M. TECH. TWO YEAR DEGREE

PROGRAM CURRICULUM

(Applicable for the batches admitted from A.Y 2025-26)

COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Aditya Nagar, ADB Road, Surampalem - 533 437

VISION & MISSION OF THE UNIVERSITY

VISION :

Aditya University aspires to be a globally recognised academic institution dedicated to quality education, cutting-edge research, and technological service to our country, and envisions itself as a beacon of holistic advancement and long-term impact, remaining dynamic in the ever-changing worlds of society, ecology, and economics..

MISSION:

- Aditya University pushes boundaries to design high-quality curricula and to provide students with a vibrant and relevant education that prepares them for a changing world. Our industry insights and creative teaching methods attempt to equip our students to be lifelong learners.
- Aditya University's learning environment encourages intellectual curiosity, critical thinking, and cooperation, with the goal of providing students with an immersive education that fosters creativity and innovation. Our cutting-edge facilities, interactive classrooms, and supportive faculty aim to motivate students to realise their full potential and contribute to society.
- Aditya University promotes cross-disciplinary inquiry and discovery and leads cutting-edge research and innovation. Through strategic partnerships, research grants, and a dedicated faculty, we aim to advance science, technology, and social sciences and empower students and faculty to conduct transformative research that solves real-world problems and elevates our institution globally.
- Aditya University is committed to producing world-changing business leaders and entrepreneurs through its emphasis on entrepreneurship, mentoring, and business incubation programmes.

VISION & MISSION OF THE UNIVERSITY

VISION :

Aditya University aspires to be a globally recognised academic institution dedicated to quality education, cutting-edge research, and technological service to our country, and envisions itself as a beacon of holistic advancement and long-term impact, remaining dynamic in the ever-changing worlds of society, ecology, and economics..

MISSION:

- Aditya University pushes boundaries to design high-quality curricula and to provide students with a vibrant and relevant education that prepares them for a changing world. Our industry insights and creative teaching methods attempt to equip our students to be lifelong learners.
- Aditya University's learning environment encourages intellectual curiosity, critical thinking, and cooperation, with the goal of providing students with an immersive education that fosters creativity and innovation. Our cutting-edge facilities, interactive classrooms, and supportive faculty aim to motivate students to realise their full potential and contribute to society.
- Aditya University promotes cross-disciplinary inquiry and discovery and leads cutting-edge research and innovation. Through strategic partnerships, research grants, and a dedicated faculty, we aim to advance science, technology, and social sciences and empower students and faculty to conduct transformative research that solves real-world problems and elevates our institution globally.
- Aditya University is committed to producing world-changing business leaders and entrepreneurs through its emphasis on entrepreneurship, mentoring, and business incubation programmes.

VISION & MISSION OF THE DEPARTMENT

VISION

To be a premier centre of excellence in AIML, fostering cutting-edge research, innovation, and leadership to meet the evolving demands of industry and society.

MISSION

M1: Provide advanced knowledge and skills in AIML through innovative teaching and research
M2: Strengthen industry and research partnerships to solve real-world problems.
M3: Promote ethical practices and awareness of societal and environmental responsibilities.
M4: Foster leadership, innovation, and lifelong learning for holistic development.

PROGRAM OUTCOMES (POs)

After successful completion of the program, the graduates will be able to

PO 1	Independently carry out research /investigation and development work to solve practical problems
PO 2	Write and present a substantial technical report/document
PO 3	Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO 4	Learn; keep up with contemporary technologies and ways of working.
PO 5	Communicate effectively as an individual or a team leader in diverse and multidisciplinary groups.
PO 6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of finance for profitable project management.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of the program, the graduates will be able to

PSO 1	Apply advanced mathematics, computing, and AI techniques to develop efficient solutions for complex real-world problems.
PSO 2	Drive innovation and research in AIML to solve interdisciplinary challenges and contribute as a professional, researcher, or entrepreneur.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the Program will

PEO 1	Apply advanced AIML tools to solve complex interdisciplinary problems.
PEO 2	Pursue research, innovation, and continuous learning in emerging technologies.
PEO 3	Lead and collaborate ethically with an understanding of social and economic impact.

Department of Artificial Intelligence and Machine Learning
Master of Technology in CSE (AI&ML)
Program Curriculum 2025
Credit Division

S.No	Category of Course	Credits
1	Program Core Courses (PCC)	30
2	Program Elective Courses (PEC)	15
3	University Elective Courses (UEC)	03
4	Summer Internship (SI)	02
4	Technical Paper Publication (TPP)	02
5	Project – Part I & II (PROJ)	28
6	Audit Course (AUC)	0
Total Credits		80

Program Core Courses (PCC) (30 Credits)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502AI01	Mathematics for Machine Learning	3			3	50	50	100	-
2502AI02	Database Management Systems	2		1	3	50	50	100	-
2502AI03	Artificial Intelligence Techniques	2		1	3	50	50	100	-
2502AI04	Data Wrangling Lab	1		2	3	50	50	100	-
2502AI05	Machine Learning Algorithms	2		1	3	50	50	100	AI
2502AI06	Big Data Analytics	3			3	50	50	100	-
2502AI07	Computer Vision and Image Processing	2		1	3	50	50	100	-
2502AI08	Deep Learning	2		1	3	50	50	100	MLA
2502AI09	Mean Stack Technologies	1		2	3	50	50	100	-
2502AI10	Internet of Things Theory and Practice	2		1	3	50	50	100	-
Total		20		10	30				

University Elective Courses (UEC) (3 Credits)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Offered to PG Program	Pre-requisite
2502CE28	Metro Rail Transportation Design and Construction (L&T Edu Tech)*	3	0	0	3	50	50	100	All, except SE	-
2502CE29	Building Information Modelling in Architecture, Engineering and Construction (L&T Edu Tech)*	3	0	0	3	50	50	100	All, except SE	-
2502CE30	Basic Concrete Technology	3	0	0	3	50	50	100	All, except SE	-
2502CE31	Repair and Rehabilitation of Structures	3	0	0	3	50	50	100	All, except SE	-
2502EE28	Neural Networks and Fuzzy Logic	3	0	0	3	50	50	100	All, except PED	-
2502EE29	Hybrid Electric Vehicles	3	0	0	3	50	50	100	All, except PED	-
2502EE30	Electrical Power Distribution and Automation (L&T EduTech)*	3	0	0	3	50	50	100	All, except PED	-
2502EE31	Renewable Energy & Power Evacuation (L&TEdu Tech)*	3	0	0	3	50	50	100	All, except PED	-
2502ME26	Design of fire and life safety systems (L&T)*	3	0	0	3	50	50	100	All, except TE	-
2502ME27	Green Engineering Systems	3	0	0	3	50	50	100	All, except TE	-
2502ME28	IC Engines	3	0	0	3	50	50	100	All, except TE	-
2502EC24	CAD Tools for VLSI Design	3	0	0	3	50	50	100	All, except VLSID	-
2502EC25	FPGA Design for Embedded Systems	3	0	0	3	50	50	100	All, except VLSID	-
2502CS26	Artificial Intelligence	3	0	0	3	50	50	100	All, except CSE	-
2502CS27	Machine Learning Techniques	3	0	0	3	50	50	100	All, except CSE	-

*The syllabus for the industry partner courses will be released in the department as and when required

Summer Internship (SI)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502AI11	Technical Seminar			02	02	100	-	100	-

Technical Paper Publication (TPP)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502AI12	Technical Paper Publication			02	02	100	-	100	-

Project –Part I & II (PROJ)

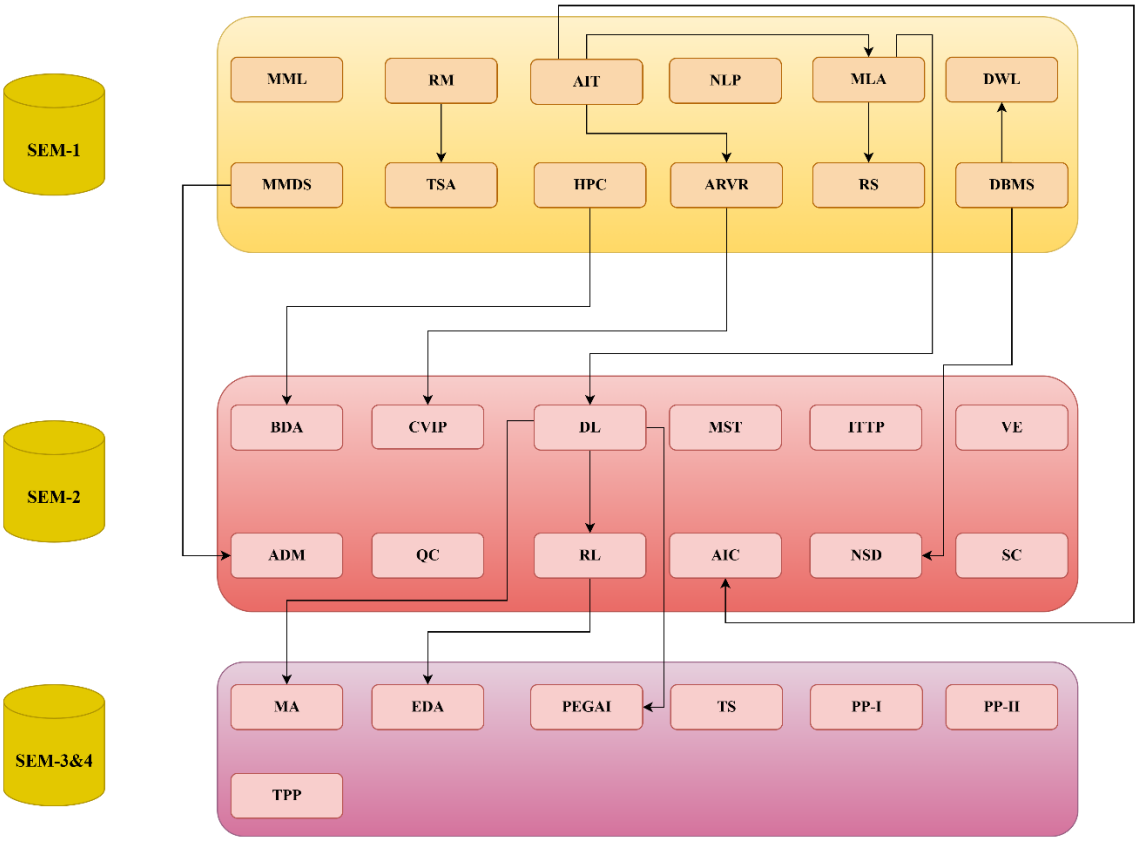
Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502AI13	Project Part I			10	10	100	-	100	-
2502AI14	Project Part II			18	18	50	50	100	

Audit Courses (AUC)

Course Code	Course Title	L	T	P	C	CIE	SEE	Total	Pre-requisite
2502CE32	Value Education	2			0	100	-	100	-
2502CE33	Research Methodology	2			0	100	-	100	-

2025 M.Tech (AI&ML) Program Curriculum

Pre-requistes Flowchart



List of Courses	
MML	Mathematics for Machine Learning
RM	Research Methodology
AIT	Artificial Intelligence Techniques
NLP	Natural Language Processing
MLA	Machine Learning algorithms
DWL	Data Wrangling Lab
MMDS	Mining Massive Data Sets
TSA	Time Series Analysis
HPC	High Performance Computing
ARVR	Augmented Reality and Virtual Reality
RS	Recommender Systems
DBMS	Database Management Systems
BDA	Big Data Analytics
CVIP	Computer Vision and Image Processing
DL	Deep Learning
MST	Mean Stack Technologies
ITTP	Internet of Things theory and Practice
VE	Value Education
ADM	Advanced Data Mining
QC	Quantum Computing
RL	Reinforcement Learning
AIC	AI Chatbots
NSD	NOSQL Databases
SC	Soft computing
MA	Multivariate Analysis
EDA	Exploratory Data Analysis
PEGAI	Prompt Engineering &GenAI
TS	Technical Seminar
PP-I	Project Part -I
PP-II	Project Part -II
TPP	Technical Paper Publication

Suggestive Semester wise Curriculum

I Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
2502AI01	Mathematics for Machine Learning	PCC	3	0	0	3	3
2502AI02	Database Management Systems	PCC	2	0	1	3	3
2502AI03	Artificial Intelligence Techniques	PCC	2	0	1	3	3
	Professional Elective Course I	PEC	2	0	1	3	3
	Professional Elective Course II	PEC	2	0	1	3	3
2502AI04	Data Wrangling Lab	PCC	1	0	2	3	5
2502AI05	Machine Learning algorithms	PCC	2	0	1	3	5
2502CE33	Research Methodology	AUC	2			0	2
Total			**16**	**0**	**7**	**21**	**27**

II Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
2502AI06	Big Data Analytics	PCC	3	0	0	3	3
2502AI07	Computer Vision and Image Processing	PCC	2	0	1	3	3
2502AI08	Deep Learning	PCC	2	0	1	3	3
	Professional Elective Course III	PEC	2	0	1	3	3
	Professional Elective Course IV	PEC	2	0	1	3	3
2502AI09	Mean Stack Technologies	PCC	1	0	2	3	5
2502AI10	Internet of Things theory and Practice	PCC	2	0	1	3	5
2502CE32	Value Education	AUC	2			0	2
Total			**16**	**0**	**7**	**21**	**27**

III Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
	Professional Elective Course V	PEC	2	0	1	3	3
	University Elective Course	UEC	3	0	0	3	3
2502AI11	Technical Seminar	SI			2	2	-
2502AI13	Project Part -I	PROJ			10	10	18
Total			**5**	**0**	**13**	**18**	**24**

IV Semester

Course Code	Course Title	Course Category	Credits				Total Hours
			L	T	P	Total	
2502AI12	Technical Paper Publication	TPP			02	02	06
2502AI14	Project Part-II	PROJ			18	18	34
Total					**20**	**20**	**40**

Professional Elective -I (I Semester)		
S.No	**Course Code**	**Course Name**
1	2502AI15	Natural Language Processing
2	2502AI16	Mining Massive Data Sets
3	2502AI17	High Performance Computing
Professional Elective -II (I Semester)		
1	2502AI18	Augmented Reality and Virtual Reality
2	2502AI19	Recommender Systems
3	2502AI20	Time Series Analysis
Professional Elective -III (II Semester)		
1	2502AI21	Advanced Data Mining
2	2502AI22	Quantum Computing
3	2502AI23	Soft computing
Professional Elective -IV (II Semester)		
1	2502AI24	AI Chatbots
2	2502AI25	NOSQL Databases
3	2502AI26	Reinforcement Learning
Professional Elective -V (III Semester)		
1	2502AI27	Exploratory Data Analysis
2	2502AI28	Multivariate Analysis
3	2502AI29	Prompt Engineering &GenAI

MATHEMATICS FOR MACHINE LEARNING

Course Code: 2502AI01

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Interpret systems of linear equations using matrix operations

CO2: Apply geometric concepts like inner products, orthogonality, and projections in analytic geometry.

