Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Information Technology
M.Tech CSE (ARTIFICIAL INTELLIGENCE)
SEMESTER- II (2025-27)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS201N	DCC	Advance Computer Architecture & Organization	60	20	20	-	-	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:
The student will have ability to:
1. Describe current and emerging trends in computer architectures, focusing on performance and the hardware/software interface.
2. Analyzing fundamental issues in architecture design and their impact on application performance.
3. Identify the performance and efficiency in advanced multiple-issue processors
4. Identify and Analyzing various memory models.
5. Describe various techniques to enhance a processors ability.

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Know the classes of computers, and new trends and developments in computer architecture
2. Understand pipelining, instruction set architectures, memory addressing.
3. Understand the performance metrics of microprocessors, memory, networks.
4. Understand the various techniques to enhance a processors ability to exploit Instruction-level parallelism (ILP), and its challenges.
5. Understand exploiting ILP using dynamic scheduling, multiple issue, and speculation.
6. Understand multithreading by using ILP and supporting thread-level parallelism (TLP).
7. Understand the performance and efficiency in advanced multiple-issue processors.
8. Understand symmetric shared-memory architectures and their performance.
9. Understand multiprocessor cache coherence using the directory based and snooping class of protocols.
10. Understand the various models to achieve memory consistency.

SYLLABUS
UNIT I — 10 HOURS
Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors, Evolution of parallel processors, Necessity of high performance, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism.

UNIT II — 9 HOURS
Principles and implementation of Pipelining, Pipeline Architecture, Study and comparison of processors with and without pipelining, Linear pipeline processor, Nonlinear pipeline processor Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling -score boarding and Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscaler pipeline design, Super pipeline processor design.

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MTCS201N	DCC	Advance Computer Architecture & Organization	60	20	20	-	-	3	0	0	3

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UNIT III **8 HOURS**

Study and comparison of Vector and array processors, Vector Processing Principles, Vector instruction types, Vector-access memory schemes. Vector supercomputer architecture, SIMD Computer Organization Masking and Data network mechanism, distributed memory model and shared memory model, Parallel Algorithms For Array Processors: Matrix Multiplication. Sorting, SIMD computer organization, Implementation issues of Matrix multiplication and sorting on array processor and their analysis

UNIT IV **7 HOURS**

Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors.Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherence, Snoopy protocols, Directory based protocols. Message routing schemes in multicomputer network, deadlock and virtual channel.

UNIT V **8 HOURS**

Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.

TEXTBOOKS:

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw- Hill international Edition
2. J.P.Hayes, “computer Architecture and organization”; MGH.

REFERENCE:

1. V.Rajaranam & C.S.R.Murthy, “Parallel computer”; PHI Learning.
2. Kain,”Advance Computer Architecture: - A System Design Approach”, PHI Learning
3. M.J Flynn, “Computer Architecture, Pipelined and Parallel Processor Design”; Narosa Publishing.
4. Hwang and Briggs, “Computer Architecture and Parallel Processing”; MGH.
5. Hwang and Briggs, “Computer Architecture and Parallel Processing”; MGH.

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MTCS202N	DCC	Advance Database Management System	60	20	20	30	20	2	0	2	3

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COURSE OBJECTIVES:
The student will have ability to:
1. Describe database management system internals. Understand and describe internal algorithms in detail. Decide on optimization issues given a known database workload, by manipulating indexes, choosing more adequate data types, and modifying queries.
2. Identify opportunities for the use of the object model, and design and code client code to manipulate an object database.
3. Analyze and optimize transactional code, identifying causes of possible anomalies and correct them.
4. Identify and be able to use recent and advanced database techniques (e.g. in concurrency control, buffer management, and recovery).
5. Analyze, describe and use other models than the Relational. Analyze, compare and evaluate alternative database architectures and models in different application contexts. Identify limitations of the standard Relational databases in certain application domains, e.g. for multidimensional data, or unstructured data.

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.
2. Be familiar with the relational database theory, and be able to write relational algebra expressions for queries.
3. Be familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B-tree, and hashing.
4. Master the basics of query evaluation techniques and and query optimization.
5 Be familiar with the basic issues of transaction processing and concurrency control.

