Step with Python: A Very Gentle Introduction to Deep Neural Networks for Practical Data Science. United States: CreateSpace Independent Publishing Platform, 2016.
2. Wani, M. Arif, Farooq Ahmad Bhat, Saduf Afzal, and Asif Iqbal Khan. Advances in deep learning. Springer, 2020.
3. Atienza, Rowel. Advanced Deep Learning with Keras: Apply deep learning techniques, autoencoders, GANs, variational autoencoders, deep reinforcement learning, policy gradients, and more. Packt Publishing Ltd, 2018.

Reference Books

1. Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. Vol. 1. Cambridge, MA, USA: MIT press, 2017.
2. Chollet, Francois. Deep learning with Python. Simon and Schuster, 2021.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	M	-	L	H	M	L
CO2	-	-	M	H	-	L	H	L	M
CO3	H	-	-	-	M	L	H	M	L
CO4	H	M	-	-	-	L	M	H	L
CO5	-	H	-	M	-	L	L	H	M

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24MCSP03: Prompt Engineering Lab using Python

Credits – 2 **Sessional Marks: 40**
L:T:P :: 0:0:4 **University Exam Marks:60**

Course Objectives

1. To provide a comprehensive understanding of the components and architecture of Large Language Models (LLMs), and document their structure and functioning.
2. To enable students to create and test various types of prompts, including few-shot learning examples, and evaluate their effectiveness in different contexts.
3. To teach students how to design prompts that reflect specific tones and styles, and to assess the impact of these variations on model outcomes.
4. To develop skills in iteratively improving prompts based on model-generated feedback and performance metrics, enhancing the reliability and effectiveness of the prompts.
5. To provide hands-on experience in applying LLMs for real-world tasks, such as generating interview questions, creating social media content, developing course materials, and interacting with the ChatGPT API.

Course Outcomes

At the end of the course, student will be able to

CO1: Analyze the components of an LLM and document its architecture, demonstrating a deep understanding of its structure and functionality.
CO2: Create and test prompts using few-shot learning and other techniques, evaluating how the model adapts to different inputs and contexts.
CO3: Design prompts that reflect specific tones and styles, and evaluate their effectiveness in achieving desired outcomes.
CO4: Iteratively improve a set of prompts based on model feedback and performance metrics, demonstrating the ability to refine and enhance prompt quality.
CO5: Develop practical applications that interact with the ChatGPT API, create content such as social media posts and course materials, and customize API parameters to achieve specific outputs.

List of Experiments

1. Analyze the components of an LLM and document the architecture.
2. Create and test prompts with few-shot learning examples to see how the model adapts.
3. Design prompts that reflect a specific tone and style, and evaluate their effectiveness
4. Compare the performance of prompts with different verb choices.
5. Create prompts with varying tones and assess their outcomes
6. Iteratively improve a set of prompts based on model feedback.
7. Design and test prompts using different template structures.
8. Develop a set of prompts, test them, and iterate based on performance metrics.
9. Use model-generated feedback to improve initial prompts.
10. Generate and refine a list of questions for a mock celebrity interview.
11. Create social media posts and promotional materials using ChatGPT.
12. Generate a syllabus, lecture notes, and hand-outs for a hypothetical course.
13. Design a set of quizzes and corresponding rubrics for course assessment.
14. Develop an application that interacts with the ChatGPT API, customizing parameters like temperature and max tokens to achieve desired outputs.