CO3: Evaluate matrix decompositions such as Eigen and Singular Value Decomposition for dimensionality reduction.

CO4: Differentiate multivariate functions and apply gradient-based methods for vector calculus problems

CO5: Analyze probabilistic models and apply optimization techniques for continuous and constrained scenarios.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	-	-
CO2	3	2	2	2	-	-
CO3	3	2	3	2	-	1
CO4	2	2	3	2	-	-
CO5	2	2	2	3	-	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	3	2
CO5	2	2

UNIT – I

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces Introduction to Threads.

UNIT – II

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations Kernel Memory Allocators.

UNIT – III

Matrix Decompositions: Determinant and Trace, Eigen values and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny Practice.

UNIT – IV

Vector Calculus : Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series.

UNIT – V

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization.

Text Books:

1. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.

Reference Books:

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.

Web Links:

1. https://archive.nptel.ac.in/courses/106/105/106105214/
2. https://archive.nptel.ac.in/courses/106/102/106102132/

Database Management Systems

Course Code: 2502AI02

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamental concepts of database systems.
CO2: Design and implement relational databases.
CO3: Formulate queries using SQL
CO4: Apply normalization techniques for database design.
CO5: Comprehend transaction management and concurrency control mechanisms

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	-	-
CO2	3	-	2	2	-	-
CO3	2	-	3	-	-	-
CO4	3	-	2	-	-	-
CO5	3	-	2	2	-	-

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	2

UNIT – I

Introduction to Databases: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators, Transaction Management, Database System Structure.Data Models: Entity-Relationship Model, Relational Model, Other Models, Database Design and ER Diagrams, Relational Algebra and Calculus

Practice:

1. Basic SQL – Table Creation and Data Insertion
2. Write queries using SELECT, DISTINCT, WHERE, ORDER BY, BETWEEN, LIKE, and IN.
3. Retrieve specific records based on conditions.

UNIT – II

Relational Model & SQL: Introduction to the Relational Model, Concepts of Domain, Attribute, Tuple, Relation, Importance of Null Values, Constraints: Domain, Key,

Integrity Constraints, Basic SQL: Simple Database Schema, Data Types, Table Definitions (CREATE, ALTER), DML Operations: INSERT, DELETE, UPDATE, Basic SQL Querying: SELECT and PROJECT using WHERE Clause, Arithmetic & Logical Operations, SQL Functions: Date and Time, Numeric, String Conversion

Practice:

1. Use functions like SUM, AVG, COUNT, MAX, and MIN.
2. Perform grouping using GROUP BY and filter groups using HAVING.
3. Practice retrieving data using joins between multiple tables.
4. Analyze relationships through INNER JOIN, LEFT JOIN, etc.

UNIT – III

Entity-Relationship Model: Overview of Database Design, ER Model: Entities, Attributes, Entity Sets, Relationships and Relationship Sets, Mapping Cardinalities Participation Constraints, Aggregation and Generalization, Reduction of an ER Schema to Tables, Design Issues

Practice:

1. Implement single-row and multi-row subqueries.
2. Use IN, ANY, ALL, and EXISTS.
3. Create VIEW for simplified access.
4. Create INDEX to improve performance.
5. Generate sequences with CREATE SEQUENCE.

UNIT – IV

Normalization: Purpose of Normalization, Functional Dependencies, Normalization Forms: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF, Decomposition Using Functional Dependencies, Lossless Join and Dependency Preservation, Schema Refinement, Design of Relational Database Schema

Practice:

1. Given unnormalized data, apply 1NF, 2NF, 3NF, and BCNF.
2. Perform decomposition ensuring dependency preservation and lossless join.
3. Create stored procedures and functions using CREATE PROCEDURE/FUNCTION.

UNIT – V

Transaction Management and Concurrency Control: Transaction Concept and State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability and Recoverability, Implementation of Isolation, Testing for Serializability, Failure Classification, Storage, Recovery, and Atomicity, Recovery Algorithms

Practice:

1. Create BEFORE INSERT, AFTER UPDATE triggers.
2. Use OLD and NEW keywords to monitor changes.
3. Use implicit and explicit cursors to fetch data row by row.
4. Implement EXCEPTION blocks for runtime error handling**.**

Text Books:

1 Silberschatz, Korth, and Sudarshan, Database System Concepts, 6th Edition, McGraw-Hill.
2 Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Pearson.

Reference Books:

1 Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill.
2 C.J. Date, An Introduction to Database Systems, 8th Edition, Addison- Wesley.

Web Links:

1 https://archive.nptel.ac.in/courses/106/105/106105214/
2 https://archive.nptel.ac.in/courses/106/102/106102132/

Artificial Intelligence Techniques

Course Code: 2502AI03

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamentals, history, languages, and applications of Artificial Intelligence and formulate problems using search strategies.
CO2: Apply logic-based knowledge representation and reasoning techniques such as propositional logic, predicate logic, and resolution.
CO3: Demonstrate various knowledge representation techniques like semantic networks, frames, conceptual dependency, and case grammars.
CO4: Analyse uncertainty using probability theory, Bayesian networks, certainty factors, and non-monotonic reasoning techniques
CO5: Explore the structure and functioning of expert systems and intelligent agents, including knowledge acquisition and reasoning under uncertainty.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	-	-
CO2	3	-	2	2	-	-
CO3	3	-	2	2	-	-
CO4	3	-	2	3	-	-
CO5	3	2	2	2	2	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

UNIT-I

Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI, Problem solving state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening A*, constraint satisfaction

Practice:
1. Implementation of DFS for water jug problem using PYTHON
2. Implementation of BFS for tic-tac-toe problem using PYTHON

UNIT-II

Problem Reduction and Game Playing: Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games, Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

Practice:

1. Implementation of TSP using heuristic approach using PYTHON
2. Implementation of Simulated Annealing Algorithm using PYTHON

UNIT-III

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames, advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, Cyc theory, case grammar, semantic web.

Practice:

1. Implementation of Hill-climbing to solve 8- Puzzle Problem using PYTHON
2. Implementation of Monkey Banana Problem using PYTHON

UNIT-IV

Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks (exact and approximate inference) certainty factor theory, dempster-Shafer theory , non-monotonic reasoning, TMS.

Practice:

1. Implementation of A* Algorithm using PYTHON
2. Implementation of AO* Algorithm using PYTHON
3. Implementation of Min-Max Game playing algorithm using PYTHON

UNIT-V

Expert systems:- Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.

Practice:

1. Implementation Expert System with forward chaining using PYTHON

2. Implementation Expert System with backward chaining using PYTHON

Text Books:

1 Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2 Artificial Intelligence, SarojKaushik, 1st Edition, CENGAGE Learning, 2011

Reference Books:

1 Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
2 Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3 Artificial Intelligence, A new Synthesis, 1st Edition, Nils J Nilsson, Elsevier, 1998
4 Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
5 Introduction To Artificial Intelligence and Expert Systems, 1st Patterson, Pearson India, 2015

Web Links:

1 https://archive.nptel.ac.in/courses/106/105/106105214/
2 https://archive.nptel.ac.in/courses/106/102/106102132/

Natural Language Processing

Course Code: 2502AI15

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Interpret systems of linear equations using matrix operations
CO2: Apply geometric concepts like inner products, orthogonality, and projections in analytic geometry.
CO3: Evaluate matrix decompositions such as Eigen and Singular Value Decomposition for dimensionality reduction.
CO4: Differentiate multivariate functions and apply gradient-based methods for vector calculus problems
CO5: Analyze probabilistic models and apply optimization techniques for continuous and constrained scenarios.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	-	-
CO2	3	2	2	2	-	-
CO3	3	2	3	2	-	1
CO4	2	2	3	2	-	-
CO5	2	2	2	3	-	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	3	2
CO5	2	2

UNIT-I

Introduction: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

Practice:

1. Implement a Finite-State Automaton (FSA) to recognize valid dates in the format "DD-MM-YYYY".
2. Create a spelling correction system using Minimum Edit Distance on a list of English words.

UNIT-II

Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

Practice:

1. Build and evaluate an unsmoothed and smoothed bigram language model on a small corpus
2. Implement a Part-of-Speech (POS) tagger using the Hidden Markov Model (HMM) with Viterbi decoding.

UNIT-III

Syntactic Analysis: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

Practice:

1. Parse English sentences using a Context-Free Grammar and visualize parse trees.
2. Implement a probabilistic CYK parser and test it on ambiguous sentences.

UNIT – IV

Semantics And Pragmatics: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

Practice:

1. Perform Word Sense Disambiguation (WSD) using the Lesk algorithm on ambiguous words
2. Compute semantic similarity between word pairs using WordNet path similarity and cosine similarity from word embeddings.

UNIT-V

Discourse Analysis And Lexical Resources: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Practice:

1. Apply Hobbs and Centering algorithms for anaphora resolution in small English passages.
2. Use lexical resources like WordNet and PropBank to extract senses, synonyms, and semantic roles for a list of given verbs

Text Books:

1 Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2 nd Edition, Daniel Jurafsky, James H. Martin―Pearson Publication,2014.
2 Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

1 Language Processing with Java and LingPipe Cookbook, 1 st Edition, Breck Baldwin, Atlantic Publisher,2015.
2 Natural Language Processing with Java, 2 nd Edition, Richard M Reese, OReilly Media,2015
3 Handbook of Natural Language Processing, Second, NitinIndurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4 Natural Language Processing and Information Retrieval, 3 rd Edition, TanveerSiddiqui, U.S. Tiwary, Oxford University Press,2008

Web Links:

1 https://archive.nptel.ac.in/courses/106/105/106105214/
2 https://archive.nptel.ac.in/courses/106/102/106102132/

Mining Massive Data Sets

Course Code: 2502AI16

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Understand the foundational concepts of data mining and computational modelling techniques.
- **CO2:** Apply distributed computing principles using MapReduce and design scalable data mining algorithms
- **CO3:** Analyse streaming data models and develop algorithms for real-time data processing.
- **CO4:** implement frequent itemset mining algorithms and analyse large datasets using scalable techniques
- **CO5:** Apply clustering and dimensionality reduction techniques for unsupervised learning and data summarization

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	-	-
CO2	3	3	2	2	-	-
CO3	2	3	3	3	-	-
CO4	2	3	3	2	-	-
CO5	3	2	2	2	2	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	3	3
CO4	2	2
CO5	3	2

UNIT-I

Data Mining: Introduction, Statistical Modelling, Machine Learning, Computational Approaches to Modelling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws.

Practice:

1. Perform data exploration and extract statistical features from a dataset (e.g., Titanic, Iris, or custom CSV) and Plot histograms, boxplots.
2. Analyze if real-world data (e.g., word frequencies, city populations) follows a power-law or logarithmic distribution and plot log-log graph.

UNIT-II

Map Reduce and the New Software Stack: Distributed File Systems, Map Reduce, Algorithms Using MapReduce, Extensions to MapReduce, Complexity Theory for MapReduce

Practice:

1. Build an inverted index using MapReduce for a document set.

UNIT-III

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Decaying Windows.

Practice:

1. Implement Count-Min Sketch algorithm.
2. Implement reservoir sampling to maintain a sample of size k from a stream of unknown length.

UNIT-IV

Frequent Item sets: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream.

Practice:

1. Apply Apriori algorithm on a dataset like Groceries or Online Retail.
2. Implement the Misra-Gries algorithm to identify frequent elements in a stream with limited memory.

UNIT-V

Clustering: Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism. Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component Analysis, Singular-Value Decomposition, CUR Decomposition

Practice:

1. Perform clustering on Iris or Mall Customer Segmentation dataset.
2. Reduce dataset dimensionality using PCA and SVD.

Text Books:

1 Mining of Massive Datasets - Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman

Reference Books:

1 Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann, 3rd Edition

2 Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson

Web Links:

1 https://nptel.ac.in/courses/106105174

High Performance Computing

Course Code: 2502AI17

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Understand fundamental concepts, architectures, and trends in parallel computing platforms and microprocessors.
- **CO2:** Apply parallel programming principles, including decomposition and load balancing, to design efficient parallel algorithms.
- **CO3:** Implement and analyse basic communication operations and shared memory parallel programming using OpenMP and threads.
- **CO4:** Analyse performance metrics and overheads in parallel programs and apply dense matrix algorithms on parallel platforms.
- **CO5:** Develop parallel algorithms for sorting and graph problems and program using CUDA architecture for GPU computing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	1
CO2	3	3	2	2	1	1
CO3	2	3	3	3	1	2
CO4	2	3	3	2	2	1
CO5	3	2	2	2	2	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	1
CO3	3	1
CO4	2	2
CO5	2	3

UNIT-I

Introduction: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi core architecture.

Practice:

1. Compare and analyze the performance of a program using single-core vs multi-core execution using a timing utility (e.g., Python's time or timeit).
2. Identify communication cost bottlenecks in different parallel architectures by simulating data exchange between processors.

UNIT-II

Parallel Programming: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Practice:

1. Design and implement a parallel algorithm using the divide-and-conquer decomposition technique for matrix addition.
2. Simulate a load balancing scenario where tasks are distributed across 4 virtual processors using mapping techniques.

UNIT-III

Basic Communication: Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads-basics, synchronization, OpenMP programming

Practice:

1. Implement One-to-All Broadcast and All-to-One Reduction using MPI or simulated message passing in Python.
2. Write a program using OpenMP to calculate prefix sums (scan operation) on an array using thread-level parallelism.

UNIT-IV

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and the effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: MatrixVector Multiplication, Matrix-Matrix Multiplication.

Practice:

1. Evaluate the performance metrics (speedup, efficiency, and scalability) for a matrix-matrix multiplication using different thread counts.
2. Implement and compare matrix-vector multiplication using serial vs parallel (OpenMP or threads) execution**.**

UNIT-V

Parallel Algorithms- Sorting and Graph : Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel BestFirst Search. CUDA Architecture : CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Practice:

1. Write a parallel version of quicksort using multiprocessing or OpenMP and compare it with serial execution for large datasets.
2. Implement a simple CUDA C kernel to perform vector addition and analyze GPU memory management and synchronization.

Text Books:

1 Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2

2 Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN 13: 978-0-13-138768-3

Reference Books:

1 Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984

2 Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884

3 David Culler Jaswinder Pal Singh, ”Parallel Computer Architecture: A Hardware/ Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1

4 Rod Stephens, “Essential Algorithms”, Wiley, ISBN: ISBN: 978-1-118-61210-

Web Links:

1 https://www.geeksforgeeks.org/computer-organization-architecture/high-performance-computing/

2 https://www.nvidia.com/en-us/glossary/high-performance-computing/

Augmented Reality and Virtual Reality

Course Code: 2502AI18	L	T	P	C
	2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamental concepts, origins, and components of Augmented Reality and its relation to other technologies.
CO2: Identify and describe the key hardware and software components required for developing Augmented Reality systems.
CO3: Comprehend the core concepts of Virtual Reality, including its history, system components, and input devices
CO4: Analyse output devices used in VR such as graphics, sound, and haptic displays, and understand human factors influencing VR usability and safety
CO5: Explore various applications of Augmented Reality and Virtual Reality across different domains and evaluate AR/VR solutions effectively.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	1
CO2	3	3	2	-	-	1
CO3	2	3	1	1	-	2
CO4	2	3	3	2	-	1
CO5	3	2	2	-	1	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	1
CO3	2	1
CO4	2	2
CO5	2	1

UNIT-I

Augmented Reality: origin of Augmented Reality, The Relationship Between Augmented Reality and Other Technologies, Augmented Reality Concepts, working of Augmented Reality, Ingredients of an Augmented Reality Experience.