SYLLABUS
UNIT I — 10 HOURS
Introduction to Database Systems: Database System Concepts and Architecture, Data Models, Data Independence, SQL: DDL, DML, DCL, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF.Query Processing and Optimization: Query Processing, Syntax Analyzer, Query Decomposition, Query Optimization, Heuristic Query Optimization, Cost Estimation, Cost Functions for Select, Join, Query Evaluation Plans.

UNIT II — 9 HOURS
Object Oriented and Object Relational Databases Object Oriented Concepts, Object Oriented Data Model, Object Definition Language, Object Query Language, Object Relational Systems, SQL3, ORDBMS Design

UNIT III — 8 HOURS

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
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MTCS202N	DCC	Advance Database Management System	60	20	20	30	20	2	0	2	3

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Transaction Processing and Concurrency Control: Transaction Processing Concepts, Concurrency Control Techniques: Two-phase Locking, Timestamp Ordering, Multiversion, Validation, Multiple Granularity Locking.

UNIT IV — 7 HOURS

Backup and Recovery: Types of Database Failures, Types of Database Recovery, Recovery Techniques: Deferred Update, Immediate Update, Shadow Paging, Checkpoints, Buffer Management.

UNIT V — 8 HOURS

Introduction to Data Warehousing and Data Mining: Introduction to OLAP, OLTP, Data Warehouse, Data Marts, Data Mining, Data Mining Process. Distributed Databases: Distributed Database Concepts, Advantages and Disadvantages, Types of Distributed Database Systems, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Five Level Schema Architecture, Query Processing, Concurrency Control and Recovery in Distributed Databases. Commercial Databases: Commercial Database Products, Familiarity with IBM DB2 Universal Database, Oracle, Microsoft SQL Server, MySQL, their features.

TEXTBOOKS:

1. C. J. Date: An Introduction to Database Systems , Addison-Wesley
2. Avi Silberschatz, Henry F. Korth ,S. Sudarshan ,Data Base System Concepts, TMH

REFERENCE:

1. Patrick O'Neil & Elizabeth O'Neil, Database Principles, Programming and Performance,
2. Morgan Kaufmann Hardcourt India
3. Gillenson, Fundamental of Data Base Management Sytem, Willey India
4. Ceri & Pelagatti, Distributed Databases Principles & Systems,TMH
5. Paulraj Ponniah, Data Ware Housing Fundamental, Willey India.
6. Jiawei Han, Data Mining Concept & Techniques, Elsevier Pub.

LIST OF PRACTICALS

1. Distributed Database for Bookstore
2. Deadlock Detection Algorithm for distributed database using wait- for graph
3. Object Oriented Database – Extended Entity Relationship (EER)
4. Parallel Database – University Counselling for Engineering colleges
5. Parallel Database – Implementation of Parallel Join & Parallel Sort
6. Active Database – Implementation of Triggers & Assertions for Bank Database
7. Deductive Database – Constructing Knowledge Database for Kinship Domain (Family Relations)
8. Study and Working of WEKA Tool

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MTCS202N	DCC	Advance Database Management System	60	20	20	30	20	2	0	2	3

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9. Query Processing – Implementation of an Efficient Query Optimizer
10. Designing XML Schema for Company Database

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MTRM301	DCC	Research Methodology in Engineering	60	20	20	0	0	3	1	0	4

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COURSE OBJECTIVES:
The student will have ability to:
1. The ensuing knowledge as property.
2. To plan and design business research using scientific and statistical methods.

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Demonstrate understanding of research methodology.
2. Apply the statistical concepts in business research.
3. Validate statistical statements relating to business research.

SYLLABUS
UNIT I — 10 HOURS
Business Research
1. An overview: Research process
2. Types of Research - Exploratory Research, Descriptive Research, Causal Research, Analytical Research
3. Problem formulation, Management problem v/s. Research problem
4. Approaches to Research
5. Importance of literature review
6. Business Research Design: Steps involved in a research design

UNIT II — 9 HOURS
Sampling and Data Collection
1. Sampling and sampling distribution: Meaning, Steps in Sampling process
2. Types of Sampling - Probability and Non probability Sampling Techniques
3. Data collection: Primary and Secondary data – Sources – Advantages/Disadvantages
4. Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.