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Textbooks

1. Mizrahi, Gilbert. Unlocking the Secrets of Prompt Engineering: Master the Art of Creative Language Generation to Accelerate Your Journey from Novice to Pro. United Kingdom: Packt Publishing, 2024.
2. Bhat, Harish. Demystifying Prompt Engineering: AI Prompts at Your Fingertips: A Step-By-Step Guide. United States: Harish Bhat, 2023.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	M	L	-	-	H	M	L
CO2	-	-	H	M	-	L	M	-	H
CO3	-	L	M	H	-	-	L	H	M
CO4	-	M	H	-	-	L	H	M	L
CO5	M	H	L	-	H	-	L	H	M

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24MCSC01: Term Paper cum Seminar

Credits – 2
L:T:P :: 0:0:4

Sessional Marks: 40
University Exam Marks:60

Course Objectives

1. Equip students with the ability to conduct in-depth research, analyze complex ideas, and synthesize information from diverse sources.
2. Focus on improving students' ability to articulate their research findings clearly and effectively through written communication.
3. Prepare students to effectively communicate their research and ideas in a structured and persuasive manner during seminars.
4. Inculcate a strong sense of academic integrity and adherence to ethical standards in research and reporting.
5. Encourage students to integrate knowledge and methods from multiple disciplines to enrich their research perspectives and outcomes.

Course Outcomes

At the end of the course, student will be able to

CO1: Students will exhibit a deep understanding of the chosen topic, showing mastery over the content, methodologies, and theories involved.

CO2: Students will competently apply appropriate research methods to their chosen topics, demonstrating the ability to collect, analyze, and interpret data.

CO3: Students will produce a well-structured term paper that clearly communicates research objectives, processes, analysis, and conclusions.

CO4: Students will deliver persuasive and well-organized presentations that effectively communicate the significance of their research findings to an audience.

CO5: Students will actively participate in scholarly discourse, demonstrating the ability to engage critically with peers, respond to feedback, and refine their perspectives based on constructive criticism.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	M	-	L	-	-	M	H	L
CO2	M	-	H	-	-	L	H	M	L
CO3	L	H	M	-	-	-	L	H	M
CO4	-	M	L	H	-	-	M	L	H
CO5	-	-	-	L	H	M	H	M	L

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Rubrics for Evaluation of Term Paper cum Seminar

Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Poor (D)
1. Content (40%)				
Depth of Research (20%)	Exhibits comprehensive and thorough research with extensive sources beyond course material.	Shows adequate research with some sources beyond the basic course material.	Meets basic research expectations with minimal external sources.	Research is underdeveloped or lacks depth with very few or no external sources.
Clarity and Relevance (20%)	The paper is exceptionally clear and directly relevant to the topic; all arguments are well supported.	The paper is clear with minor ambiguities; most arguments are supported.	Some sections are unclear or not completely relevant; some arguments lack support.	The paper lacks clarity and relevance; arguments are poorly supported or absent.
2. Organization (20%)				
Structure (10%)	Exceptionally well-organized, logical flow that enhances the clarity of the paper.	Well-organized, with a clear structure that occasionally lacks smooth transitions.	Organization is apparent but not maintained throughout the paper.	Poorly organized, lacks logical flow, making it hard to follow.
Formatting and Style (10%)	Impeccable formatting and professional style; follows academic standards precisely.	Minor errors in formatting and style; mostly follows academic standards.	Some inconsistent formatting and stylistic choices; generally follows academic standards.	Frequent errors in formatting and style; does not adhere to academic standards.

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3. Presentation (20%)				
Delivery (10%)	Engaging, confident presentation style; excellent eye contact and body language; speaks clearly at an appropriate pace.	Generally clear and confident; minor issues with eye contact, body language, or pace.	Somewhat clear but lacks confidence; noticeable issues with eye contact, body language, or pace.	Unclear, unconfident delivery; poor eye contact, body language; inappropriate pace.
Use of Visual Aids (10%)	Visual aids are professionally crafted, enhance the presentation, and are completely relevant.	Visual aids are well-prepared and relevant with minor issues in design or relevance.	Visual aids are used but do not significantly enhance the presentation or have design issues.	Visual aids are poorly prepared or irrelevant to the presentation.
4. Understanding and Interaction (20%)				
Question Handling (10%)	Answers all questions with depth and clarity, demonstrating a strong understanding of the topic.	Answers most questions correctly but may lack depth in some responses.	Struggles with some questions; responses lack depth or clarity.	Unable to answer questions adequately; shows poor understanding of the topic.
Engagement and Discussion (10%)	Actively engages the audience, stimulating discussion and thought.	Generally engages the audience but with limited discussion.	Limited engagement with the audience, minimal discussion.	Does not engage the audience or stimulate discussion.