Practice:
1. Create a presentation or infographic comparing Augmented Reality (AR) with Virtual Reality (VR) and Mixed Reality (MR), focusing on use cases and working principles.
2. Simulate the workflow of an AR experience using diagrams showing camera input, processing, object detection, and overlay display.

UNIT-II

Augmented Reality Hardware: Major Hardware Components for Augmented Reality

Systems, Augmented Reality Software, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

Practice:

1. Identify and list major hardware components (camera, display, processor, sensors) from a commercial AR device (e.g., Microsoft HoloLens or Magic Leap), and explain their roles.
2. Use a basic AR development toolkit (e.g., Unity with Vuforia or AR.js) to create a simple AR application that overlays a 3D object on a marker.

UNIT-III

Virtual Reality: The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology , VR Becomes an Industry, The Five Classic Components of a VR System. Input Devices: Trackers, Navigation, and Gesture Interfaces: Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces

Practice:

1. Compare different VR input devices (like 3D trackers, gloves, joysticks) based on accuracy, cost, and immersion level.
2. Design a simple interactive VR environment (mockup or using Unity) that includes basic navigation and manipulation using virtual controllers.

UNIT-IV

Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays :Graphics Displays, Sound Displays, Haptic Feedback. Human Factors in VR: Methodology and Terminology, User Performance Studies, VR Health and Safety Issues, VR and Society

Practice:

1. Analyze the impact of using haptic feedback in VR training simulations (e.g., medical or industrial applications).
2. Conduct a mini research activity on VR-induced motion sickness: causes, effects, and mitigation strategies.

UNIT-V

Augmented Reality Applications: characteristics of a Good Augmented Reality Application, Application Areas, Magic Books, Magic Windows and Doors, Applying Augmented Reality to a Problem, Evaluating Augmented Reality Applications, VR Applications in Manufacturing, Applications of VR in Robotics**.**

Practice:

1. Choose a real-world problem (e.g., industrial training, medical visualization, or education) and propose an AR-based solution — describe the ingredients and evaluate feasibility.
2. Explore and document one VR application used in manufacturing or robotics — describe its functionality, benefits, and limitations.

Text Books:

1 Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2 Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.

Reference Books:

1 LaValle, “Virtual Reality”, Cambridge University Press, 2016.
2 Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
3 John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
4 Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.

Web Links:

1 https://www.coursera.org/articles/augmented-reality-vs-virtual-reality
2 https://www.geeksforgeeks.org/python/virtual-reality-vs-augmented-reality-whats-the-difference/

Recommender Systems

Course Code: 2502AI19	L	T	P	C
	2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the core functions and applications of recommender systems, along with mathematical foundations such as matrix operations and covariance matrices.
CO2: Analyse and implement collaborative filtering techniques, including user-based, item-based, and model-based approaches, and identify associated challenges like system attacks.
CO3: Apply content-based and knowledge-based recommendation methods using item/user profiles, document features, and similarity or classification algorithms
CO4: Evaluate and design hybrid recommender systems by integrating various strategies such as feature combination, weighted approaches, and meta-level architectures.
CO5: Assess the effectiveness of recommender systems using evaluation metrics and understand the role of social, trust-based, and community-based recommendation approaches.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	1
CO2	3	3	2	1	2	1
CO3	2	3	2	1	-	2
CO4	2	3	3	2	1	2
CO5	3	2	2	-	1	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	1
CO3	2	3
CO4	2	2
CO5	2	2

UNIT-I

Introduction: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Practice:
1. Given a small user-item rating matrix, perform matrix addition, transposition, and compute the covariance matrix to analyze rating patterns.
2. List and explain at least three real-world applications of recommender systems and discuss the primary challenges (e.g., cold start, sparsity) faced by each.

UNIT-II

Collaborative Filtering: User-based nearest neighbour recommendation, Item-based nearest neighbour recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.

Practice:

1. Implement a user-based collaborative filtering system on a movie rating dataset using cosine similarity to recommend top 5 movies.
2. Simulate an attack on a collaborative filtering system (e.g., profile injection) and observe how it affects recommendation outcomes.

UNIT-III

Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, discovering features of documents, obtaining item features from tags, representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

Practice:

1. Create item profiles using tags or text descriptions for a sample product dataset and compute similarity scores using TF-IDF.
2. Implement a constraint-based recommender (e.g., for travel packages or laptops) that filters items based on user-specified attributes.

UNIT-IV

Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta level, Limitations of hybridization strategies.

Practice:

1. Design a hybrid recommender combining content-based and collaborative filtering using a weighted method and evaluate its output.
2. Create a flowchart showing a pipelined hybrid recommender system using the cascade or meta-level strategy for book recommendations.

UNIT-V

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics. Recommender Systems and communities: Communities, collaboration and recommender systems in personalized web search, social tagging recommender systems, Trust and recommendations

Practice:

1. Evaluate a recommender system using RMSE, Precision, and Recall on historical rating data and interpret the results.
2. Analyze the role of trust in recommender systems by comparing recommendations from social tagging platforms vs. anonymous systems

Text Books:

1 Jannach D., Zanker M. andFelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.
2 Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.

Reference Books:

1 Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems for Learning, Springer (2013), 1st ed.

Web Links:

1 NPTEL, Websites etc. https://www.coursera.org/specializations/recommender systems.
2 MOOC on NPTEL :https://nptel.ac.in/courses/, NPTEL / Swayamwww.edx. com www.coursera.com

Time Series Analysis

Course Code: 2502AI20

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamentals of time series data, its internal structure, and various forecasting models and processes.
CO2: Analyse and visualize time series data using statistical techniques, transformations, and evaluate forecasting model performance.
CO3: Apply regression techniques to time series data including exponential smoothing, model adequacy checking, and forecasting future values.
CO4: Develop and implement ARMA, ARIMA, and seasonal ARIMA models, and evaluate their effectiveness in forecasting real-world datasets.
CO5: Explore multivariate time series models such as VAR and Vector ARIMA, and understand advanced forecasting approaches using neural networks, spectral and Bayesian analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	-	1
CO2	3	3	2	1	2	1
CO3	2	3	2	1	-	2
CO4	2	3	3	2	1	2
CO5	3	2	2	-	1	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	1	1
CO3	2	3
CO4	2	2
CO5	2	2

UNIT-I

Introduction of Timeseries Analysis: Introduction to Time Series and Forecasting, Different types of data, Internal structures of time series. Models for time series analysis, Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting, Forecasting Process, Data for forecasting, Resources for forecasting

Practice:

1. Identify and classify different time series components (trend, seasonality, noise) using real-world datasets such as stock prices or weather data.
2. Compute and interpret Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots for a time series dataset.

UNIT-II

Statistics Background For Forecasting: Graphical Displays, Time Series Plots, Plotting Smoothed Data, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments, General Approach to Time Series Modelling and Forecasting, Evaluating and Monitoring Forecasting Model Performance.

Practice:

1. Generate and interpret time series plots, histograms, and smoothed plots (e.g., using moving average or LOESS) for a given dataset.
2. Apply a Box-Cox transformation to a non-stationary time series and observe the effects on variance stabilization and normality.

UNIT-III

Time Series Regression Model: Introduction Least Squares Estimation in Linear Regression Models, Statistical Inference in Linear Regression, Prediction of New Observations, Model Adequacy Checking, Variable Selection Methods in Regression, Generalized and Weighted Least Squares, Regression Models for General Time Series Data, Exponential Smoothing, First order and Second order

Practice:

1. Fit a linear regression model on time series data and predict future values; check model adequacy using residual plots.
2. Implement exponential smoothing (single and double) and compare the forecasts with linear regression outputs**.**

UNIT-IV

Autoregressive Integrated Moving Average (Arima)Models: Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Detecting Nonstationary, Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA, Seasonal Data, Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models Introduction, Finding the "BEST" Model.

Practice:

1. Use ADF (Augmented Dickey-Fuller) test to check stationarity, difference the series accordingly, and fit an appropriate ARIMA(p,d,q) model.
2. Model and forecast seasonal data (e.g., monthly sales or temperature) using Seasonal ARIMA and evaluate the forecast accuracy.

UNIT-V

Multivariate Time Series Models And Forecasting: Multivariate Time Series Models and Forecasting, Multivariate Stationary Process, Vector ARIMA Models, Vector AR (VAR) Models, Neural Networks and Forecasting Spectral Analysis, Bayesian Methods in Forecasting.

Practice:

1. Fit a Vector Autoregression (VAR) model on multivariate time series data (e.g., GDP growth and inflation) and analyze interactions.
2. Build a neural network-based time series forecaster (e.g., using LSTM or simple feed-forward NN) and compare its performance with ARIMA.

TextBooks:

1	Introduction to Time Series Analysis and Forecasting, 2nd Edition, Wiley Series in Probability and Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015)
2	Master Time Series Data Processing, Visualization, and modelling Using Python Dr. Avishek PalDr. PksPrakash (2017)

Reference Books:

1	Time Series Analysis and Its Applications: With R Examples, Robert H. Shumway and David S. Stoffer, Springer, 4th Edition, ISBN: 978-3-319-52451-1

Web Links:

1	https://www.geeksforgeeks.org/machine-learning/time-series-analysis-and-forecasting/
2	https://onlinecourses.nptel.ac.in/noc21_ch28/preview

Data Wrangling Lab

Course Code: 2502AI04

L	T	P	C
1	0	2	3

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Read and process data from CSV, Excel, XML, and JSON files using Python libraries
- **CO2:** Apply data extraction techniques to parse content from PDF documents and spreadsheets using specialized libraries
- **CO3:** Perform data wrangling, cleaning, and insertion operations using Pandas and SQLite databases. .
- **CO4:** Analyse and manipulate datasets using statistical and exploratory tools like agate
- **CO5:** Create effective data visualizations and maps using matplotlib and pygal to interpret and communicate results.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	1
CO2	3	3	2	1	2	2
CO3	2	1	2	1	2	1
CO4	2	2	2	2	2	2
CO5	2	2	2	2	1	3

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	2	1
CO4	2	2
CO5	1	2

LIST OF EXPERIMENTS:

1. Write a Python script to read each row from a given csv file and print a list of strings.
2. Write a Python program to read a given CSV file as a dictionary.
3. Write a Python program to convert Python dictionary object (sort by key) to JSON data. Print the object members with indent level 4
4. Write the python script to Read the XML file
5. Write a Pandas program to import excel data (child labour and child marriage data.xlsx) into a Pandas data frame and process the following a. Get the data types of the given excel data b. Display the last ten rows. c. Insert a column in the sixth position of the said excel sheet and fill it with NaN values
6. Develop the python script to parse the pdf files using pdfminer.
7. Extract the Table from the child labour and child marriage data.xlsx using pdfables

library
8. Write a Python data wrangling scripts to insert the data into SQLite database
9. Develop the Python Shell Script to do the basic data cleanup on child labour and child marriagedata.xlsx a. Check duplicates and missing data b. Eliminate Mismatches c. Cleans line breaks, spaces, and special characters.
10. Import the data into `agate` then explores the table using agate methods and perform statistical correlations
11. Draw the chart between perceived corruption scores compared to the child labour percentages using matplotlib.
12. Write the python script to Map the Child Labour Worldwide using pygal.

Text Books:

1 Jacqueline Kazil& Katharine Jarmul," Data Wrangling with Python", O'Reilly Media, Inc,2016
2 Dr. TirthajyotiSarkar, Shubhadeep," Data Wrangling with Python: Creating actionable data from raw sources", Packt Publishing Ltd,2019.

Reference Books:

1 Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Wes McKinney, O'Reilly Media, 2nd Edition, ISBN: 978-1491957660

Web Links:

1 https://www.kaggle.com/code/ahmedashrafahmed/hands-on-practice-lab-data-wrangling
2 https://colab.research.google.com/github/dikoharyadhanto/Data-Analyst-Capstone-Project-Coursera/blob/main/M2DataWrangling_lab.ipynb

Machine Learning Algorithms

	L	T	P	C
Course Code: 2502AI05	2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Outline the Concepts of Machine Learning and Statistical Learning
CO2: Build Regression and Classification models for given data
CO3: Make use of ensemble learning techniques to improve the performance of a model
CO4: Apply clustering techniques on high dimensional data to group the similar entities
CO5: Implement neural network models using keras and tensor flow libraries

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	-	-	-	-
CO2	2	2	3	-	-	-
CO3	2	2	3	-	1	-
CO4	3	2	3	-	-	-
CO5	2	2	2	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Introduction- Artificial Intelligence, Machine Learning, Deep Learning, Types of Machine Learning Systems, Main Challenges of Machine Learning. Statistical Learning: Introduction, Supervised and Unsupervised Learning, Training and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator, Empirical Risk Minimization.

Practice:

1. Simulate Empirical Risk Minimization (ERM) on a simple dataset by minimizing squared error for a linear function.
2. Compare training and test loss on a dataset (e.g., Boston Housing) to demonstrate overfitting and underfitting with plots

UNIT – II

Supervised Learning(Regression/Classification):Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, Linear Models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Binary Classification: Multiclass/Structured outputs, MNIST, Ranking.

Practice:

1. Implement and compare Decision Tree, K-Nearest Neighbors, and Logistic Regression classifiers on the Iris dataset.
2. Apply Support Vector Machine (SVM) on the MNIST dataset and evaluate its performance using confusion matrix and accuracy.

UNIT – III

Ensemble Learning and Random Forests: Introduction, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking.Support Vector Machine: Linear SVM Classification, Nonlinear SVM Classification SVM Regression, Naïve Bayes Classifiers.

Practice:

1. Train Bagging, Random Forest, and Gradient Boosting models on a classification dataset and compare their performance metrics.
2. 2. Implement a Voting Classifier combining SVM, Naive Bayes, and Logistic Regression and test it on a binary classification dataset.

UNIT-IV

Unsupervised Learning Techniques: Clustering, K-Means, Limits of K-Means, Using Clustering for Image Segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures. Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA.

Practice:

1. Perform clustering on image data (e.g., digits) using K-Means and visualize clusters using PCA for dimensionality reduction.
2. Use DBSCAN and Gaussian Mixture Models on a synthetic 2D dataset and compare their clustering behavior visually.

UNIT – V

Neural Networks and Deep Learning: Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, Installing TensorFlow 2, Loading and Preprocessing Data with TensorFlow.