UNIT III — 8 HOURS
Measurement and Scaling Techniques
1. Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement
2. Attitude measurement – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale

UNIT IV — 10 HOURS

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
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MTRM301	DCC	Research Methodology in Engineering	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Statistical Tools for Data Analysis

1. Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles
2. Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness
3. Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation
4. Regression: Method of Least Squares
5. Formulation of hypothesis
6. Testing of hypothesis
7. Type I and Type II Errors.
8. Parametric tests: Z-Test, t-test, F-test, Analysis of Variance – One-Way and Two-way classification.
9. Non parametric tests - Chi-Square test

UNIT V **9 HOURS**

Report writing

1. Reporting Research
2. Types of reports
3. Characteristics of a research report

TEXTBOOKS:

1. MalhotraNaresh K. (2008). Marketing Research. Pearson publishers, Latest Edition.
2. Zikmund, Babin,Carr,Griffin (2003). Business Research Methods. Cengage Learning, India, Latest Edition.

REFERENCE:

1. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education, Latest Edition.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning, Latest Edition.
3. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House, Latest Edition.
4. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd, Latest Edition.
5. ekaran Uma (2003). Research Methods for Business. Wiley India, Latest Edition.
6. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons, Latest Edition.
7. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill,Latest Edition.
8. Kothari C. R. (2004). Research Methodology. VishwaPrakashan, Latest Edition.

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MTCS2051	DSE	Reinforcement Learning	60	20	20	30	20	2	0	2	3

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COURSE OBJECTIVES:
The student will have ability to:
1. Develop a Comprehensive Understanding
2. Master Data Preparation and Modeling:
3. Apply Advanced Analytics Techniques:

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Understand the core principles of reinforcement learning
2. Understand the model decision-making process using Markov Decision making processes
3. Understand and apply exploration and exploitation strategies in reinforcement learning
4. Acquire Skills in Monte Carlo methods for practical policy evaluation and control
5. Understand function approximation in the context of Reinforcement Learning

SYLLABUS

UNIT I **8 HOURS**

Overview of reinforcement learning, Difference between supervised, unsupervised, and reinforcement learning, Components of reinforcement learning (agent, environment, state, action, reward, transaction function, Discount, episode), Bandit problem.

UNIT II **8 HOURS**

Understanding Markov Decision Processes (MDPs), Policy, State value function, Action value function, Bellman equation, Dynamic Programming—Policy iteration, Policy Improvement, Value iteration, and Limitations of dynamic programming.

UNIT III **10 HOURS**

Exploration and exploitation strategies- Random, Greedy, Epsilon-Greedy, Softmax, UCB. Monte Carlo Methods: First-Visit Monte Carlo, Every-Visit Monte Carlo, Monte Carlo simulation for policy evaluation.

UNIT IV **10 HOURS**

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MTCS2051	DSE	Reinforcement Learning	60	20	20	30	20	2	0	2	3

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Temporal Difference Learning (TD), n-step TD, Q-learning, SARSA, bootstrapping

UNIT V **8 HOURS**

Function Approximation, linear function approximation, Deep Q-networks (DQN), Double Deep Q-networks (DDQN), Dueling Q-networks (Dueling DQN), Policy gradient methods, and Actor Critic methods.

TEXTBOOKS:

1. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto

REFERENCE:

1. "Grokking Deep Reinforcement Learning" by Miguel Morales, 2020
2. Alexander Zai , Brandon Brown, Deep Reinforcement Learning in Action, 2020, 1st Edition, Manning Publications.
3. Mohit Sewak, Deep Reinforcement Learning: Frontiers of Artificial Intelligence, 2019, Springer.
4. Sugiyama, Masashi, Statistical reinforcement learning: modern machine learning, 2015, Chapman and Hall

LIST OF PRACTICALS

1. Understand agent–environment interaction and the RL loop through a simple simulation.
2. Differentiate learning paradigms using small examples.
3. Implement and analyze the k-armed bandit problem.
4. Represent and visualize an MDP for a small environment (e.g., GridWorld)..
5. Implement iterative policy evaluation for a known policy.
6. Implement Monte Carlo methods for value estimation.
7. Implement one-step TD learning for state-value prediction.
8. Implement and train a DQN agent.

