



BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

M.Sc. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2026 - 2027 onwards)

Sem	Course	Course Title	Ins. Hrs	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
I	Core Course - 1 (CC - 1)	Design and Analysis of Algorithms	6	4	3	30	70	100
	Core Course - 2 (CC - 2)	Foundations of Artificial Intelligence	6	4	3	30	70	100
	Core Practical - 1 (CP - 1)	Design and Analysis of Algorithms Lab	3	2	3	40	60	100
	Discipline Centric Elective Course - 1 (DCEC - 1)	Any one from the list	5	4	3	30	70	100
	Discipline Centric Elective Practical - 1 (DCEP - 1)	Any one from the list	3	2	3	40	60	100
	Generic Elective Course - 1 (GEC - 1)	Any one from the list	5	3	3	30	70	100
	Skill Enhancement Course - 1 (SEC - 1)	Soft Skills	2	2	3	30	70	100
	Value Added Course - 1 (VAC - 1) *	Full Stack Development	-	2*	3	30	70	100*
	Total		30	21	-	-	-	700
II	Core Course - 3 (CC - 3)	Machine Learning Techniques	6	4	3	30	70	100
	Core Course - 4 (CC - 4)	Blockchain Technologies	6	4	3	30	70	100
	Core Practical - 2 (CP - 2)	Machine Learning Techniques Lab	3	2	3	40	60	100
	Discipline Centric Elective Course - 2 (DCEC - 2)	Any one from the list	4	4	3	30	70	100
	Discipline Centric Elective Practical - 2 (DCEP - 2)	Any one from the list	3	2	3	40	60	100
	Generic Elective Course - 2 (GEC - 2)	Any one from the list	4	3	3	30	70	100
	Skill Enhancement Course - 2 (SEC - 2)	Data Analytics using R Programming	2	2	3	30	70	100
	Non-Major Elective - 1 (NME -1)	One Course from Outside Department	2	2	3	30	70	100
		Total	30	23	-	-	-	800
Summer Internship / Industrial Activity during the Summer Vacation after 1 st Year								

III	Core Course - 5 (CC - 5)	Deep Learning Techniques	6	4	3	30	70	100
	Core Course - 6 (CC - 6)	Quantum Computing Fundamentals	6	4	3	30	70	100
	Core Practical - 3 (CP - 3)	Deep Learning Techniques Lab	3	2	2	40	60	100
	Discipline Centric Elective Course - 3 (DCEC - 3)	Any one from the list	5	4	3	30	70	100
	Discipline Centric Elective Practical - 3 (DCEP - 3)	Any one from the list	3	2	2	40	60	100
	Generic Elective Course - 3 (GEC - 3)	Any one from the list	5	3	3	30	70	100
	Non-Major Elective - 2 (NME - 2)	One Course from Outside Department	2	2	3	30	70	100
	Summer Internship / Industrial Activity @			2		20	80	100
		Total	30	23	-	-	-	800
IV	Core Course - 7 (CC - 7)	Agile Process and Devops	5	4	3	30	70	100
	Core Course - 8 (CC - 8)	Generative AI and Large Language Models	5	4	3	30	70	100
	Core Course - 9 (CC - 9)	Prompt Engineering	5	4	3	30	70	100
	Discipline Centric Elective Course - 4 (DCEC - 4)	Any one from the list	4	4	2	30	70	100
	Entrepreneurship / Industry Based Course @	Entrepreneurial Development	3	3	3	30	70	100
	Project Work @		8	5	-	20	80	100
	Value Added Course – 2 (VAC - 2)*	Data Visualization using R & Python	-	2*	3	30	70	100*
	Total		30	24	-	-	-	600
Grand Total				91				2900

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE / PRACTICAL

Discipline Centric Elective Course 1		Discipline Centric Elective Practical 1	
1.	Advanced Python Programming	1.	Advanced Python Programming Lab
2.	Database Technology	2.	Database Technology Lab
Discipline Centric Elective Course 2		Discipline Centric Elective Practical 2	
1.	Fuzzy Logic And Nature Inspired Computing	1.	Fuzzy Logic And Nature Inspired Computing Lab
2.	Cryptography and Network Security	2.	Cryptography and Network Security Lab
Discipline Centric Elective Course 3		Discipline Centric Elective Practical 3	
1.	Big Data Technologies	1.	Big Data Technologies Lab
2.	Natural Language Processing	2.	Natural Language Processing Lab
Discipline Centric Elective Course 4			
1.	Cloud Computing and Internet of Things		
2.	Federated Learning		