Practice:

1. Build and train a simple Multi-Layer Perceptron (MLP) using Keras on the Fashion MNIST dataset.

2. Use TensorFlow to load a custom dataset (CSV or image), preprocess it, and feed it into a neural network for classification.

Text Books:

1 Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019
2 Data Science and Machine Learning Mathematical and Statistical Methods,Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman,25th November 2020

Reference Books:

1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.
2 Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3 Andreas C. Müller and Sarah Guido "Introduction to Machine Learning with Python: A Guide for Data Scientists", Oreilly

Web Links:

1 https://www.deeplearning.ai/machine-learningyearning/
2 https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
3 https://onlinecourses.nptel.ac.in/noc21_cs24/preview
4 https://www.udemy.com/course/machinelearning/

Research Methodology

Course Code: 2502CE33

L	T	P	C
2	0	0	0

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamentals of identifying and formulating a research problem, along with appropriate methods for data collection, analysis, and instrumentation.
CO2: Apply ethical principles in research, conduct effective literature reviews, and develop well-structured research proposals and technical reports.
CO3: Understand the concepts of Intellectual Property (IP), including patents, copyrights, trademarks, and the international scenario of IP protection.
CO4: Analyse patent rights, licensing procedures, technology transfers, and utilize patent databases and information resources.
CO5: Explore recent developments in IPR, including biological systems, software, traditional knowledge, and understand their relevance through case studies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	1
CO2	3	3	2	1	2	2
CO3	2	1	2	1	2	1
CO4	2	2	2	2	1	2
CO5	2	2	2	2	1	3

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	2	1
CO4	2	2
CO5	1	2

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

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

UNIT–IV

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

UNIT–V

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 Research methodology: an introduction for science & engineering students,1st Edition, Stuart Melville, Wayne Goddard, 1996

Reference Books:

1 Research Methodology: A Step-by-Step Guide for beginners, 2nd Edition, Ranjit Kumar, 2011
2 Resisting Intellectual Property, 1st Edition, Halbert, Taylor & Francis Ltd., 2007

Web Links:

1 https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview

Big Data Analytics

	L	T	P	C
Course Code: 2502AI06	3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Illustrate big data challenges in different domains.
CO2: Use various techniques for mining data stream.
CO3: Demonstrate Building blocks of Hadoop.
CO4: Choose map reduce approach to solve big data Problems.
CO5: Make use of Pig and Hive to structure and work with big Data.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	1	2	-
CO2	2	3	-	1	2	-
CO3	2	1	-	3	2	-
CO4	3	2	-	2	2	-
CO5	2	3	-	2	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Introduction: Introduction to big data: Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

UNIT – II

Stream Processing: Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications.

UNIT – III

Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analyzing the Data with Hadoop, Scaling Out, Hadoop

Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

UNIT – IV

Pig: Hadoop Programming Made Easier: Admiring the Pig Architecture, Going with the Pig Latin Application Flow, working through the ABCs of Pig Latin, Checking out the Pig Script Interfaces, Scripting with Pig Latin. Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works with examples, Querying and Analyzing Data.

UNIT – V

Spark: Installing Spark, Spark applications, Jobs, stages and Tasks, Resilient Distributed data sets, Shared Variables, Anatomy of a Spark job run

Text Books:

1 Hadoop: The Definitive Guide, Tom White, 4 th Edition, O'reilly, 2012.
2 Hadoop for Dummies, Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk, BruceBrown, RafaelCoss, John Wiley & Sons, 2014.
3 Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP, 2012

Reference Books:

1 Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons, 2012.
2 Paul Zikopoulos, DirkdeRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, "Harness the Power of Big Data:The IBM Big Data Platform", Tata McGraw Hill Publications, 2012.
3 Arshdeep Bahga and Vijay Madisetti, "Big Data Science & Analytics: A Hands On Approach ", VPT, 2016.
4 Learning Spark: Lightning Fast Big Data Analysis Paperback, Holden Karau

Web Links:

1 Hadoop: http://hadoop.apache.org/
2 Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3 http://nptel.ac.in/courses/106106142/
4 https://hortonworks.com/tutorial/how-to-process-data-with-apache-hive/
5 https://databricks.com/spark/getting-started-with-apache-spark

COMPUTER VISION AND IMAGE PROCESSING

Course Code: 2502AI07

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Classify Image representations.
CO2: Apply Image transformation methods
CO3: Implement image processing algorithms.
CO4: Design the face detection and recognition algorithms.
CO5: Summarize information, knowledge about the objects in the scene.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	2	2	-	-	-
CO2	1	2	1	-	-	-
CO3	1	2	2	2	-	2
CO4	1	2	1	-	-	-
CO5	1	2	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	1	-
CO2	1	-
CO3	1	2
CO4	3	-
CO5	3	-

UNIT-I

Introduction about computer vision: Advantages and disadvantages of computer vision, general applications of computer vision, Feature detection and matching. Review of basics of Digital image processing

UNIT-II

The image model and acquisition, image shape, sampling, intensity images, color images,Range images, image capture, scanners. Statistical and spatial operations, Gray level transformations, histogram equalization, multi image operations.

Practice:
1. Image Arithmetic
2. Affine Transformation
3. Point Operations

UNIT-III

Spatially dependent transformations, templates and convolution, window operations, directional smoothing, other smoothing techniques. Segmentation and Edge detection, region Operations, Basic edge detection, second order detection, crack edge detection, edge following, gradient operators, compass & Laplace operators.

Practice:

1. Neighbourhood Operations
2. Image Histogram
3. Fourier Transform

UNIT – IV

Morphological and other area operations, basic morphological operations, opening and closing operations, area operations, morphological transformations. Image compression: Types and requirements, statistical compression, spatial compression, contour coding, quantizingcompression.

Practice:

1. Morphological Operations
2. Image Segmentation
3. Image Processing Test Bench

UNIT – V

Representation and Description, Object Recognition, 3-D vision and Geometry, Digital Watermarking. Texture Analysis

Practice:

1. Case studies of computer vision projects such as content-based image retrieval facerecognition etc

Text Books:

1 Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, 2nd Edition PearsonEducation. ISBN-13. 978-9332550117

2 Digital Image Processing and Computer Vision, Milan Soanka, Vaclav Hlavac and RogerBoyle, Cengage Learning. ISBN-13. 978-8131505557

3 Digital Image Processing, R.C. Gonzalez and R.E. Woods, 4th Edition, Pearson Education.ISBN-13, 978-9353062989

Reference Books:

1 "Computer Vision: Algorithms and Applications" by "Richard Szeliski" Springer. ISBN-13978-1848829343

2 "Fundamentals Of Machine Vision", by "Harley R. Myler" PHI Learning. ISBN 13: 9780819430496

3 "Computer Vision: A Modern Approach" by Forsyth David A., Ponce Jean, Prentice Hallof India, ISBN 13: 9788120323728

Web Links:

1 https://nptel.ac.in/courses/108103174/
2 https://cse19-iiith.vlabs.ac.in/

Deep Learning

Course Code: 2502AI08

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Demonstrate the mathematical foundation of neural network
CO2: Explain various machine learning algorithms and their importance for data analysis.
CO3: Illustrate the challenges and optimization strategies of deep neural network
CO4: Choose map reduce approach to solve big data Problems.
CO5: Build and train RNN and LSTMs using sequence modelling

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	-	2	1	-	2	-
CO2	-	2	1	-	2	-
CO3	-	2	-	3	1	-
CO4	2	2	3	-	1	-
CO5	1	2	3	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT-I

Linear Algebra: Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis. Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bayes' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.

Practice:

1. Perform Eigen decomposition and Singular Value Decomposition (SVD) on a given matrix using NumPy and interpret the results.
2. Apply Bayes' Theorem to a real-world classification example and compute mutual information between two discrete variables.

UNIT-II

Machine Learning: Basics and Underfitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning. Deep Feedforward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation, and other Differentiation Algorithms.

Practice:

4. Implement a simple neural network to solve the XOR problem using backpropagation and ReLU activation.
5. Demonstrate the impact of different learning rates and architectures on bias-variance trade-off using a synthetic dataset.

UNIT-III

Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. Optimization for Training Deep Models: Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.

Practice:

1. Implement L2 regularization and dropout on a neural network and observe their impact on training and test loss.
2. Compare Adam, RMSProp, and SGD optimizers on the same deep network and evaluate training convergence visually.

UNIT – IV

Convolutional Networks: The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolutional NetworkKS.

Practice:

1. Build a basic CNN using Keras to classify images from the CIFAR-10 dataset and visualize intermediate feature maps.
2. Experiment with different pooling strategies (max, average, global) and compare their effects on model performance.

UNIT – V

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs,

Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM, Gated RNNs, Optimization for Long- Term Dependencies, Auto enc

Practice:

2. Implement a simple LSTM-based sequence-to-sequence model for English-to-French translation using Keras.
3. Train a character-level RNN to generate text in the style of Shakespeare and analyze the impact of sequence length.

Text Books:

1 Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press.
2 Josh Patterson and Adam Gibson, "Deep learning: A practitioner's approach", O'Reilly Media, First Edition

Reference Books:

1 Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O'Reilly, Shroff Publishers.
2 Deep learning Cookbook, Practical recipes to get started Quickly, DouweOsinga, O'Reilly, Shroff Publishers.

Web Links:

1 https://keras.io/datasets/
2 http://deeplearning.net/tutorial/deeplearning.pdf
3 https://arxiv.org/pdf/1404.7828v4.pdf

Advanced Data Mining

Course Code: 2502AI21	L	T	P	C
	2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand data mining methodologies (CRISP-DM, SEMMA) and predictive modelling techniques including decision trees and Bayesian methods.
CO2: Apply frequent itemset generation and association rule mining algorithms like Apriori and FP-Growth and analyse data correlations.
CO3: Analyse advanced association mining with categorical/continuous data, sequential pattern mining, and frequent subgraph mining.
CO4: Implement and compare clustering techniques such as K-means, Hierarchical Clustering, and DBSCAN on various datasets.
CO5: Evaluate clustering algorithms, mine complex data types (text, spatial, graph), and apply preprocessing for real-world applications

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	-	-
CO2	3	-	2	2	-	-
CO3	2	-	3	3	-	-
CO4	2	-	3	3	-	-
CO5	3	2	2	2	2	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	3	3
CO4	2	2
CO5	3	2

UNIT-I

Data Mining Methodologies: CRISP-DM and SEMMA, Comparison of Data Mining Methodologies. Statistical Limits on Data Mining, Introduction to Predictive Analytics, Classification & Prediction: Predictive Modelling; Concepts, General Approach to solving a classification problem, - ZeroR, OneR, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Model Evaluation and Selection, Visualization techniques and experiments with weka.

Practice:

1. Use a dataset with student demographics and academic records to build and evaluate a model that classifies students as pass/fail
2. Build a decision tree and Naive Bayes classifier. Compare accuracy, precision, and recall.

UNIT-II

Association Analysis: Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm, Generating item sets and rules efficiently, Covariance and Correlation analysis.

Practice:

1. Given a transaction dataset from a retail store, generate frequent itemsets and association rules using Apriori and FP-Growth
2. Use a dataset of book purchases to find strong rules with minimum support 30% and confidence 70%. Interpret the top 5 rules.

UNIT-III

Advanced Concepts on Association Analysis: Handling Categorical and Continuous Attributes, handling a Concept Hierarchy, Sequential Patterns: Preliminaries, Sequential Pattern Discovery, Timing Constraints, Alternative Counting Schemes; Subgraph Patterns: Preliminaries: Frequent Subgraph Mining, Candidate Generation, Candidate Pruning, Support Counting

Practice:

1. Use sequential transaction data to find patterns like "if a user buys A → B → C".
2. Use molecular graph data to identify frequent substructures across compounds.

UNIT-IV

Clustering: Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center- Approach, DBSCAN Algorithm, Strengths and Weaknesses**.**

Practice:

1. Apply K-means on a dataset with GDP, literacy rate, and life expectancy to find similar countries.
2. Analyze the differences in clusters formed by DBSCAN vs. K-means and interpret their strengths.

UNIT-V

Cluster Analysis - Additional Issues and Algorithms: Cluster Evaluation, Characteristics of Data, Clusters, and Clustering Algorithms. (Tan &Vipin Kumar) Mining rich data types: Mining text data, Spatial-temporal data, Graph and networks Mining real data: preprocessing

data from a real medical domain, data mining techniques to create a comprehensive and accurate model of data.

Practice:

1. Use TF-IDF to vectorize text and apply K-means to group articles into topics like politics, sports, technology.
2. Use a preprocessed medical dataset (e.g., patient symptoms and diagnoses) to build a predictive model using classification or clustering.

Text Books:

1	Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, AnujKarpatne, Vipin Kumar, 2nd edition
2	Data Mining: Concepts and Techniques, J. Han and M. Kamber, Morgan Kaufmann C.J. Date, Database Systems, Pearson, 4th edition

Reference Books:

1	Fundamentals of Data Warehouses, 2nd edition,Jarke, Lenzerini, Vassiliou, Vassiliadis, Springer

Web Links:

1	https://nptel.ac.in/courses/106105174/
2	http://cse20-iiith.vlabs.ac.in/

Quantum Computing

Course Code: 2502AI22

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamental concepts and principles of quantum mechanics relevant to quantum computing.
CO2: Analyze and design quantum logic gates and circuits..
CO3: Apply key quantum algorithms and understand their advantages over classical algorithms.
CO4: Comprehend the impact of decoherence and the mechanisms for quantum error correction.
CO5: Explore quantum computing platforms, write basic quantum programs, and identify real-world applications

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	-	-
CO2	3	2	2	2	-	-
CO3	3	2	3	2	-	1
CO4	2	2	3	2	-	-
CO5	2	2	2	3	-	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	3	2
CO5	2	2

UNIT – I

Introduction to Quantum Computing: Classical vs Quantum computation, Need and scope, quantum computing , History of quantum computing, Basic quantum mechanics: Qubits, Superposition, Entanglement, Quantum bits vs Classical bits, Quantum States and Bra-Ket Notation, Quantum postulates

Practice:

1. Explain the differences between classical bits and qubits using the concepts of superposition and entanglement
2. Represent the state $|\psi\rangle = (1/\sqrt{2})|0\rangle + (1/\sqrt{2})|1\rangle$ using bra-ket notation and normalize it

UNIT – II

Quantum gates: Pauli-X, Pauli-Y, Pauli-Z, Hadamard gate, Phase gate, T gate, Unitary transformations, multi-qubit gates: CNOT gate, Toffoli gate, Fredkin gate, Quantum circuit

representation, Measurement in quantum systems, Circuit equivalences and simplification.

Practice:

1. Apply a Hadamard gate followed by a Pauli-X gate to the |0⟩ state. What is the resulting state?
2. Construct a quantum circuit using CNOT and Toffoli gates to implement a 3-bit controlled-NOT operation

UNIT – III

Quantum parallelism: Deutsch's Algorithm, Simon's Algorithm, Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Fourier Transform, Applications of quantum algorithms.

Practice:

1. Explain how Deutsch's algorithm solves the problem of determining whether a function is constant or balanced with a single evaluation
2. Given an unstructured database of 16 elements, calculate the number of iterations needed by Grover's algorithm to find a target element.