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MTCS2052	DSE	Natural Language Processing	60	20	20	30	20	2	0	2	3

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COURSE OBJECTIVES:
The student will have ability to:
1. Identify deals with processing text data using probabilistic model with n-grams and preprocessing techniques.
2. Concepts of text classification, text summarization, semantic analysis drives the subject to machine translation.
3. student knowledge to a level that can help to develop NLP applications like surveys, chatbots QA system etc..

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Understand the basic concepts and requirements of NLP.
2. Understand and apply various NLP Models and Algorithms.
3. Design and develop basic applications for text or information extraction.
4. Apply Machine translation techniques for language translation.

SYLLABUS
UNIT I — 8 HOURS
Introduction to NLP: What is NLP? Challenges of NLP, History of NLP, Advantages of NLP, Disadvantages of NLP, Components of NLP, Applications of NLP, how to build an NLP pipeline? Phases of NLP, NLP APIs, NLP Libraries

UNIT II — 9 HOURS
Natural Language Processing Models and Algorithm: Unigram Language Model, Bigram, Trigram, N-gram, Advanced smoothing for language modelling, Applications of Language Modeling, Natural Language Generation, Parts of Speech Tagging, Morphology, Named Entity Recognition

UNIT III — 8 HOURS
Text Processing: Continuous Bag-Of-Words, embedding representations for words Lexical Semantics, Word Sense Disambiguation, Knowledge-Based and Supervised Word Sense Disambiguation, Tokenization, Cleaning, Tokenizing, Removing Special Characters, Expanding Contractions, Removing Stop words, Correcting Words, Stemming, Lemmatization, Understanding Text structure.

UNIT IV — 7 HOURS
Text Analysis, Summarization and Extraction: Text Classification, Text Summarization, Information Extraction, Named Entity Recognition, Question Answering in Multilingual Setting; NLP in Information Retrieval,

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MTCS2052	DSE	Natural Language Processing	60	20	20	30	20	2	0	2	3

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Cross-Lingual IR

UNIT V **8 HOURS**

Applications of NLP: Unsupervised Learning on Text Clustering by Document Similarity – Distance Metrics, Partitive Clustering, Hierarchical Clustering: Analyzing Document Similarity, Document Clustering, Speech recognition

TEXTBOOKS:

1. Foundations of Statistical Natural Language Processing, Chris Manning and Hinrich Schütze, MIT Press
2. Natural Language Understanding, James Allen. The Benjamin/Cummings Publishing Company Inc.

REFERENCE:

1. Computational Nonlinear Morphology: With Emphasis on Semitic Languages, Kiraz, George Anton; Cambridge University Press
2. Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit, Steven Bird, Ewan Klein, and Edward Loper.
3. Speech and Language Processing - An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition Second Edition by Daniel Jurafsky and James H. Martin, Pearson Education India

LIST OF PRACTICALS

1. Introduction to python libraries for feature extraction and NLP.
2. Apply preprocessing steps on the selected Dataset. Support link for data set: https://www.kaggle.com/learn/natural-language-processing.
3. Tokenization: Split the text sentence/paragraph/Data set and generate Tokens.
4. Implement a suitable stemming algorithm based on chosen data set
5. POS tagging part 1: Perform POS tagging annotation on input text.
6. POS tagging part 2: Analyze the result of POS Tagging.
7. Generate N-grams of the text.
8. Convert text into TF IDF vectors.
9. Case Study – Study and prepare a report of Machine translation of Google
10. Case Study - Identify the sentiment of tweets

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MTCS2053	DSE	Computer Vision	60	20	20	30	20	2	0	2	3

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COURSE OBJECTIVES:
The student will have ability to:
1. To understand the fundamental concepts related to Image formation and processing.
2. To become familiar with feature-based alignment and motion estimation
3. To understand image-based rendering and recognition

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. To understand basic knowledge, theories and methods in image processing and computer vision.
2. To implement basic and some advanced image processing techniques in OpenCV
3. To apply 2D a feature-based based image alignment, segmentation and motion estimations
4. To apply 3D image reconstruction techniques
5. To design and develop innovative image processing and computer vision applications