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24MECT21: COMMUNICATION NETWORKS

Credits: 3
L: T: P: 3: 0 :0

Sessional Marks:40
University Exam. Marks: 60

Course Outcomes: Students completing this course will be well positioned to

- Understand advanced concepts in Communication Networking.
- Design and develop protocols for Communication Networks.
- Understand the mechanisms in Quality of Service in networking.
- Optimise the Network Design

Course Outcomes

At the end of this course students will demonstrate the ability to

CO1. To impart knowledge on the fundamental principles of network services and layered architecture.
CO2. To develop an understanding of ISDN and B-ISDN technologies
CO3. To equip students with the skills needed to design and optimize ATM networks
CO4. To provide insights into advanced TCP/IP networks and interconnection technologies

UNIT- I

NETWORK SERVICES & LAYERED ARCHITECTURE: Traffic characterization and quality of service, Network services, High performance networks, Network elements, Basic network mechanisms, layered architecture.

UNIT- II

ISDN & B-ISDN: Over view of ISDN, ISDN channels, User access, ISDN protocols, Brief history of B-ISDN and ATM, ATM based services and applications, principles and building block of B-ISDN, general architecture of B-ISDN, frame relay.

UNIT- III

ATM NETWORKS: Network layering, switching of virtual channels and virtual paths, applications of virtual channels and connections.

QOS parameters, traffic descriptors, ATM service categories, ATM cell header, ATM layer, ATM adaptation layer.

UNIT- IV

INTERCONNECTION NETWORKS: Introduction, Banyan Networks, Routing algorithm & blocking phenomenon, Batcher-Banyan networks, crossbar switch, three stage class networks.

REARRANGEABLE NETWORKS: Rearrangeable class networks, folding algorithm, bens network, looping algorithm.

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UNIT- V

TCP/IP NETWORKS: History of TCP/IP, TCP application and Services, Motivation, TCP, UDP, IP services and Header formats, Internetworking, TCP congestion control, Queue management: Passive & active, QOS in IP networks: differentiated and integrated services.

TEXTBOOKS

1. William Stallings, "ISDN & B-ISDN with Frame Relay", PHI.
2. Leon Garcia widjaja, "Communication Networks", TMH, 2000.
3. N. N. Biswas, "ATM Fundamentals", Adventure books publishers, 1998.

Course Outcomes-Program Outcomes – Program Specific Outcomes – (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	L					H		H
CO2	L	M	H	M		L	L	M	H
CO3			M		H				
CO4		L	M		H				
CO5		M		L	H		L	H	M

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24MEET17 SOLAR ENERGY UTILIZATION

Credits - 3 | Sessional Marks: 40
L: T: P:: 3:0:0 | University Exam Marks: 60

Course Objectives

1. Understand the various typesofsolar collectors and solar radiation
2. Learn the present application of solar energy in different fields
3. Explain the concept of solar thermal power generation and solar economics
4. Understand Construction and working conceptsof Photo-voltaic cell
5. Study the different concepts of Energy Storages.

Course Outcomes

At the end of this course, students will demonstrate the ability to

CO1. acquire knowledge on different solar collectors and their performance
CO2. attain the knowledge on different applications of solar energy
CO3. understand the solar thermal power generation and the performance characteristics
CO4. analyze the performance characteristicsof photovoltaic cell
CO5. understand the energy Storage and its applications

UNIT I

Solar radiation, availability, measurement and estimation; Isotropic and anisotropic models; empirical relations, solar collectors and types: flat plate, concentrating solar collectors, advanced collectors and solar concentrators, Selective coatings.