LIST OF NON-MAJOR ELECTIVE COURSE (for other Department Students only)

NON-MAJOR ELECTIVE COURSE – 1 (NME-1)	
1	Data Analysis Using Excel
NON-MAJOR ELECTIVE COURSE – 2 (NME-2)	
2	Social Media Crimes

LIST OF GENERIC ELECTIVE COURSE

Generic Elective Course 1	
1.	Mathematical Foundation for Artificial Intelligence
2.	Biological Databases
3.	Design Thinking
Generic Elective Course 2	
1.	Statistical Computing
2.	Business Intelligence
3.	Research Methodology
Generic Elective Course 3	
1.	Data Science in Bio Informatics
2.	Foundation of Remote Sensing
3.	Digital Marketing

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course	9	4	36	900
2.	Core Practical	3	2	6	300
3.	Discipline Centric Elective Course	4	4	16	400
4.	Discipline Centric Elective Practical	3	2	6	300
4.	Generic Elective Course	3	3	9	300
5.	Skill Enhancement Course	2	2	4	200
6.	Non-Major Elective Courses	2	2	4	200
7.	Internship / Industrial Activity @	1	2	2	100
8.	Entrepreneurship / Industry Based Course @	1	3	3	100
9.	Project @	1	5	5	100
Total		29	-	91	2900
Value Added Courses *		2*	2	4*	200

*	The value-added courses credit will not be included in the total CGPA. These courses are extra-credit courses. Instruction hours for these courses is 30 hours								
@	Summer Internship will be carried out during the summer vacation after the First year. Viva Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 3rd semester Mark Statement. Summer Internship / Industrial Activity& Project Scheme of Evaluation: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Description</th><th style="text-align: center;">Marks</th></tr> <tr> <td>Report</td><td style="text-align: center;">80</td></tr> <tr> <td>Viva</td><td style="text-align: center;">20</td></tr> <tr> <td>Total</td><td style="text-align: center;">100</td></tr> </table>	Description	Marks	Report	80	Viva	20	Total	100
Description	Marks								
Report	80								
Viva	20								
Total	100								

Programme Outcome

PO1	Disciplinary Knowledge: Broad and in-depth knowledge of advanced scientific concepts, principles, and methodologies within the chosen domain. Ability to critically explain, integrate, and apply scientific knowledge to theoretical and practical problems. Opportunities to earn additional credits through specialized and interdisciplinary courses further enhance expertise and broaden disciplinary understanding.
PO 2	Critical Thinking: Field visits, academic interactions, and experiential learning activities will help students develop critical observation, interpretation, and analytical skills. Ability to evaluate and interpret scientific data, formulate hypotheses, and draw logical conclusions. Encourages independent thinking and the ability to assess scientific problems from multiple perspectives.
PO 3	Analytical Reasoning: Through classroom discussions, scientific literature reviews, and interactive learning environments, students will strengthen their analytical reasoning abilities. Ability to critically evaluate scientific texts, identify gaps in existing knowledge, formulate research questions, and synthesize new ideas and concepts. Promotes evidence-based reasoning and logical interpretation of scientific information.
PO 4	Scientific Reasoning: Strong foundation in scientific methods, experimental design, and data interpretation through laboratory-based courses. Enhances practical knowledge of scientific instrumentation, calibration procedures, laboratory safety, and appropriate research techniques. Ability to conduct scientifically sound experiments and interpret results accurately.
PO 5	Self-Directed Learning: Encourages independent and self-directed learning through assignments, field reports, project work, and literature-based studies. Ability to organize, analyze, and present scientific findings in professional formats relevant to academic and industrial settings. Fosters responsibility, time management, and continuous self-improvement in learning.
PO 6	Reflective Thinking: Laboratory-intensive core courses will expose students to a broad range of research methodologies and experimental techniques. Ability to reflect on learning experiences, evaluate the effectiveness of scientific approaches, and understand the broader applications of scientific techniques within the discipline.
PO 7	Problem-Solving Skills: Ability to develop and apply scientific principles, quantitative reasoning, and mathematical concepts to solve discipline-specific problems. Ability to analyze experimental data, interpret scientific observations, and derive meaningful conclusions. Prepares students to address real-world scientific and societal challenges effectively.
PO 8	Research-Related Skills: Internships, dissertation work, and research-oriented projects provide opportunities to design, develop, and execute independent research studies. Students gain hands-on experience in research methodology, experimental techniques, data analysis, scientific writing, and ethical research practices. These experiences strengthen laboratory competence and prepare students for advanced research and professional careers.
PO 9	Lifelong Learning: Cultivates a mindset of continuous learning and professional adaptability. Ability to identify gaps in knowledge and skills, adapt to emerging technologies and scientific advancements, and pursue self-directed learning throughout their careers. Encourages lifelong learning that supports academic growth, employability, and professional excellence.
PO 10	Leadership Readiness: Ability to take initiative, work collaboratively, and manage academic and research responsibilities effectively. Through seminars, group projects, internships, and research activities, students develop decision-making, problem-solving, organizational, and interpersonal skills. Ability to lead scientific teams, communicate effectively in professional environments, and contribute responsibly to academic, industrial, and societal development.