SYLLABUS
UNIT I — 10 HOURS
INTRODUCTION TO IMAGE FORMATION AND PROCESSING: Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II — 9 HOURS
FEATURE DETECTION, MATCHING AND SEGMENTATION: Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III — 8 HOURS
FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV — 7 HOURS
3D RECONSTRUCTION: Shape from X - Active rangefinding - Surface representations - Point-based representationsVolumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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MTCS2053	DSE	Computer Vision	60	20	20	30	20	2	0	2	3

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UNIT V **8 HOURS**

MAGE-BASED RENDERING AND RECOGNITION: View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TEXTBOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

LIST OF PRACTICALS

1. OpenCV Installation and working with Python.
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
6. Image segmentation using Graphcut / Grabcut
7. Pose Estimation
8. 3D Reconstruction – Creating Depth map from stereo images

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2041	DSE	Introduction to Statistical Methods	60	20	20	30	20	2	0	2	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:
The student will have ability to:
1. Understanding Probability and Distributions
2. Mastering Descriptive Statistics and Estimation Techniques
3. Applying Regression and Correlation Analysis

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Proficiency in Probability Concepts and Distributions
2. Competency in Descriptive Statistics and Estimation
3. Expertise in Regression and Correlation Analysis

SYLLABUS
UNIT I — 10 HOURS
Introduction to probability: Probability, conditional probability, independence, Bayes' theorem. Random variables: discrete and continuous, distribution functions and their properties, probability mass and density functions, expectation & moments, moment generating function & its properties. Multiple random variables: joint distributions, marginal and conditional distributions.
Discrete probability distributions: Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric and Poisson distribution. Continuous probability distributions: Uniform, Exponential, Gamma, Normal & Log-normal distribution.

UNIT II — 9 HOURS
Descriptive Statistics: Inferential statistics, population, sample, parameter, statistic, random sample, sampling techniques. Summarizing and Exploring Data: Concept of frequency distribution, measures of central tendency, moments, measures of dispersion/variability, measures of skewness and kurtosis.

UNIT III — 8 HOURS
Estimation: Sampling distributions, basic concepts of inference (estimation & hypothesis testing), point estimation & interval estimation

UNIT IV — 10 HOURS
Testing of Hypothesis: Null and alternate hypothesis, simple & composite hypotheses, critical region, N-P lemma, tests for mean, variance and proportion in one and two sample problems. Chi-square goodness of fit test. Introduction to nonparametric test, Contingency table, test of independence

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UNIT V **8 HOURS**

Regression and Correlation: Simple linear regression, least squares fit and correlation analysis. Tests for slope & correlation, prediction problem, residual plots. Multiple linear regression. Analysis of Variance.

TEXTBOOKS:
1. *Probability and Statistics in Engineering* by Hines, Montgomery, Goldsman & Borror. Wiley Student Edition.
2. *An Introduction to Probability and Statistics* by Rohatgi and Saleh. Wiley

REFERENCE:
1. *Introduction to Probability Models* by Sheldon M. Ross, Academic Press.
2. *Probability and Statistics* by Spiegel, Schiller and Srinivasan. Tata McGraw-Hill Pub. Co. Ltd.
3. *Miller and Freund's Probability and Statistics for Engineers* by Johnson/Miller, Pearson Education India.
4. *Introduction to Probability and Statistics* by J. Susan Milton & J.C. Arnold, 4th Ed.,

LIST OF PRACTICALS
1. :Conduct experiments to calculate probabilities using classical, frequency, and axiomatic approaches. Apply Bayes' theorem to real-world scenarios.
2. Implement and analyze the Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, and Poisson distributions using sample data.
3. Develop and interpret continuous probability distributions
4. Write Python scripts to perform descriptive statistical analysis and visualize various probability distributions.
5. Calculate point estimates and construct confidence intervals for different parameters using sample data. Perform estimation using Python.
6. Hypothesis Testing for Means and Variances
7. Chi-Square Goodness of Fit and Independence Tests
8. Simple and Multiple Linear Regression
9. ANOVA and Correlation Analysis

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MTCS2042	DSE	DATA WAREHOUSING	60	20	20	30	20	2	0	2	3

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COURSE OBJECTIVES:
The student will have ability to:
1. Understand the components and architecture of data warehousing and data mining systems.
2. Implement data preprocessing, cleaning, integration, and transformation techniques.
3. Analyze and evaluate clustering methods, classification algorithms, and regression models for data analysis.