UNIT – IV

Sources of quantum noise: Decoherence in quantum systems, Quantum error correction codes: Bit flip code, Phase flip code, Shor code, Steane code, Fault-tolerant quantum computing, Quantum threshold theorem.

Practice:

1. Describe how a 3-qubit bit-flip code detects and corrects a single bit-flip error.
2. Explain the impact of decoherence on a quantum system and how quantum error correction helps mitigate it.

UNIT – V

Quantum programming languages: Qiskit and Cirq, Quantum simulation basics, Physical realizations of quantum computers: Ion traps, Superconducting qubits, Topological qubits, Applications in cryptography, optimization, machine learning, and quantum chemistry, Future directions and challenges in quantum computing**.**

Practice:

1. Write a Qiskit code to create a Bell state and measure the output in the standard basis.
2. Explain how quantum computing can be applied to machine learning or optimization problems with a relevant example.

Text Books:

1 Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 10th Anniversary Edition, 2010.

2 Quantum Mechanics: The Theoretical Minimum, Leonard Susskind and Art Friedman, Basic Books, 2014.

Reference Books:

1 Quantum Computing: An Applied Approach, Jack D. Hidary, Springer, 2nd Edition, 2021.
2 Quantum Computing for Computer Scientists, Noson S. Yanofsky and Mirco A. Mannucci, Cambridge University Press, 2008.
3 Quantum Computation, Phillip Kaye, Raymond Laflamme, and Michele Mosca, Oxford University Press, 2007.
4 Programming Quantum Computers: Essential Algorithms and Code Samples, Eric R. Johnston, Nic Harrigan, Mercedes Gimeno-Segovia, O'Reilly Media, 2019.

Web Links:

1 https://onlinecourses.nptel.ac.in/noc25_cs95/preview
2 https://nptel.ac.in/courses/106106232

Soft Computing

Course Code: 2502AI23

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Elaborate fuzzy logic to handle uncertainty in engineering problems.
CO2: Make use of genetic algorithms to combinatorial optimization problems.
CO3: Distinguish artificial intelligence techniques, search heuristics, knowledge representation, planning and reasoning.
CO4: Illustrate and apply the principles of self-adopting and self-organizing neuro fuzzy inference systems.
CO5: Choose appropriate soft computing approach for a given problem.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	-	-	-	-
CO3	1	2	1	2	-	-
CO4	2	1	1	-	-	-
CO5	2	1	1	3	1	-

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	-	2
CO4	1	-
CO5	1	-

UNIT – I

Fuzzy Set Theory: Introduction to Neuro, Fuzzy and Soft Computing, Fuzzy Sets, Basic function and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

Practice:
1. Fuzzy Membership Function Formulation
2. Fuzzy Inference System Design using Tsukamoto Fuzzy Models.

UNIT – II

Optimization: Derivative based Optimization, Descent Methods, and The Method of Steepest

Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, and Random Search.

Practice:

1. Gradient Descent for Minimizing a Simple Quadratic Function
2. Simulated Annealing for Solving the Traveling Salesman Problem (TSP)

UNIT – III

Artificial Intelligence: Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Prepositional and Predicate Calculus Rule Based knowledge Representation, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent-directed Search Production System and Learning.

Practice:

1. Implementing Propositional Logic in a Rule-Based Knowledge Representation System
2. Heuristic Search in a Maze Using a Simple Graph Search Algorithm

UNIT – IV

Neuro Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference Systems, Architecture Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN Coactive Neuro Fuzzy Modeling.

Practice:

1. Implementing a Basic Adaptive Neuro-Fuzzy Inference System (ANFIS)
2. Neuro-Fuzzy Coactive Modeling for Classification

UNIT – V

Applications of Computational Intelligence: Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Coloripe Prediction.

Practice:

1. Printed Character Recognition using Neural Networks
2. Automobile Fuel Efficiency Prediction using Fuzzy Logic

Text Books:

1 Neuro-Fuzzy and Soft Computing, J.S.R.Jang, C.T.Sun and E.Mizutani, PHI Pearson Education ISBN-13 :978-0132610667

2 Artificial Intelligence by Saroj Koushik, Cengage Learning. ISBN : 9789355730428

3 Artificial Intelligence and Intelligent System, N.P.Padhy, Oxford University Press ISBN: 978-0195671544

Reference Books:

1 Artificial Intelligence, Second Edition, Elaine Rich & Kevin Knight, Tata McGraw Hill Publishing Comp., New Delhi ISBN: 0074600818

Web Links:

1 https://nptel.ac.in/courses/106105173/
2 https://cse.iitkgp.ac.in/~dsamanta/courses/archive/sca/Slides.htm/

AI Chatbots

Course Code: 2502AI24

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamental concepts of database systems.
CO2: Design and implement relational databases.
CO3: Formulate queries using SQL
CO4: Apply normalization techniques for database design.
CO5: Comprehend transaction management and concurrency control mechanisms

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	-	-
CO2	3	-	2	2	-	-
CO3	2	-	3	-	-	-
CO4	3	-	2	-	-	-
CO5	3	-	2	2	-	-

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	2

UNIT-I

Introduction: Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape, Identifying the Sources of Data: Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

Practice:

1. List and explain three benefits businesses gain from implementing chatbots in financial services or insurance.
2. Explain how GDPR impacts chatbot development, especially when handling personal user data

UNIT-II

Chatbot Development Essentials: Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in

Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

Practice:

1. Differentiate between Rules-Based and AI-Based chatbot approaches with examples.
2. Define the terms: Utterance, Intent, Entity. Create one example for each using an insurance-related use case.

UNIT-III

Building a Chatbot Solution: Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots

Practice:

1. Compare chatbots with mobile apps in terms of user engagement and business cost.
2. Identify and explain at least three metrics used to evaluate chatbot success.

UNIT-IV

Natural Language Processing: Understanding, and Generation: Chatbot Architecture, Popular Open-Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

Practice:

1. Explain the differences between Natural Language Understanding (NLU) and Natural Language Generation (NLG) with examples.
2. List any two open-source NLP/NLU tools and describe their roles in chatbot development.

UNIT-V

Introduction to Microsoft Bot: RASA, and Google Dialogflow: Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialogflow Chatbot Integration Mechanism: Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

Practice:

1. Compare Microsoft Bot Framework and RASA in terms of features and use cases.
2. Explain how a chatbot can be integrated with a third-party API and an enterprise data store. Give an example scenario

Text Books:

1 Abhishek Singh, Karthik Ramasubramanian, Shrey Shivam, “Building an Enterprise Chatbot: Work with Protected Enterprise Data Using Open Source Frameworks”, ISBN 978-1-4842-5034-1, Apress,2019 JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA KAKINADA – 533 003, Andhra Pradesh, India

Reference Books:

1 Janarthanam and Srini, Hands-on chatbots and conversational UI development: Build chatbots and voice user interfaces with C (1 ed.), Packt Publishing Ltd, 2017. ISBN 978-1788294669.
2 Galitsky, Boris., Developing Enterprise Chatbots (1 ed.), Springer International Publishing, 2019. ISBN 978-303004298
3 Kelly III, John E. and Steve Hamm, Smart machines: IBM's Watson and the era of cognitive computing (1 ed.), Columbia University Press, 2013. ISBN 978-0231168564.
4 Abhishek Singh, Karthik Ramasubramanian and Shrey Shivam, Building an Enterprise Chatbot (1 ed.), Springer, 2019. ISBN 978-1484250334.

Web Links:

1 https://onlinecourses.nptel.ac.in/noc22_ge29/preview
2 https://www.geeksforgeeks.org/nlp-vs-nlu-vs-nlg/
3 https://dev.botframework.com/

NOSQL Databases

Course Code: 2502AI25

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamental concepts and need for NoSQL databases in modern data management.
CO2: Differentiate various types of NoSQL databases such as key-value, document, column-family, and graph databases.

CO3: Design and implement CRUD operations in NoSQL environments using MongoDB and other popular platforms.

CO4: Analyze consistency, availability, and partition tolerance in distributed NoSQL systems using the CAP theorem.
CO5: Evaluate the performance, scalability, and use-cases of different NoSQL databases in real-world applications

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	2	-	-	-
CO3	3	3	3	2	-	1
CO4	2	3	2	3	-	1
CO5	2	2	3	3	2	-

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	3	3
CO4	3	2
CO5	2	2

UNIT – I

Introduction to NoSQL: Overview of traditional RDBMS vs. NoSQL, characteristics and advantages of NoSQL, types of NoSQL databases – Key-value, Document, Column-family, and Graph. Use-cases and industry trends

Practice:

1. Compare RDBMS and NoSQL in terms of scalability, schema design, and data models. Provide examples.
2. Classify the four types of NoSQL databases (Key-Value, Document, Column-Family, Graph) and suggest one real-world use case for each.

UNIT – II

Key-Value and Document Databases: Design and implementation using Redis and MongoDB. Data modeling techniques, indexing, querying, and aggregation. MongoDB shell and CRUD operations. Schema-less data handling

Practice:

1. Perform CRUD operations in MongoDB for a product catalog (insert, find, update, delete). Use appropriate JSON documents.
2. Design a Redis key-value store to manage a user session system for a web application. Explain key structure and value types**.**

UNIT – III

Column-Family and Graph Databases: Introduction to Cassandra and HBase, data modeling and partitioning. Introduction to Graph databases like Neo4j. Graph theory concepts – nodes, relationships, properties, and Cypher query language

Practice:

1. Model a column-family database in Cassandra for an online learning platform storing courses and student interactions.
2. Using Neo4j and Cypher, write a query to find mutual friends between two users in a social network**.**

UNIT – IV

Distributed NoSQL Systems: Replication and sharding, Consistency and Availability trade-offs, CAP theorem, Eventual consistency. BASE vs. ACID. Case studies on distributed NoSQL architectures.

Practice:

1. **Explain the CAP theorem with respect to Cassandra. Identify which two properties Cassandra prioritizes and why.**
2. **Differentiate between BASE and ACID. Give one real-world scenario where BASE is more suitable.**

UNIT – V

Advanced Topics and Applications: Performance tuning and benchmarking NoSQL databases. Integration with big data tools like Hadoop and Spark. Security and access control. Real-time applications: IoT, social media analytics, recommendation systems.

Practice:

1. Explain how a NoSQL database like MongoDB can be integrated with Spark for real-time analytics.
2. Describe how NoSQL is used in a recommendation system (e.g., for an e-commerce platform). What type of NoSQL database is best suited and why?

Text Books:

1 NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – Pramod J. Sadalage and Martin Fowler, Addison-Wesley.
2 Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement – Eric Redmond, Jim R. Wilson, Pragmatic Bookshelf.

Reference Books:

1 Professional NoSQL – Shashank Tiwari, Wiley India.
2 MongoDB: The Definitive Guide – Kristina Chodorow, O'Reilly Media.

Web Links:

1 https://www.mongodb.com/university
2 https://cassandra.apache.org/
3 https://neo4j.com/
4 https://nptel.ac.in/courses/106/106/106106221/

Reinforcement Learning

Course Code: 2502AI26

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO 1: Understand basic concepts of Reinforcement learning.
CO 2: Identifying appropriate learning tasks for Reinforcement learning techniques.
CO 3: Implement and apply adversarial training techniques to train GAN models.
CO 4: Analyse the applications of VAEs in various domains such as image generation, anomaly detection, and data imputation.
CO 5: Evaluate the ethical considerations and societal impact of reinforcement learning and generative AI technologies.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	-	-	2	-
CO2	2	2	-	-	-	-
CO3	3	2	-	-	-	-
CO4	3	2	1	-	-	-
CO5	2	1	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	1
CO3	3	1
CO4	2	-
CO5	3	1

UNIT-I

Basics of reinforcement learning (RL): RL components: agents, environments, rewards Markov Decision Processes (MDPs), Exploration vs. Exploitation dilemma, Basic algorithms: Q-learning, SARSA, Monte-Carlo (MC) Learning, Temporal-Difference (TD) Learning, TD-Lambda and Eligibility Traces

Practice:
1. Installation of TensorFlow and implement the basic programs.
2. Installation of PYTORCH and implement the basic programs.

UNIT-II

Advanced Reinforcement Learning Techniques: Deep Q-Networks (DQN), Policy Gradient methods, Actor-Critic architectures, Advantage Actor-Critic (A2C) and Proximal Policy

Optimization (PPO), Continuous action spaces and algorithms like Deep Deterministic Policy Gradient (DDPG)

Practice:

1. Implement a simple grid world environment where an agent learns to navigate from a starting point to a goal while avoiding obstacles.
2. Train an agent to balance a pole on a cart using discrete actions such as pushing the cart left or right.

UNIT-III

Generative Adversarial Networks (GANs): Introduction to generative models, Basics of GANs: generator, discriminator ,Training GANs: adversarial training ,Variants of GANs: Conditional GANs, Wasserstein GANs, etc, Applications of GANs in image generation, style transfer, and data augmentation

Practice:

1. Model an agent learning to drive a car up a steep mountain by applying the correct amount of throttle and braking.
2. Train an agent to play the classic game of Pong, where it learns to control a paddle to hit a ball back to the opponent while preventing it from reaching its own side.

UNIT-IV

Variational Autoencoders (VAEs): Introduction to autoencoders , Variational inference and latent variable models ,Encoder and decoder architectures in VAEs , Training VAEs: maximizing evidence lower bound (ELBO) , Applications of VAEs in image generation, anomaly detection, and data imputation.

Practice:

1. Use deep reinforcement learning to train an agent to play various Atari games, such as Breakout, Space Invaders, or Pac-Man.
2. Experiment with different strategies for solving the multi-armed bandit problem, where an agent must decide which arm of a slot machine to pull to maximize cumulative reward.
3. Design an agent to control traffic lights at intersections to optimize traffic flow and reduce congestion.

UNIT-V

Advanced Topics in Reinforcement Learning and Generative AI: Model-based RL and world models, multi-agent reinforcement learning, Transfer learning and meta-learning in RL, Adversarial attacks and defences in generative models, Ethical considerations and societal impact of RL and generative AI

Practice:

1. Train an agent to play Flappy Bird, a side-scrolling game where the agent controls the flight of a bird through a series of pipes.
2. Develop an agent capable of playing Tic-Tac-Toe optimally against a human opponent or another agent.

3. Simulate a colony of ants foraging for food in a dynamic environment, where the agent learns to find and retrieve food while avoiding obstacles and predators.