Programme Specific Outcome

PSO1: Technical Proficiency Graduates will proficiently use advanced programming languages, statistical methods data visualization tools, and to solve real world problems by using big data analytics.

PSO 2: Enhance the logical and analytical thinking to understand the computational systems

PSO 3: Problem-Solving Skills Graduates will design and solve complex data science related problems using mathematical models and computational techniques

PSO 4: Deep understanding and proficiency in advanced topics such as Algorithms, Artificial Intelligence and Data Science

PSO 5: Graduates should be able to evolve AI based efficient domain specific processes for effective decision making in several domains such as business and governance domains

PSO 6: Graduates should be able to arrive at actionable fore sight, insight, hind sight from data for solving business and engineering problems.

PSO 7: Graduates should be able to create, select and apply the theoretical knowledge of AI and Data Analytics along with practical industrial tools and techniques to manage and solve wicked societal problems.

PSO 8: Training in research methodologies, experimental design, and critical analysis to contribute to the advancement of computer science through original research

PSO 9: Specialization opportunities in areas such as Computer Vision, Natural Language Processing, Bioinformatics, Software Engineering, Cyber Security, and Cyber Physical Systems based on personal interests and career goals

PSO 10: Understanding the ethical implications of technology and the responsibility of computer scientists to develop and use technology in an ethical and society responsible way.

Year: I

CORE COURSE 1

Semester: I

Code:

**DESIGN AND ANALYSIS OF
ALGORITHMS
(Theory)**

Credits: 4

Course Objectives: After completing this course, students will be able to:

1. This core course covers principles of algorithm design, elementary analysis of algorithms, and fundamental data structures.
2. Understand divide and conquer methodology
3. Explore Dynamic programming
4. Understand Backtracking
5. Analyze branch and bound

UNIT - I: Algorithms as technology: Analyzing and Designing algorithms – Asymptotic notations – Recurrences – Methods to solve recurrences – Heap Sort – Quick Sort – Sorting in linear time – Radix sort – Selection in linear time. Introduction: Algorithms, Pseudo code for expressing algorithms, performance analysis Space complexity, Time Complexity, Asymptotic notation Big oh notation, omega notation and theta notation

UNIT - II: Divide and conquer methodology: Multiplication of large integers – Strassen's matrix multiplication – Greedy method – Prim's algorithm – Kruskal's algorithm – algorithm for Huffman codes, Knapsack problem, Spanning trees, Minimum cost spanning trees, Single source shortest path problem.

UNIT – III: Dynamic Programming: General method, applications- Matrix chained multiplication, Optimal binary search trees, 0/1 Knapsack problem, All pairs shortest path problem, Traveling sales person problem, Reliability design.

UNIT – IV: Backtracking: General method, Applications- n-queue problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles.

UNIT – V: Branch and Bound: General method, applications- Travelling sales person problem, 0/1 Knapsack problem- LC branch and Bound solution, FIFO branch and Bound solution. NP-Hard and NP-Complete Problems: Basic concepts, Non deterministic algorithms, NP-Hard and NP Complete classes

Unit – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books and Reference Books

- [1] Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni and Rajasekharan, Universities press
- [2] Design and Analysis of Algorithms, P. h. Dave, 2nd Edition, Pearson Education Essential Reading / Recommended Reading [1] Introduction to the Design And Analysis of Algorithms A Levitin Pearson Education

- [3] Algorithm Design foundations Analysis and Internet examples, M.T.Goodrich and R Tomassia John Wiley and sons
- [4] Design and Analysis of Algorithms, S. Sridhar, Oxford Univ.Press
- [5] Design and Analysis of Algorithms, Aho, Ulman and Hopcraft, Pearson Education.
- [6] Foundations of Algorithms, R. Neapolitan and K.Naimipour , 4th edition

Web Resources:

www.w3cschools.com 5. <https://archive.ics.uci.edu>

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

CO1: Analyze the complexity of polynomial algorithms.