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Describe the architecture and functionalities of data warehousing and data mining systems.
2. Implement data extraction, cleanup, and transformation processes using appropriate tools.
3. Evaluate various clustering, classification, and regression methods, assessing their effectiveness in different scenarios.

SYLLABUS
UNIT I
Data Warehousing and Business Analysis: Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II
Data Mining: Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.
Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

UNIT III
Classification and Prediction: Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT IV
Cluster Analysis: Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods –

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MTCS2042	DSE	DATA WAREHOUSING	60	20	20	30	20	2	0	2	3

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Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis

UNIT V

Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

TEXTBOOKS:

1. Jiawei Han, Micheline Kamber and Jian Pei“Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.
2. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.

REFERENCE:

1. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
2. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.

LIST OF PRACTICALS

1. Build and implement a data warehouse architecture using a sample dataset.
2. Perform data extraction, cleanup, and transformation using ETL tools.
3. Design and execute OLAP queries for multidimensional data analysis.
4. Conduct data preprocessing, cleaning, and integration on raw data.
5. Implement frequent item set mining and association rule mining techniques.
6. Classify data using decision tree and Bayesian classification methods.
7. Evaluate the accuracy and error measures of different classifiers.
8. Apply partitioning, hierarchical, and density-based clustering methods to a dataset.
9. Analyze multimedia and spatial data using data mining techniques.
10. Perform text mining and web mining on real-world data sources.

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MTCS2043	DSE	Ethics for Data Science	60	20	20	30	20	2	0	2	3

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COURSE OBJECTIVES:
The student will have ability to:
1. Understand the Fundamentals of Ethics
2. Analyze Ethical Implications of AI and Technology
3. Apply Ethical Principles in Real-world Scenarios

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. Comprehend Key Ethical Concepts
2. Evaluate Ethical Challenges in AI and Technology
3. Implement Ethical Practices

SYLLABUS
UNIT I
Introduction to Ethics: What are Ethics?, History, Concept of Informed Consent, Data Ownership, Privacy, Anonymity, Data Validity, Algorithmic Fairness, Societal Consequences, Code of Ethics, Attributions.

UNIT II
Ethics in the age of AI: Artificial Intelligence Algorithms Models and Limitations, Artificial Intelligence Data Fairness and Bias, Artificial Intelligence Privacy and Convenience, Artificial Intelligence Ethics in Action, The Complex World of Data, The Challenges & Strategies of Putting Ethics into Practice.

UNIT III
Ethics, Technology, and Engineering – Eindhoven: Introduction, Codes of Conduct, Normative Ethics, The Ethical Cycle, Ethical Questions in the Design of Technology, Designing Morality, Ethical Aspects of Technological Risks, Distribution of Responsibility.

UNIT IV
Data Ethics, AI, and Responsible Innovation: Getting Started and Big Data Opportunities, Big Data Limitations, Research Ethics, Law and Ethics, Crime and Justice, Home and City, Money and Markets, Life and Health.

UNIT V
Ethical Implications of Emerging Technologies: New and upcoming technologies and their potential impact on society. Ethical Challenges and Considerations, Case Studies of Emerging Technologies, Regulation and Policy, Future Directions in Technology Ethics.

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MTCS2043	DSE	Ethics for Data Science	60	20	20	30	20	2	0	2	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

TEXTBOOKS:
1. American Civil Liberties Union. (2004). "Scary Pizza." (video.) 01:42. Available online: https://www.youtube.com/watch?v=33CIVjvYyEk
2. Raji, Deborah. (December 10, 2020). "How our data encodes systematic racism." MIT Technology Review.

REFERENCE:
1. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O'Reilly Media. Chapter 1, "Doing Good Data Science"
2. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O'Reilly Media. Chapter 3, "The Five Cs."
3. Zook, Matthew, Solon Barocas, Kate Crawford, Emily Keller, Alyssa Goodman, Rachelle Hollander, Barbara A. Koenig, Jacob Metcalf, Arvind Narayanan, Alondra Nelson, and Frank Pasquale. 2017.