Additional Practice:

1. Train a robotic arm to perform various tasks, such as reaching a target location or manipulating objects, using reinforcement learning.
2. Develop a trading agent that learns to make profitable trades in financial markets by analysing historical data and adapting its trading strategy over time

Text Books:

1 R. S. Sutton and A. G. Bart,. "Reinforcement Learning - An Introduction," MIT Press, 2018

Reference Books:

1 Szepesvári, Csaba, "Algorithms for Reinforcement Learning," United States: Morgan &
Claypool, 2010.
2 Puterman, Martin L., "Markov Decision Processes: Discrete Stochastic Dynamic Programming," Germany: Wiley, 2014

Web Links:

1 https://onlinecourses.nptel.ac.in/noc20_cs74/preview
2 https://www.coursera.org/learn/fundamentals-of-reinforcement-learning

Mean Stack Technologies

Course Code: 2502AI09	L	T	P	C
	1	0	2	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Build static web pages using HTML5.
CO2: Apply JavaScript to embed programming interface for web pages
CO3: Build a basic web server using Node.js, NPM and Express.js.
CO4: Apply typescript for strict typing in applications and perform CRUD operations using MongoDB.
CO5: Develop responsive web pages using Angular.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	-	1	-
CO2	2	2	2	-	1	-
CO3	1	2	2	-	3	-
CO4	2	2	2	1	3	-
CO5	2	2	2	1	3	-

Mapping of course outcomes with program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT-I

HTML 5: Introduction to Web, Overview of Web Technologies, HTML - Introduction, HTML - Need, Case- insensitivity, Platform-independency, DOCTYPE Declaration, Types of Elements, HTML Elements - Attributes, Metadata Element, Sectioning Elements, Paragraph Element, Division and Span Elements, List Element, Link Element, Character Entities, HTML5 Global Attributes, Creating Table Elements, Table Elements : Colspan/Rowspan Attributes, border, cellspacing and cellpadding attributes, Creating Form Elements, Input Elements - Attributes, Color and Date Pickers, Select and Datalist Elements, Editing Elements, Media, Iframe, Why HTML Security, HTML Injection, Clickjacking, HTML5 Attributes & Events Vulnerabilities, Local Storage Vulnerabilities, HTML5 - Cross-browser support, Best Practices For HTML Web Pages.

Practice:
1. Create a registration form using HTML5 with fields like name, email, date of birth, gender (radio), and a submit button. Use proper input types and form elements.
2. Design an HTML5 table to display student records with attributes like name, roll number, and marks. Apply rowspan and colspan where appropriate.

UNIT-II

Javascript: Why we need JavaScript, What is JavaScript, Environment Setup, Working with Identifiers, Type of Identifiers, Primitive and Non Primitive Data Types, Operators and Types of Operators, Types of Statements, Non - Conditional Statements, Types of Conditional Statements, If and Switch Statements, Types of Loops, Types of Functions, Declaring and Invoking Function, Arrow Function, Function Parameters, Nested Function, Built-in Functions, Variable Scope in Functions, Working With Classes, Creating and Inheriting Classes, In-built Events and Handlers, Working with Objects, Types of Objects, Creating Objects, Combining and cloning Objects using Spread operator, Destructuring Objects, Browser and Document Object Model, Creating Arrays, Destructuring Arrays, Accessing Arrays, Array Methods, Introduction to Asynchronous Programming, Callbacks, Promises

Practice:

1. Write a JavaScript program using functions and arrow functions to calculate and return the factorial of a number entered by the user.
2. Create an object representing a student and use object destructuring and spread operator to clone and modify the object. Also, use an array of students and apply array methods (map, filter) on it

UNIT-III

Node.js: Why and What Node.js, How to use Node.js, Create a web server in Node.js, Node Package Manager, Modular programming in Node.js, Restarting Node Application, File Operations.
Express.js: Express Development Environment, defining a route, Handling Routes, Route and Query Parameters, How Middleware works, Chaining of Middlewares, Types of Sessions, Why and What Security, Helmet Middleware, Using a Template Engine Middleware, Stylus CSS Preprocessor.

Practice:

1. Build a basic Node.js application with Express.js that has two routes: / for home and /about for about page. Use query parameters and route parameters.
2. Create a file upload handler using Express middleware. Include usage of helmet for security and configure a template engine like pug or ejs.

UNIT-IV

Typescript: Installing TypeScript, Basics of TypeScript, Function, Parameter Types and Return Types, Arrow Function, Function Types, Optional and Default Parameters, Rest Parameter, Creating an Interface, Duck Typing, Function Types, Extending Interfaces, Classes, Constructor, Access Modifiers, Properties and Methods, Creating and using Namespaces, Creating and using Modules, Module Formats and Loaders, Module Vs Namespace, What is Generics, What are Type Parameters, Generic Functions, Generic Constraints. MongoDB: Introduction Module Overview, Document Database Overview, Understanding JSON, MongoDB Structure and Architecture, MongoDB Remote Management, Installing MongoDB on the local computer (Mac or Windows), Introduction to MongoDB Cloud, Create MongoDB Atlas Cluster, GUI tools Overview, Install and Configure MongoDBCompass, Introduction to the MongoDB Shell, MongoDB Shell JavaScript Engine, MongoDB Shell JavaScript Syntax, Introduction to the MongoDB Data Types, Introduction to the CRUD Operations on documents, Create and Delete Databases and Collections, Introduction to MongoDB Queries.

Practice:

1. Write a TypeScript program that uses a class Car with properties, constructor, access modifiers, and a method to return car details. Also, use a generic function to log any type of input.
2. Using MongoDB shell or Compass, perform CRUD operations (Create, Read, Update, Delete) on a products collection. Include at least one example of a query using a filter condition.

UNIT-V

What is Angular, Features of Angular, Angular Application Setup, Components and Modules, Executing Angular Application, Elements of Template, Change Detection, Structural Directives - ngIf, ngFor, ngSwitch, Custom Structural Directive, Attribute Directives - ngStyle, ngClass, Custom Attribute Directive, Property Binding, Attribute Binding, Style and Event Binding, Built in Pipes, Passing Parameters to Pipes, Nested Components Basics, Passing data from Container Component to Child Component, Passing data from Child Component to Container Component, Shadow DOM, Component Life Cycle, Template Driven Forms, Model Driven Forms or Reactive Forms, Custom Validators in Reactive Forms, Custom Validators in Template Driven forms, Dependency Injection,Services Basics,RxJS Observables, Server Communication using HttpClient, Communicating with different backend services using Angular HttpClient, Routing Basics, Router Links, Route Guards, Asynchronous Routing, Nested Routes

Practice:

1. Create an Angular component that uses ngIf, ngFor, and property binding to display a list of products. Include a button to toggle display using event binding.
2. Build a reactive form with Angular that includes fields for username and email. Add custom validation for email format and required fields. Show appropriate validation messages.

Text Books:

1 Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson
2 Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly
3 Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.

Reference Books:

1 HTML and CSS: Design and Build Websites, Jon Duckett, Wiley, ISBN: 978-1118008188
2 JavaScript: The Definitive Guide, David Flanagan, O'Reilly, ISBN: 978-1491952023

Web Links:

1 https://nodejs.org/docs/latest/api/
2 https://expressjs.com/

Internet Of Things Theory and Practice

	L	T	P	C
Course Code: 2502AI10	2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain in a concise manner how the general Internet as well as Internet of Things work.
CO2: Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
CO3: Use basic sensing and measurement and tools to determine the real-time performance of network of devices.
CO4: Develop prototype models for various applications using IoT technology
CO5: Explain in a concise manner how the general Internet as well as Internet of Things work

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	-	-	-
CO2	2	3	1	2	-	-
CO3	2	3	-	2	-	-
CO4	2	3	1	2	-	-
CO5	2	3	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	1	-
CO4	1	-
CO5	2	-

UNIT – I

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles for Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet

Practice:
1. List and explain three real-world IoT applications. For each, describe the sensors/devices involved and how they communicate.
2. Compare HTTP, HTTPS, FTP, and Telnet in terms of use cases, security, and suitability for IoT devices.

UNIT – II

Business Models for Business Processes in the Internet of Things ,IoT/M2M systems

LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High- level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

Practice:

1. Explain the modified OSI stack for IoT/M2M systems and how it differs from the traditional OSI model.
2. Identify the ETSI M2M domains and describe how device management and affordability influence the design of IoT systems.

UNIT – III

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

Practice:

1. Differentiate between web communication protocols (HTTP/CoAP) and message communication protocols (MQTT/AMQP) in IoT applications.
2. Design a communication flow diagram for a smart home IoT device communicating with a web server. Indicate the protocols used.

UNIT – IV

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

Practice:

1. Describe how IoT data is acquired and organized for analytics. Give an example of a business process that benefits from this data.
2. Create a simple data flow for a smart agriculture system showing how sensor data is acquired, stored, and used in analytics.

UNIT – V

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory
Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World

Practice:

1. Compare different cloud service models (IaaS, PaaS, SaaS) in the context of IoT applications. Give one example each.
2. Explain the role of sensors, RFID, and wireless sensor networks in enabling participatory sensing in smart city applications.

Text Books:

1 Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
2 Internet of Things, A.Bahgya and V.Madisetti, Univesity Press,2015

Reference Books:

1 Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer, ISBN: 978-3642191565
2 Internet of Things: Principles and Paradigms, Rajkumar Buyya, Amir Vahid Dastjerdi, Elsevier, ISBN:978-0128053959

Web Links:

1 https://www.geeksforgeeks.org/computer-networks/introduction-to-internet-of-things-iot-set-1/
2 https://onlinecourses.nptel.ac.in/noc25_cs147/preview

Value Education

Course Code: 2502CE32	L	T	P	C
	2	0	0	0

Course Outcomes:
At the end of the Course, Student will be able to:

CO 1: Understand value of education and self- development.
CO 2: Explain the need of good values in students.
CO 3: Developing the overall personality.
CO 4: Explain the need of character in a student.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	2	-
CO2	3	2	1	1	3	-
CO3	3	3	2	2	2	-
CO4	2	1	1	1	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

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

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity oflabour, Universal brotherhood and religious

tolerance, True friendship

UNIT – IV

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, Scienceof reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, mind your Mind, Self-control, Honesty, Studying effectively.

Text Books:

1 Chak ro borty, S.K. "Values and Ethics for organizations Theory and practice", OxfordUniversity Press, New Delhi. (ISBN: 9780195643077)

Reference Books:

1 Value Education and Professional Ethics by R.P. Shukla ISBN: 978-8183560995
2 Value Education: A Textbook for Schools by Dr. N. Venkataiah ISBN: 978-8120731965
3 Value Education: Theory and Practice by G. Rajagopal ISBN: 978-8182475191

Web Links:

1 https://nptel.ac.in/courses/109/104/109104068/
2 https://nptel.ac.in/courses/109/105/109105116/
3 https://nptel.ac.in/courses/109/105/109105116/

Exploratory Data Analysis (EDA)

Course Code: 2502AI27

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the role of EDA in the data science lifecycle and identify data types.
CO2: Perform data cleaning techniques such as handling missing values, detecting and treating outliers..
CO3: Apply descriptive statistics and data transformation for data summarization.
CO4: Use visualization techniques to explore patterns and relationships within the data.
CO5: Develop EDA pipelines using Python libraries such as Pandas, Matplotlib, and Seaborn.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2				
CO2	3	2	2			
CO3	3	2	3	2		
CO4	2	2	3	2		1
CO5	2	2	2	3	2	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	3	2
CO5	2	2

UNIT – I

Introduction to EDA: Importance of EDA in data science. Understanding variable types – numerical, categorical, ordinal. Overview of the data science pipeline

Practice:

1. Explain the role of EDA in the data science pipeline. Why is it a critical first step before modeling?
2. Classify the following variables into numerical, categorical, or ordinal: income, blood group, education level, temperature. Justify your classification.

UNIT – II

Data Cleaning and Transformation: Missing values – detection and imputation. Outlier detection techniques – IQR, Z-score. Data transformation – normalization and scaling

Practice:

1. Given a dataset with missing values in the 'Age' and 'Salary' columns, demonstrate how to detect and impute missing values using mean and median methods.
2. Apply Z-score and IQR techniques to detect outliers in a numeric column of a dataset. Compare the results.

UNIT – III

Descriptive Statistics and Summary Measures: Mean, median, mode, variance, standard deviation. Frequency distributions. Quantiles and percentiles. Correlation and covariance.

Practice:

1. Calculate and interpret the mean, median, mode, variance, and standard deviation for a list of exam scores.
2. Given a dataset with two numerical columns (e.g., height and weight), compute and interpret the correlation and covariance between them.

UNIT – IV

Visualization Techniques: Histograms, bar plots, box plots, scatter plots, pair plots. Python visualization tools – Matplotlib, Seaborn. Data profiling reports using pandas_profiling, sweetviz.

Practice:

1. Use Matplotlib or Seaborn to create a box plot and histogram for a numerical column (e.g., age or income) from a dataset. Interpret the insights.
2. Create a pair plot using Seaborn for a dataset with at least three numerical features. What relationships or patterns do you observe?

UNIT – V

EDA in Python (Hands-on): Pandas for data manipulation, visualization with Seaborn/Matplotlib, case studies on real-world datasets (e.g., Titanic, IPL, Healthcare).

Practice:

1. Perform EDA on the Titanic dataset using Pandas and Seaborn. Identify key insights about survival rate based on gender and passenger class.
2. Generate an automated data profiling report using pandas_profiling or sweetviz on the IPL dataset. List three insights you obtained from the report.

Text Books:

1 Python for Data Analysis – Wes McKinney, O'Reilly
2 Practical Statistics for Data Scientists – Peter Bruce, Andrew Bruce, O'Reilly.

Reference Books:

1 Data Wrangling with Pandas – Jacqueline Kazil.

2 Storytelling with Data – Cole Nussbaumer Knaflic.

Web Links:

1 https://www.kaggle.com/learn/pandas
2 https://archive.nptel.ac.in/courses/106/106/106106212/

Multivariate Analysis

Course Code: 2502AI28

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the structure and representation of multivariate data.
CO2: Analyse correlation, covariance, and multicollinearity in multivariate datasets.
CO3: Apply dimension reduction techniques such as PCA, LDA, and Factor Analysis.
CO4: Perform multivariate regression and classification techniques on real-world data.
CO5: Conduct clustering and evaluate performance of unsupervised learning algorithms.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2				
CO2	3	2	2			
CO3	3	2	3	2		1
CO4	2	2	3	2		1
CO5	2	2	2	3	2	

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	3	2
CO4	3	2
CO5	2	2

UNIT – I

Multivariate Data Basics: Types of multivariate data, data structures, measurement levels, data visualization in high dimensions.

Practice:

1. List and describe different types of multivariate data structures (e.g., data matrix, dissimilarity matrix). Provide one real-life example for each.
2. Explain how high-dimensional data can be visualized using pair plots or dimensionality reduction techniques. Apply one such method to a dataset.

UNIT – II

Correlation and Covariance: Covariance matrix, correlation matrix, partial correlation. Multicollinearity – causes, detection (VIF), and remedies

Practice:

1. Given a dataset with three numerical variables, compute the covariance matrix and correlation matrix. Interpret the results.
2. Explain what multicollinearity is. Given a regression dataset, calculate the VIF (Variance Inflation Factor) for each variable and identify multicollinearity issues.

UNIT – III

Dimension Reduction Techniques: Principal Component Analysis (PCA), Eigen decomposition, scree plot, explained variance. Linear Discriminant Analysis (LDA). Factor Analysis – orthogonal vs oblique rotation.