CO2: Apply various design strategies for solving problems

CO3: Distinguish NP hard and NP complete problems from other problems

CO4: Explore Backtracking

CO5: Understand **Branch and Bound**

Year: I

CORE COURSE 2

Semester: I

Code:

**FOUNDATIONS OF ARTIFICIAL
INTELLIGENCE
(Theory)**

Credits: 4

Course Objectives : After completing this course, students will be able to:

1. Understand basics of AI
2. Explore Intelligent agents
3. Analyze Local Search Algorithm Searching
4. Apply Knowledge Representation
5. Understand Ethics and Social Implications of AI

UNIT – I: Introduction to AI: The Foundations of AI, AI Technique -Tic-Tac-Toe. Problem characteristics, Production system characteristics, Production systems: 8-puzzle problem.

UNIT – II: Intelligent Agents: Agents and Environments, Good Behavior: The concept of rationality – The nature of Environments, The Structure of Agents - Expert Systems-Types of Expert Systems

UNIT – III: Local Search Algorithm Searching: Uninformed search strategies – Breadth first search, depth first search. Generate and Test, Hill climbing, simulated annealing search, Greedy best first search, A* search, AO* search

UNIT – IV: Knowledge Representation: Propositional logic - syntax & semantics - First order logic. Inference in first order logic, propositional Vs. first order inference, unification & lifts, Clausal form conversion, Forward chaining, Backward chaining, Resolution

UNIT – V: Ethics and Social Implications of AI: Ethical Considerations on AI – bias – privacy – philosophical challenge in human judgement – faulty algorithms - Social Implications of AI – Case studies Planning and Acting in the Real World

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Essential Reading

- [1] E. Rich and K. Knight, Artificial Intelligence, 3rd Edition, New york: TMH, 2019
- [2] S. Russell and P. Norvig, Artificial Intelligence A Modern Approach, 3rd Edition, Pearson Education, 2019.

Recommended Reading

- [1] Eugene Charniak and Drew McDermott, Introduction to Artificial Intelligence, 2nd Edition. Pearson Education, 2005.
- [2] George F Luger, Artificial Intelligence Structures and Strategies for Complex Problem Solving, 4th Edition. Pearson Education, 2008
- [3] N.L. Nilsson, Artificial Intelligence: A New Synthesis, 1st Edition. Morgan Kaufmann, 2000

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

C01: Express the modern view of AI and its foundation

C02: Illustrate Search Strategies with algorithms and Problems.

C03: Implement Propositional logic and apply inference rules.

C04: Understand Knowledge Representation

C05: Explore Ethics and Social Implications of AI

Year: I

CORE PRACTICAL 1

Semester: I

Code:

**DESIGN AND ANALYSIS OF
ALGORITHMS LAB**

Credits: 2

List of Practical: (Using C/C++/Python)

1. Write a program to perform operation count for a given pseudo code
2. Write a program to perform Insertion sort for any given list of numbers.
3. Write a program to perform Quick Sort for the given list of integer values.
4. Write a Program to perform Merge Sort on the given two lists of integer values.
5. Write a Program to perform Binary Search for a given set of integer values recursively and nonrecursively.
6. Write a program to find solution for knapsack problem using greedy method.
7. Write a program to find minimum cost spanning tree using Prim's Algorithm.
8. Write a program to perform Single source shortest path problem for a given graph.
9. Write a program to find solution for job sequencing with deadlines problem.
10. Write a program for all pairs shortest path problem.
11. Write a program to solve N-QUEENS problem.