LIST OF PRACTICALS
1. **Facebook-Cambridge Analytica Scandal**: This case study explores the misuse of data by Cambridge Analytica, which harvested personal data from millions of Facebook users without their consent. It raises issues of data ownership, privacy, informed consent, and the societal consequences of data misuse.
2. **COMPAS Recidivism Algorithm**: This case study examines the use of the COMPAS algorithm in the US criminal justice system to predict recidivism rates. It highlights issues of algorithmic fairness, bias, and the ethical implications of using AI in decision-making processes that affect people's lives.
3. **Volkswagen Emissions Scandal**: This case study discusses the ethical breaches by Volkswagen when they installed software in diesel engines to cheat emissions tests. It covers topics such as codes of conduct, normative ethics, the ethical cycle, and the distribution of responsibility in technological design.
4. **Google Street View Privacy Concerns**: This case study explores the privacy issues raised by Google's Street View project, which involved capturing images of streets and homes worldwide. It addresses the balance between innovation and privacy, research ethics, and the societal impact of big data projects.
5. **CRISPR Gene Editing**: This case study examines the ethical challenges and considerations surrounding the use of CRISPR technology for gene editing. It discusses the potential impact on society, regulation and policy, and the future directions in technology ethics.

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MTCS207	SEC	PYTHON FOR DATA SCIENCE LAB	0	0	0	0	50	0	0	2	1

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COURSE OBJECTIVES:
The student will have ability to:
1. To explore the programming skills relevant to data science and to gain knowledge of various libraries and packages like NumPy, Pandas and Matplotlib required for data analysis, data visualization, natural language processing and machine learning.

COURSE OUTCOMES:
Upon completion of the subject, students will be able to:
1. To understand data types in python and to apply array concepts using NumPy.
2. Structuring data using NumPy and manipulating the data using Pandas.
3. Using Pandas to analyze and work with data sets.
4. Graphical visualization of data using Matplotlib.

SYLLABUS
UNIT I
Compilation v/s Interpretation · Script mode and Interactive mode · Command Line Arguments, Data Types: Numbers, string, bool, Advanced Data Types: list, tuple set, dictionary, Type casting: implicit, explicit.

UNIT II
Function: User defined function, Built in functions, Lambda Function: filter, reduce, map, reverse function, doc string, types of arguments: positional, default, keyword, variable length, variable length keyword.

UNIT III
Exception Handling: User defined exception handler, disadvantages of having single except block, grouping multiple exception in single except block, printing the default message of exception by aliasing, optional else block, propagation of exception object.

UNIT IV
File handling: Reading a file, modes of file, closing a file, context managers in python, reading file contents line by line, reading a single line in a file, reading a multiple lines in a file, reading a character in a line, readline()

UNIT V
OOPS concepts: Encapsulation, polymorphism, inheritance, abstraction, operator overloading and magical methods, multi threading in python

TEXTBOOKS:
1. Python Data Science Handbook: Essential Tools for Working with Data, by Jake VanderPlas, O'reilly Media, 2017.

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MTCS207	SEC	PYTHON FOR DATA SCIENCE LAB	0	0	0	0	50	0	0	2	1

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REFERENCE:

1. Python for Data Science by Mohd. Abdul Hameed, May 2021, Wiley.
2. Python for Data Science: The Ultimate Step-by-Step Guide to Python Programming by Daniel, March 2021, O'reilly.
3. Python for Data Science: A Crash Course for Data Science and Analysis, Python Machine Learning and Big Data by Computer Science Academy

LIST OF PRACTICALS
1. Write a program to demonstrate a) Different numeric data types and b) To perform different Arithmetic Operations on numbers in Python
2. Write a program to create, append, and remove lists in Python.
3. Write a program to demonstrate working with tuples in Python
4. Write a program to demonstrate working with dictionaries in Python.
5. Write a program to demonstrate a) arrays b) array indexing such as slicing, integer array indexing and Boolean array indexing along with their basic operations in NumPy.
6. Write a program to compute summary statistics such as mean, median, mode, standard deviationand variance of the given different types of data.
7. Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be the input that to be written to the second file.
8. Write a program to demonstrate Regression analysis with residual plots on a given data set.
9. Write a program to demonstrate the working of the decision tree-based ID3 algorithm.
10. Write a program to implement the Naïve Bayesian classifier for a sample training data set stored as a .CSV file.