Practice:

1. Perform Principal Component Analysis (PCA) on a dataset. Plot the scree plot and explain how many components to retain based on explained variance.
2. Differentiate between PCA and LDA in terms of their objectives. Apply LDA to a dataset with labeled classes and interpret the transformation

UNIT – IV

Multivariate Regression and Classification: Multiple linear regression, logistic regression, assumptions, model diagnostics, residual analysis.

Practice:

1. Fit a multiple linear regression model on a dataset. Check for assumptions using residual plots and interpret the diagnostic results.
2. Apply logistic regression to a binary classification problem. Evaluate the model using accuracy and confusion matrix.

UNIT – V

Clustering and Applications: K-Means, Hierarchical Clustering, DBSCAN. Evaluation methods – silhouette score, confusion matrix (for classification). Case studies using R/Python.

Practice:

1. Perform K-Means and Hierarchical Clustering on a dataset. Use the silhouette score to determine the optimal number of clusters.
2. Apply DBSCAN on a dataset with noise/outliers. Compare results with K-Means and explain when DBSCAN is preferable.

Text Books:

1 Applied Multivariate Statistical Analysis – Richard A. Johnson, Dean W. Wichern.
2 Multivariate Data Analysis – Hair, Black, Babin, Anderson, Pearson Education.

Reference Books:

1 An Introduction to Statistical Learning – Gareth James, Daniela Witten.
2 The Elements of Statistical Learning – Hastie, Tibshirani, Friedman.

Web Links:

1 https://nptel.ac.in/courses/111/104/111104135/
2 https://scikit-learn.org/stable/modules/classes.html

Prompt Engineering &GenAI

Course Code: 2502AI29

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the fundamentals and mechanics of prompt engineering.
CO2: Gain hands-on experience in using large language models (LLMs) like GPT, BERT, etc.
CO3: Explore different generative AI models and their applications.
CO4: Learn to fine-tune prompts for specific downstream tasks.
CO5: Develop practical applications using generative AI tools and APIs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	-	-
CO2	3	-	2	2	-	-
CO3	2	-	3	-	-	-
CO4	3	-	2	-	-	-
CO5	3	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	1
CO3	3	2
CO4	3	2
CO5	3	2

UNIT I

Introduction to Prompt Engineering and Generative AI: Overview of Foundation Models and LLMs (GPT, T5, PaLM, Claude), What is Prompt Engineering? ,Importance of Prompts in NLP, Generative AI: Definition, History, and Scope ,Applications: Text Generation, Image Generation, Code Completion, Chatbots, Practical Demonstration: Exploring ChatGPT and Google Gemini with basic prompts

Practice:

1. Compare GPT, T5, and PaLM in terms of architecture, capabilities, and use cases. Which would you use for summarization and why?
2. Interact with ChatGPT or Google Gemini using basic prompts to generate a story or answer a query. Analyze how different phrasings of the same prompt impact the output.

UNIT II

Prompt Engineering Techniques: Types of Prompts: Zero-shot, One-shot, Few-shot Chain-of-Thought (CoT) prompting, Prompt Templates and Structure, Contextual Prompting and

Instruction Tuning, Common Prompt Patterns and Use Cases Practical Demonstration: Experimenting with prompt tuning using OpenAI playground or Hugging Face

Practice:

1. Create examples of zero-shot, one-shot, and few-shot prompts for a task like sentiment classification. Observe how performance varies with each type.
2. Design a chain-of-thought prompt to solve a multi-step math problem or logic puzzle using OpenAI Playground or Hugging Face.

UNIT III

Advanced Prompting Strategies & Evaluation: Role of Tokenization and Model Limitations, Prompt Injection and Safety Concerns, Techniques: Retrieval-Augmented Generation (RAG), Self-Consistency, ReAct, Evaluation of Prompt Quality (BLEU, ROUGE, Human eval) ,Tools for Prompt Engineering: LangChain, PromptSource, Guidance, Practical Demonstration: Designing a prompt for multi-turn dialogue or classification task

Practice:

1. Explain how Retrieval-Augmented Generation (RAG) works. Build a prompt that uses external knowledge to improve answer quality.
2. Evaluate two different prompts using automatic metrics like BLEU or ROUGE for text summarization. Which prompt performs better and why?

UNIT IV

Generative AI Models and Architectures: Architecture of GPT, BERT, DALL·E, Stable Diffusion, Diffusion Models and Transformers, Fine-tuning vs Prompt Tuning vs In-context Learning, Tools & APIs: OpenAI, Hugging Face Transformers, Cohere, Stability AI,Practical Demonstration: Using Diffusers library to generate text/image/audio using pre-trained models

Practice:

1. Differentiate between fine-tuning, prompt tuning, and in-context learning. Give a use case where each would be most appropriate.
2. Use the Diffusers library or Hugging Face to generate an image or text using a pre-trained model (e.g., Stable Diffusion or GPT-2). Share the output and explain the model used.

UNIT V

Applications and Case Studies: GenAI in Education, Software Development, Healthcare, and Design, Ethical Considerations and Bias in Generative Models, Legal & Copyright Issues in Generative Content, Case Studies: GitHub Copilot, ChatGPT Plugins, GenAI in Search Engines, Mini-Project: Build a simple GenAI-powered app (Chatbot/Image Creator/Content Generator)Practical Demonstration: Team-based implementation using LangChain or Gradio

Practice:

1. Explore a real-world use case (e.g., GitHub Copilot or GenAI in healthcare). Describe the underlying model and ethical implications.
2. Design and implement a simple GenAI app (e.g., chatbot or content generator) using

LangChain or Gradio. Briefly describe the architecture and features.

Text Books:

1 Deep Learning with Transformers:Building Language Applications with Hugging Face", Author: Luis Serrano, Packt Publishing. "Practical Natural Language Processing

2 A Comprehensive Guide to Building Real-World NLP Systems", by Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta**.**

Reference Books:

1 Architects of Intelligence: The Truth About AI from the People Building It", by MartinFord

Web Links:

1 https://www.geeksforgeeks.org/machine-learning/machine-learning-algorithms/

2 https://www.coursera.org/in/articles/machine-learning-algorithms

Basic Concrete Technology
(Common to All, except SE)

Course Code: 2502CE30

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Understand the chemical composition, hydration, and physical properties of Portland cement.
CO2: Evaluate the effects of mineral and chemical admixtures on concrete performance.
CO3: Classify and assess aggregates based on mechanical properties, grading, and thermal behavior.
CO4: Analyze workability and setting characteristics of fresh concrete, including relevant testingmethods.
CO5: Design and proportion concrete mixes using BIS and ACI methods, ensuring quality control.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	-	-	-
CO2	2	1	3	-	-	-
CO3	2	1	3	-	-	-
CO4	2	1	3	-	-	-
CO5	2	2	3	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Cement: Portland cement – chemical composition – Hydration, Setting of cement – Structure of hydrate cement – Test on physical properties – Different grades of cement. Admixtures: Types of admixtures – mineral and chemical admixtures

UNIT II

Aggregates: Classification of aggregate – Particle shape & texture –, strength & other mechanical properties of aggregate – Specific gravity, Bulk density, porosity, adsorption &moisture content of aggregate – Bulking of sand – Deleterious substance in aggregate –

Soundness of aggregate – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Gap graded aggregate – Maximum aggregate size.

UNIT III

Fresh Concrete: Workability – Factors affecting workability – Measurement of workability by different tests – Setting times of concrete – Effect of time and temperature on workability – Segregation & bleeding – Mixing and vibration of concrete – Steps in manufacture of concrete – Quality of mixing water

UNIT IV

Hardened Concrete : Water / Cement ratio – Abram's Law – Gelspaoe ratio – Nature of strength of concrete – Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compressive & tensile strength - Curing. Testing Of Hardened Concrete: Compression tests – Tension tests– Flexure tests – Splitting tests – Pull-out test, Non-destructive testing methods – codal provisions for NDT. Elasticity, Creep & Shrinkage – Modulus of elasticity – Dynamic modulus of elasticity – Poisson's ratio – Creep of concrete – Factors influencing creep.

UNIT V

Mix Design: Factors in the choice of mix proportions – Durability of concrete – Quality Control of concrete – Statistical methods – Acceptance criteria – Proportioning of concrete mixes by IS codes mix design. Special Concretes: Introduction to light weight concrete – Cellular concrete

Text Books:

1 Properties of Concrete by A. M. Neville Pearson 5th edition Education ltd. (ISBN:9780273755807)
2 Concrete Technology by M. S. Shetty. – S. Chand & Co. (ISBN: 9788121900034)
3 Concrete Technology by Job Thomas-Cengage learning India Pvt Ltd.(ISBN: 9788131521099)

Reference Books:

1 Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi. (ISBN:9780070141100)
2 Concrete: Microstructure, Properties and Materials – P. K. Mehta and J. M. Monteiro, McGrawHill Publishers. (ISBN: 9780071797870)

Web Links:

1 https://nptel.ac.in/courses/105102012/
2 www.archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-ce01/
3 https://archive.nptel.ac.in/courses/105/102/105102012/

Repair and Rehabilitation of Structures
(Common to All, except SE)

Course Code: 2502CE31

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Identify the causes of deterioration of concrete structures.
CO2: Illustrate the various materials for repair and rehabilitation techniques.
CO3: Construct the various strengthening and stabilization techniques.
CO4: Determine various repair techniques of damaged structures.
CO5: Evaluate the usage of different types of concretes and durability aspects.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	-
CO2	3	2	2	2	2	-
CO3	3	2	2	2	2	-
CO4	3	2	2	2	2	-
CO5	3	2	2	2	2	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Materials for Repair and Rehabilitation: Admixtures- types of admixtures- purposes of using admixtures- chemical composition- Natural admixtures- Fibers- wraps- Glass and Carbon fiber wraps- Steel Plates-Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods-Corrosion activity measurement-chloride content– Depth of carbonation- Impact echomethods- Ultrasound pulse velocity methods- Pull out tests

UNIT II

Strengthening and Stabilization:Techniques- design considerations-Beam shear capacity strengthening- Shear Transfer strengthening-stress reduction techniques- Column

strengthening-flexural strengthening-Connection stabilization and strengthening, Crack stabilization

UNIT III

Bonded Installation Techniques: Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms-intermediate crack debonding- CDC debonding- plate end debonding- strengthening of floor of structures.

UNIT IV

Fibre Reinforced Concrete: Properties of constituent materials- Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete- applications of fibre reinforced concretes-Light weight concrete- properties of light weight concrete-Nofinesconcrete-design of light weight concrete- Flyash concrete- Introduction-classification of flyash- properties and reaction mechanism of flyash- Properties of flyash concrete in fresh state and hardened state- Durability of flyashconcretes

UNIT V

High Performance Concrete: Introduction- Development of high performance concretes-Materials of high performance concretes-Properties of high performance concretes - Self Consolidating concrete-properties- qualifications

Text Books:

1 Concrete repair and maintenance illustrated-Peter Emmons, published by Brandon W.Emmons.(ISBN: 9780876291916)
2 Experimental Techniques and Instrumentation,Dr.M.Sreenivasa Reddy, Dr.S.Govindarajanand Dr.S.Pachaiappan, Charulatha Publications, 2022

Reference Books:

1 Rehabilitation of Concrete Structures, Dr. B. Vidivelli, Standard Publishers Distributors.(ISBN: 978-8180140276)
2 Concrete technology, M S Shetty, S. Chand Publications. (ISBN: 9788121900034)
3 Concrete technology, Neville & Brooks, pearson education ltd. (ISBN: 9788131708384)

Web Links:

1 http://nptel.ac.in/courses/112101095/38
2 http://www.nptel.ac.in/courses/105105041/module%206.pdf
3 https://www.youtube.com/watch?v=N4KrZ_DczrE

Neural Networks and Fuzzy Logic
(Common to All, except PED)

Course Code: 2502EE28

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain artificial neuron models.
CO2: Explain various learning methods of ANN.
CO3: Apply different algorithms of ANN.
CO4: Distinguish between Classical and Fuzzy Sets.
CO5: Apply application of fuzzy logic control to real time systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	1	-	-
CO2	3	-	1	1	-	-
CO3	3	-	1	1	-	-
CO4	3	-	1	1	-	-
CO5	3	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and Fire Neuron Model,Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Applications of ANN

UNIT II

Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN, Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

UNIT III

Multilayer feed forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements, Radial Basis Function (RBF) Neural Network – Kohonen Self Organising feature Map (KSOM).

UNIT IV

Classical & Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions

UNIT V

Fuzzy Logic Modules: Fuzzification, Membership value assignment, development of rule base and decision makingsystem, Defuzzification to crisp sets, Defuzzification methods

Text Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication. (ISBN: 9788120353343)
2. Introduction to Neural Networks using MATLAB 6.0 - S.N.Sivanandam, S.Sumathi, S.N.Deepa,TMH. (ISBN: 9780070591127)

Reference Books:

1. Neural Networks, James A Freeman and Davis Skapura, Pearson Education.(ISBN:9780201513769)
2. Fuzzy sets University and information, J.Klin and T.A.Folger, Prentice Hall. (ISBN:9789353065782)
3. Introduction to artificial neural systems, J.M.Zurada, Jaico Publication house. (ISBN:9780314933911)

Web Links:

1. http://nptel.ac.in/courses/108104049/16
2. www.archive.nptel.ac.in/courses/127/105/127105006/
3. www.geeksforgeeks.org/fuzzy-logic-introduction/

Hybrid Electric Vehicles
(Common to All, except PED)

Course Code: 2502EE29

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Analyze the architectures of HEVs with various components.
CO2: Illustrate the concept of Electric Vehicle and Hybrid Electric Vehicles.
CO3: Explain the Plan concept of Plug-in Electrical Vehicles.
CO4: Analyze the power electronics converters for HEVs.
CO5: Apply various energy storage technologies in Hybrid Vehicles.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	3	2	-	-
CO2	1	-	3	2	-	-
CO3	1	-	3	2	-	-
CO4	1	-	3	2	-	-
CO5	1	-	3	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Introduction: Introduction to Electric Vehicles: History of electric vehicles, social and environmental importanceof electric vehicles, impact of modern drive-trains on energy supplies-Challenges and Key Technologies of EVs – Challenges for EV Industry in India

UNIT II

Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle and propulsion load, Drive cyclesand drive terrain, Concept of electric vehicle and hybrid electric vehicle, Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT III

Plug-in Hybrid Electric Vehicle: PHEVs and EREVs, PHEV Architectures, equivalent electric range of blended PHEVs, Fueleconomy and power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, battery charging.