UNIT II

Solar water heating, solar cooking, solar drying, Solar distillation and solar refrigeration. Active and passive heating and cooling of buildings, Solar Chimney. Solar drying

UNIT III

Solar thermal power generation, Home lighting systems, Solar lanterns, Industrial process heat systems, Solar thermal power generation and sterling engine, Solar economics.

UNIT IV

Photo-voltaic cell – characteristics- cell arrays-power electric circuits for output of solarpanels-choppers-inverters-batteries-charge regulators, Construction concepts.

UNIT V

Energy Storage - Sensible, latent heat and thermo-chemical storage-pebble bed etc. materialsfor phase change-Glauber's salt-organic compounds. Solar ponds.

Text Books

1. D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", 2ndEdition, Taylor & Francis, 2000; Indian reprint, 2003
2. Edward E. Anderson, "Fundamentals for solar energy conversion", Addison WesleyPubl. Co., 1983.
3. Duffie J. A and Beckman, W .A., "Solar Engineering of Thermal Process". John Wiley.1991.
4. G. N. Tiwari and M. K. Ghosal, "Fundamentals of Renewable energy Sources", NarosaPublishing House, New Delhi, 2007

Reference Books

1. Energy Studies, Second Edition, by W. Shepherd and D. W. Shepherd. Imperial CollegePress London, 2004.
2. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hil, New Delhi, 1996.
3. M. S. Sodha, N. K. Bansal, P. K. Bansal, A. Kumar and M. A. S. Malik, Solar Passive .
4. M. A. S. Malik, G. N. Tiwari, A. Kumar and M.S. Sodha, Solar Distillation. Pergamon P.

Course Outcomes-Program outcomes-Program specific outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	M	-	-	-	H	M	-	H	-
CO2	H	-	-	L	-	M	H	-	-
CO3	H	-	-	L	-	M	M	H	-
C04	H	-	-	L	-	M	H	-	-
C05	H	-	-	L	-	M	M	H	-

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24MMET20: COMPUTER INTEGRATED MANUFACTURING .

Credits –3 | **Sessional Marks: 40**
L:T:P :: 3:0:0 | **University Exam Marks: 60**

Course Objectives:
To expose the students to the following

To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

Course Outcomes
After successful completion of course the student should be able to

CO1 Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems
CO2: Summarize the production planning and control and computerized process planning
CO3: Differentiate the different coding systems used in group technology
CO4: Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system
CO5: Classification of robots used in industrial applications

UNIT I

INTRODUCTION : Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II

PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING : Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III

CELLULAR MANUFACTURING : Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV

FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) : Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V

INDUSTRIAL ROBOTICS : Robot Anatomy and Related Attributes – Classification of Robots-Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TEXT BOOKS:

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.

2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.

2. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.

3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

Course Outcomes - Program Outcomes - Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	H				M			M	M	M
CO2	M	H							M	
CO3		M	M					M	M	L
CO4	M	M	H	H	H					
CO5			H		H					M

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24MHMT07: BUSINESS ANALYTICS
(Open Elective – II)

Credits – 3 **Sessional Marks: 40**
L:T:P :: 3:0:0 **University Exam Marks: 60**

Course Objectives

1. To introduce students to the basics of R programming, including data structures, descriptive statistics, and foundational statistical tests and distributions.
2. To equip students with the skills necessary for effective data visualization, emphasizing the creation of meaningful and informative charts and graphs using R.
3. To develop students' abilities in exploratory data analysis, focusing on data preparation, handling big data, and implementing automation in data analytics.
4. To provide an understanding of advanced data analytics techniques, including prediction analysis, clustering, machine learning, and text mining using R.
5. To familiarize students with forecasting techniques and their applications in business, including time series analysis, regression forecasting, and Monte Carlo simulation.

Course Outcomes

At the end of the course, student will be able to

CO1: Apply fundamental R programming commands and perform basic statistical analyses.
CO2: Design and implement effective visualizations for data-driven decision-making using R.
CO3: Conduct exploratory data analysis, including data cleaning and big data management, to prepare datasets for advanced analysis.
CO4: Utilize advanced data analytics techniques such as clustering, decision trees, machine learning, and text mining to derive insights from data.
CO5: Implement forecasting models and simulations to predict future trends and analyze risks in various business scenarios.