UNIT IV

Power Electronics in HEVs: Rectifiers and Buck converter used in HEVs, isolated and non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, PWM rectifier in HEVs, EV and PHEV battery chargers

UNIT V

Battery and Storage Systems: Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels – Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

Text Books:

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press.(ISBN: 9781138072855)
2. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press. (ISBN:9780367693930)

Reference Books:

1. Introduction to Hybrid Vehicle System Modeling and Control, Wei Liu, Wiley.(ISBN: 9788126556205)
2. Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach", Amir Khajepour, Saber Fallahand Avesta Goodarzi, John Wiley & Sons Ltd. (ISBN: 9781118341513)

Web Links:

1. https://archive.nptel.ac.in/courses/108/103/108103009/
2. https://ndl.iitkgp.ac.in/he_document/nptel/nptel/INN1EE12391ItHaEV1402 4DoHEv1403014031

Green Engineering Systems
(Common to All, except TE)

Course Code: 2502ME27

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Distinguish the various solar energy collection methods and measuring instruments
CO2: Explain the different methods of solar energy storage and their applications.
CO3: Illustrate the various types of wind mills and performance characteristics.
CO4: Explain the principle of Biomass production, Geothermal energy sources andOcean thermal energy conversion
CO5: Illustrate the various types of electrical systems and mechanical systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	-	-
CO2	2	2	1	1	-	-
CO3	2	2	2	1	-	-
CO4	2	1	-	1	-	-
CO5	2	1	-	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Introduction: Solar Radiation: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells, I-V characteristics
Solar Energy Collection: Flat plate and concentrating collectors, classification of concentratingcollectors, orientation and thermal analysis, advanced collectors.

UNIT II

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified

storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.
Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement

UNIT III

Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.
Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.
Ocean Energy: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT IV

Electrical Systems: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.
Mechanical Systems: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmentally friendly and Energy efficient compressors and pumps

UNIT V

Energy Efficient Processes: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmentally friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.
Green Buildings: Definition, features and benefits. Sustainable site selection and planning of building for maximum comfort. Environmentally friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste.

Text Books:

1 Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/ TMH
2 Non-Conventional Energy Resources/ Khan B.H/ Tata McGraw Hill, New Delhi

Reference Books:

1 Renewable Energy Technologies /Ramesh & Kumar /Narosa
2 Renewable Energy Resources-2 Edition/ J. Twidell and T. Weir/ BSP Books Pvt. Ltd

Web Links:

1 https://onlinecourses.nptel.ac.in/noc17_me33
2 https://nptel.ac.in/courses/105107176/20

IC Engines
(Common to All, except TE)

Course Code: 2502ME28

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Summarize the finite element methods
CO2: Analyse one-dimensional problems in trusses and beams
CO3: Solve structural problems using CST and axis - symmetric formulation
CO4: Apply finite elements to higher order, Iso-parametric elements, and one-dimensional heattransfer analysis.
CO5: Apply finite element methods to dynamic analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	-	-
CO2	2	2	1	1	-	-
CO3	2	2	2	1	-	-
CO4	2	1	-	1	-	-
CO5	2	1	-	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Gas Exchange Processes: Inlet and exhaust processes in the four stroke cycle volumetric efficiency quasi static effects combined quasi static and dynamic effects variation with speed and valve area and timing- flow through valves poppet valve geometry and timing flow rate and discharge efficient, residual gas fraction exhaust gas flow rate and temperature variation, scavenging in wnike eyelid engines, scavenging parameters and mdeluctual scavenging processes. Flow through parts supercharging and turbo changing methods of power buying abusive relationships compressors, turbines wave compression devices

UNIT II

Charge Motion Within The Cylinder: Intake Jet Flow, Mean velocity and turbulence characteristics definitions application to enginevelocity data swirl swirl measurement, swirl

generation during induction swit modification within the cylinder squish pre chamber engine flow crevice flows and blowby News neratedby piston-cylinder wall interaction

UNIT III

Combustion In S.I And C.I Engines: Review of normal and abnormal combustion in SI and Ci engine cyclic variation in combustion of St engine analysis of cylindrical pressure data in SI and CI engine. EMP Flix SI engines common rail fuel injection system in Ci engines fuel spray behavior in CI engine

UNIT IV

Electric Vehicles: Introduction Limitations of IC Engines as prime mover. History of EV, Components of EV. and AC electric machines: Introduction and basic structure, Electric vehicle drive train, advantages and limitations Permanent magnet and switched reluctance motors

UNIT V

Hybrid Vehicles: Configurations of hybrid, Series and parallel, advantages and limitations, Hybrid drive trains, sizing of components Initial acceleration, rated vehicle velocity, Maximum velocity and maximum gradeability, Hydrogen: Production, Hydrogen storage systems, reformrs.
Fuel Cell Vehicles: Introduction, Fuel cell characteristics, Thermodynamics of Fuel cells, Fuell cell types; emphasis on PEM fuel cell

Text Books:

1. Internal Combustion Engine Fundamentals, J.B. Heywood, Mc Graw Hill Co, (ISBN:978-1259002076)
2. Build your own electric vehicle, Seth Leitman and Bob Brant. McGraw Hill, Co, 3 rdedition, (ISBN: 978-0071770569

Reference Books:

1. Engineering Fundamentals of IC Engine, H.N. Gupta, 2nd edition PHI Pvt. Ltd. (ISBN: 9788120346802)
2. PEM Fuel Cells-Theory and Practice, F. Barbir Elsevier Academic Press, (ISBN 9780128102398)

Web Links:

1. http://nptel.ac.in/courses/112101097/
2. www.thermopedia.com/content/786

CAD Tools for VLSI Design
(Common to All, except VLSID)

Course Code: 2502EC24

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Comprehend the insight of CAD Tools in modern design.
CO2: Develop combinational logic circuits by using CAD tools
CO3: Build sequential logic circuits using Verilog HDL operators
CO4: Analyze the performance of logic schematics using CAD simulation tools
CO5: Infer the performance of logic circuits in terms of DRC, LVS and PEX.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	1	2	2	1
CO2	2	3	1	2	1	2
CO3	2	2	3	2	2	1
CO4	2	3	1	2	2	1
CO5	2	3	2	2	2	1

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Understanding the working platform with Xilinx Vivado and its device, family and package Selection. Design and Implementation of Combinational Circuits Priority Encoder and Comparator using data flow & structural style

UNIT II

Design and Implementation of Sequential Circuits to detect a given sequence using with and without overlapping (mealy & Moore machines). Design and Implementation of a traffic light controller in three road & four road junctions

UNIT III

Exercise on Concatenation, Replication operators, Reduction and Conditional operators

in Verilog HDL. Performance characteristics of an n-channel and p-channel MOSFET.

UNIT IV

Working with Schematic for Ring Oscillator with variable amounts of Pull up to pull down ratios. Design a full adder by instantiating the logic gates. Make a comment on design styleon its performance.

UNIT V

Design a NAND gate by using NMOS, PMOS and CMOS technologies and make a comment on its performance. Design a Schematic, stick and layout for given logic

Text Books:

1 S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design,Third Edition, MH, (ISBN Number-0072460539)
2 Plummer, Deal, Griffin "Silicon VLSI Technology: Fundamentals, Practice & Modeling"PH, (ISBN Number-0130850373)

Reference Books:

1 P. VanZant , "Microchip Fabrication", 5th Edition, MH, (ISBN Number-6053901308)
2 R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design, Layout and Simulation,PH, (ISBN Number-1119481511)

Web Links:

1 https://themosisservice.com/university-support
2 https://youtu.be/OF3Zwfu6Ngc
3 https://newsroom.ibm.com/2021-05-06-IBM-Unveils-Worlds-First-2

FPGA Design for Embedded Systems
(Common to All, except VLSID)

Course Code: 2502EC25

L	T	P	C
3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Outline the concepts of Embedded System and Hardware Description Languages
CO2: Develop an embedded system using FPGA
CO3: Explain FPGA platforms and cross development tools.
CO4: Illustrate Parallelism and scheduling concepts
CO5: Interpret the parallelism with in FPGA hardware core.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	1	-	-
CO2	3	-	2	-	-	-
CO3	1	-	2	-	-	-
CO4	1	-	2	-	-	-
CO5	1	-	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Embedded System Overview & Hardware Description Languages: H/W-FPGA-Embedded SoC and use of VLSI circuit technology-platform FPGA's-Altera, Cyclone, Hardware Description Languages - VHDL , Verilog , Other High-Level HDLs, From HDL to Configuration Bit-stream

UNIT II

System Design using FPGA: Principles of system design-Design quality, Modules and interfaces, Abstraction and state, Cohesion and coupling, Designing and Reuse, Control flow graph, Design-Origins of platform FPGA designs

UNIT III

FPGA Platform: Components, adding to platform FPGA systems, assembling custom compute cores. Software Design-System Software Options, Root File system, Cross-Development Tools, Monitors andBoot-loader.

UNIT IV

Partitioning, Scheduling & Communication: Overview of Partitioning Problem, Analytical Solution to Partitioning-Basic definitions, expected performance gain, resource considerations, Analytical Approach, Communication- Invocation/Coordination, Transfer of State, Practical Issues- Profiling Issues, Data Structures Manipulate Feature Size.

UNIT V

Spatial Design: Principles of Parallelism-Identifying Parallelism - Spatial Parallelism with Platform FPGAsParallelism within FPGA Hardware Cores, Parallelism within FPGA Designs

Text Books:

1. Embedded Systems Design with Platform FPGAs, Ron Sass, Andrew G Schmidt Principles and Practices, First Edition, Tata McGraw Hill, India, ISBN Number-0123743338
2. Digital Systems design using VHDL, Charles H Roth. Jr, Re-Print, PWS publishing company (Thomson Books), USA, ISBN Number-9788131518304

Reference Books:

1. Design with VHDL,V A. Padroni Circuit First Edition, MIT Press Cambridge, England, ISBN Number-0262162245
2. FPGA Based System Design, Wayne Wolf, First Edition, Prentices Hall Modern Semiconductor Design Series, USA, ISBN Number-0131424610

Web Links:

1. https://www.coursera.org/learn/intro-fpga-design-embedded-systems
2. https://www.colorado.edu/ali/fpga-design-embedded-systems-specialization

Artificial Intelligence
(Common to All, except CSE, AIML)

Course Code: 2502CS26	**L**	**T**	**P**	**C**
	2	**0**	**1**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Describe fundamentals of Artificial Intelligence and its applications
CO2: Solve basic AI based problems and construct logical building blocks for problem Formulation
CO3: Apply various logical systems inferencing different logicalproblems.
CO4: Illustrate knowledge representation using predicate logic and predicate rules.
CO5: Design expert systems that leverage domain knowledge effectively.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	1	-
CO2	2	1	2	-	1	-
CO3	2	1	2	2	1	2
CO4	2	1	2	-	1	-
CO5	2	1	-	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Introduction to Artificial Intelligence: Introduction, History, Intelligent Systems, Foundations of AI, Applications, Tic-Tac-ToeGame playing, Development of AI Languages, Current trends in AI

UNIT II

Problem Solving: State-Space Search And Control Strategies: Introduction, General Problem Solving, Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative- Deepening A*, Constraint Satisfaction.
Problem Reduction And Game Playing: Problem Reduction, Game Playing, Minimax algorithm, Alpha- Beta Pruning, Two-player perfect information games

UNIT III

Logic Concepts: Introduction, Propositional calculus, Proportional logic, Representing facts in logic, functions and predicates, Axiomatic System, Semantic Tableau System in Proportional logic, Resolution Refutation in proportional logic, predicate logic

UNIT IV

Knowledge Representation: Knowledge Representation Using Predicate logic, Knowledge Representation using SemanticNetwork, Knowledge Representation using Frames.
Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning

UNIT V

Expert System: Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells,Support for explanation examples, Knowledge acquisition-examples

Text Books:

1 Artificial Intelligence- Saroj Kaushik, 1st edition CENGAGE Learning, ISBN: 9789355730428
2 Artificial intelligence, A modern Approach, Stuart Russel, Peter Norvig, Pearson Education Ltd,2nd ed, ISBN-13. 978-81203238
3 Artificial Intelligence- Elaine Rich, Kevin Knight, Shivashankar B Nair, 3rd ed, McGraw HillEducation, ISBN-13. 978-0070087705

Reference Books:

1 Artificial intelligence structures and strategies for complex problem solving, George F Lugar, 5th Edition, Addison Wesley. ISBN-13: 978-0321263186

Web Links:

1 https://www.tutorialspoint.com/artificial_intelligence/index.htm/
2 https://www.slideshare.net/slideshow/logic-in-ai/5005940/
3 https://www.slideshare.net/slideshow/artificial-intelligence-3638681/3638681/

Machine Learning Techniques
(Common to All, except CSE, AIML)

Course Code: 2502CS27

L	T	P	C
2	0	1	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Describe the need for AI and ML, and the types of ML algorithms..
CO2: Apply regression techniques and dimensionality reduction methods.
CO3: Implement and evaluate various classification techniques.
CO4: Describe and implement Artificial Neural Networks.
CO5: Utilize unsupervised learning methods for clustering and dimensionality reduction

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	-
CO2	2	1	2	-	-	-
CO3	2	1	2	2	-	2
CO4	2	1	2	-	-	-
CO5	2	1	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Introduction: Understanding the need for AI and Machine Learning (ML), AI & Data, Types of ML Algorithms: Supervised, Unsupervised Learning and semi supervised learning, reinforcement learning, evolutionary computation ML Model development life cycle Deep Learning for Human Like Learning

UNIT II

Regression Techniques: Regression for prediction, Gradient Descent and Ascent, Learning with Momentum, Loss Functions, Over fitting and under fitting, Model evaluation techniques Types of Regression: Linear Regression

UNIT III

Classification Techniques: Naïve Bayes Classification: Bayesian Learning, Naïve Bayes Classification, MAP, Bayesian Belief Networks, Decision Tree, K-Nearest Neighbors Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measuresfor Classification Techniques

UNIT IV

Classification Techniques: Naïve Bayes Classification: Bayesian Learning, Naïve Bayes Classification, MAP, Bayesian Belief Networks Decision Tree K-Nearest Neighbors Support Vector Machines: Hard Margin and Soft Margin, Kernels and Kernel Trick, Evaluation Measures for Classification Techniques

UNIT V

Unsupervised Learning: Uses in Clustering, associations and dimensionality reduction Clustering, Hierarchical Agglomerative Clustering, k-means Algorithm

Text Books:

1 Machine Learning, Tom Mitchell, McGraw-Hill international editions, TMH, (ISBN:0071154671)
2 Pattern Recognition and Machine Learning C. Bishop, Springer, (ISBN: 9781493938438)
3 Elements of Artificial Neural Networks , Kishan Mehrotra, Chilukuri Mohan and SanjayRanka, Penram International, (ISBN: 9780262133289).

Reference Books:

1 Pattern Recognition, Techniques and Applications , Rajjan Shinghal, OXFORD Higher Education , (ISBN:9780195676853)
2 Andrew Kelleher, Adam Kelleher, Applied Machine Learning for Data Scientist andSoftware engineers, Addison-Wesley Professional, (ISBN:9780134116549)

Web Links:

1 https://onlinecourses.nptel.ac.in/noc21_cs24/preview/
2 https://www.udemy.com/course/machinelearning/