UNIT – I

INTRODUCTION TO R : Basic commands of R using R console and R studio, Data structures using R, Descriptive Statistics: Measure of Central Tendency and Measure of Dispersion, Binomial, Poisson and Normal Distribution, Chi-square test, ANOVA and Co-variance.

UNIT – II

DATA VISUALIZATION FOR MANAGERS: Visualization Imperative – Message to Charts – Visual Perception – Grammar for Graphics (using R) – Component level design of tables and graphs – Storytelling using Visualization.

UNIT – III

EXPLORATORY DATA ANALYSIS: Data mugging / scraping/ sampling/ cleaning – handling big data – automation of data analytics solutions – Non-linear optimization models.

UNIT – IV

DATA ANALYTICS: Best practices in data analytics and business intelligence – Prediction Analysis - Clustering – Decision tree – Machine learning - Neural networks – Associations / market basket analysis – Text Mining using R.

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UNIT – V

FORECASTING TECHNIQUES: Qualitative and Judgemental Forecasting, Statistical Forecasting, models, forecasting models for stationary Time Series, Forecasting Models for Time Series with a Linear Trend. Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables. Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-product development model, Newsvendor modes, overbooking model, Cash budget model – Customer management model – Marketing Mix Model.

Reference Books

1. Prasad, R. N., and Seema Acharya. Fundamentals of business analytics (with cd). John Wiley & Sons, 2011.
2. Asllani, Arben. Business analytics with management science models and methods. FT Press, 2014.
3. Hodeghatta, Umesh R., and Umesha Nayak. Business analytics using R-a practical approach. Apress, 2016.
4. Schniederjans, Marc J., Dara G. Schniederjans, and Christopher M. Starkey. Business analytics principles, concepts, and applications: what, why, and how. Pearson Education, 2014.
5. James Evans. Business Analytics. Pearson Education 2021.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	M	L	H	-	-	-	L	-	-
CO2	H	M	-	L	-	-	-	L	-
CO3	M	H	-	-	L	-	-	-	L
CO4	H	-	M	-	-	L	M	-	-
CO5	-	M	-	H	-	-	-	M	-

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Semester: II – I

M.Tech(AI&DS) – R24

24MCSV01: Comprehensive Viva

Credits – 2
L:T:P :: 0:0:0

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

To assess the overall knowledge of the student in the Computer Science and Engineering acquired over 3 semesters of study in the postgraduate program.

Course Outcomes

At the end of the course, student will be able to

CO1: Demonstrate Knowledge in the program domain.
CO2: Present his views cogently and precisely.
CO3: Exhibit professional etiquette suitable for career program

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	M	-	H	-	L	-	M	-	L
CO2	L	H	-	-	-	M	-	-	H
CO3	-	-	L	M	-	H	-	L	-

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24MCSJ01: Dissertation Phase – I

Credits – 10 **Sessional Marks: 100**

Course Objectives

1. Develop a clear, relevant, and research-worthy problem statement in the field of Computer Science and Engineering.
2. Perform a thorough review of existing research and technologies to identify gaps and establish the context for the proposed dissertation.
3. Create a detailed plan for the research approach, including data collection, analysis methods, and project milestones.
4. Design and document the initial system architecture or solution framework, outlining the key modules and their interactions.
5. Complete the development and testing of at least one-third of the planned system or project modules and document the work done. Prepare to present this progress effectively.

Course Outcomes

At the end of the course, student will be able to

CO1: Formulate a well-defined problem statement that addresses a specific issue

CO2: Critically evaluate existing literature and identify gaps that their research will address.

CO3: Create a coherent research methodology that includes data collection and analysis plans.

CO4: Present a structured system design or architecture that outlines the intended solution's components.

CO5: Document their progress, including the implementation of initial modules, and deliver an effective presentation on their work.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	L	-	M	M	H	L
CO2	M	L	H	-	-	-	H	M	L
CO3	-	H	M	-	L	-	L	H	M
CO4	-	M	-	H	-	L	M	L	H
CO5	-	-	M	L	H	-	H	M	L

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Rubrics for Evaluation of Dissertation Phase - I

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Poor (1)
Problem Statement (15)	Clear, original, and highly relevant	Clear and relevant, but slightly vague	Relevant but lacks clarity or originality	Unclear or somewhat irrelevant	Unclear and irrelevant
Literature Review (15)	Thorough, critical, and well-organized	Comprehensive with minor gaps	Adequate but lacks depth or organization	Basic review with significant gaps	Incomplete or poorly organized
System Architecture and Modules Implementation (30)	Comprehensive and well-implemented	Clear but with minor omissions	Basic design, lacks some detail or clarity	Incomplete or poorly Implemented	Very vague or incomplete
Progress Documentation (20)	Detailed, clear, and well-organized	Clear and organized, with minor issues	Adequate but lacks some detail or organization	Incomplete or poorly organized	Poorly documented or incomplete
Presentation (20)	Engaging, well-structured, and highly informative	Clear and well-structured, minor improvements needed	Adequate but lacks polish or clarity	Disorganized or lacks clarity in parts	Poorly presented or ineffective

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24MCSJ02: Dissertation Phase – II

Credits – 16

Sessional Marks: 40
University Exam Marks: 60

Course Objectives

1. Finalize the development and integration of the remaining two-thirds of the system or project modules.
2. Perform rigorous testing and validation of the entire system, including functional, performance, and usability testing.
3. Analyze and interpret the results obtained from testing, comparing them with the expected outcomes and addressing any discrepancies.
4. Compose a detailed and well-structured dissertation report that documents the research, implementation, and findings. Prepare and deliver an effective oral presentation of the completed research.
5. Show how the completed dissertation contributes to the field of Computer Science and Engineering through novel insights, solutions, or advancements.

Course Outcomes

At the end of the course, student will be able to

CO1: Integrate and finalize the entire system or project, including all planned modules.

CO2: Demonstrate thorough testing and validation of the system, ensuring reliability and accuracy.

CO3: Effectively analyze and interpret results, drawing meaningful conclusions and addressing any issues.

CO4: Produce a high-quality dissertation report and deliver a professional presentation that effectively communicates their research findings.

CO5: Clearly articulate the contribution of their work to the field of Computer Science and Engineering, highlighting innovation or impact.

Course Outcomes – Program Outcomes – Program Specific Outcomes (CO-PO-PSO) Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	H	-	-	L	-	M	M	H	L
CO2	M	L	H	-	-	-	H	M	L
CO3	L	H	-	-	M	-	L	H	M
CO4	-	M	L	-	-	H	M	L	H
CO5	-	-	M	L	H	-	H	M	L

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Rubrics for Evaluation of Dissertation Phase - II

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Needs Improvement (2)	Poor (1)
System Implementation (30)	Fully integrated with excellent functionality	Complete with minor issues	Mostly complete with some issues	Incomplete or with significant issues	Poorly implemented or incomplete
Testing (20)	Thorough and rigorous, with comprehensive coverage	Good testing with minor gaps	Adequate testing but lacks depth	Incomplete or inconsistent testing	Poor or minimal testing
Result Analysis (20)	Insightful and well-supported analysis	Clear analysis with minor issues	Basic analysis with some gaps	Limited analysis or lacks clarity	Poorly analyzed or unsupported results
Dissertation Report & Presentation (20)	Well-organized, detailed, and professional	Clear and well-structured, minor improvements needed	Adequate but lacks some detail or polish	Disorganized or lacks clarity in parts	Poorly organized or incomplete
Contribution to Field (10)	Significant and original contribution	Clear contribution with minor gaps	Noticeable contribution but lacks depth	Limited contribution or impact	Minimal or no discernible contribution

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