Year: I	DISCIPLINE CENTRIC ELECTIVE COURSE 1	Semester: I
Code:	1. ADVANCED PYTHON PROGRAMMING (Theory)	Credits: 4

Course Objectives: After completing this course, students will be able to:

1. Acquire programming skills in core Python
2. Learn Strings and function
3. Develop object oriented skills in Python.
4. Comprehend various Python Packages
5. Develop web applications using Django

UNIT – I: Introduction: Fundamental ideas of Computer Science - Strings, Assignment, and Comments - Numeric Data types and Character sets - Expressions – Loops and Selection Statements: Definite iteration: the for Loop - selection: if and if-else statements - Conditional iteration: the while Loop

UNIT – II: Strings and Text Files: Accessing Characters and substrings in strings - Data encryption - Strings and Number systems- String methods – Text - Lists and Dictionaries: Lists – Dictionaries – Design with Functions: A Quick review - Problem Solving with top-down Design - Design with recursive Functions - Managing a Program's namespace – Higher Order Functions

UNIT – III: Design with Classes: Getting inside Objects and Classes – Data-Modeling Examples – Building a New Data Structure – The Two – Dimensional Grid - Structuring Classes with Inheritance and Polymorphism – Graphical User Interfaces - The Behavior of terminal Based programs and GUI-Based programs - Coding Simple GUI-Based programs - Windows and Window Components - Command Buttons and responding to events

UNIT – IV: Working with Python Packages: NumPy Library-Ndarray – Basic Operations – Indexing, Slicing and Iteration – Array manipulation - Pandas –The Series – The Data Frame - The Index Objects – Data Visualization with Matplotlib – The Matplotlib Architecture – pyplot – The Plotting Window – Adding Elements to the Chart – Line Charts – Bar Charts – Pie charts

UNIT – V: Django: Installing Django – Building an application – Project Creation – Designing the Data Schema - Creating an administration site for models - Working with Query Sets and Managers – Retrieving Objects – Building List and Detail Views

Unit – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Book:

1. K.A. Lambert, "Fundamentals of Python: first programs", Second Edition, Cengage Learning, 2018
2. Fabio Nelli, "Python Data Analytics: With Pandas, NumPy, and Matplotlib", Second Edition, Kindle Edition, 2018
3. Antonio Mele, "Django 3 By Example", Third Edition, 2020

Reference books:

1. Advanced Python Programming, Dr. Gabriele Lanaro, Quan Nguyen, SakisKasampalis, Packt Publishing, 2019
2. Daniel Howard," Python and SQL: Step-By-Step Guide to Database Programming".
3. Python: The Complete Reference, Martin C. Brown, McGraw Hill, 2018 Web

Resources:

1. <https://onlinecourses.nptel.ac.in>
2. <https://k21academy.com/datascience-blog/step-by-step-guide-setup-sql-withpython/>

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

C01: Comprehend the programming skills in python and develop applications using conditional branches and loops.

C02: Create Python applications with strings and functions.

C03: Understand and implement the Object Oriented Programming paradigm with the concept of objects and classes, Inheritance and polymorphism.

C04: Evaluate the use of Python packages to perform numerical computations and data visualization.

C05: Design interactive web applications using Django.

Year: I

**DISCIPLINE CENTRIC ELECTIVE
PRACTICAL 1**

Semester: I

Code:

**1. ADVANCED PYTHON PROGRAMMING LAB
(Practical)**

Credits: 2

1) Exception Handling and User defined exception(s) a) Write a python program to create user defined exceptions. b) Write a python program to understand the use of else and finally block with try block. c) Write a python program that uses raise and exception class to throw an exception.

2) Modules and Packages a) Write a python program to create a module and import the module in another python program. b) Create a python package having at least two modules in it. c) Create a python package having at least one subpackage in it.

3) Numpy Library a) Create a numpy array from list, tuple with float type b) Python program to demonstrate slicing, integer and boolean array indexing c) Write a python program to find min, max, sum, cumulative sum of array.

4) Numpy Library: Linear Algebra a) Write a python program to find rank, determinant, and trace of an array. b) Write a python program to find eigenvalues of matrices c) Write a python program to find matrix and vector products (dot, inner, outer, product), matrix exponentiation.

5) Numpy Advanced a) Create a white image using NumPy in Python and b) Convert a NumPy array to an image and Convert images to NumPy array? c) Perform Sorting, Searching and Counting using Numpy methods.

6) Object Oriented Programming: a) Write a python program to demonstrate various kinds of inheritance. b) Write a python program to demonstrate operator overloading. c) Write a python program to create abstract classes and abstract methods.

7) Regular Expressions a) Write a python program to check the validity of a password given by the user. The password should satisfy the following criteria: i) Contain at least 1 letter between a and z ii) Contain at least 1 number between 0 and 9 iii) Contain at least 1 letter between A and Z iv) Contain at least 1 character from \$, #, @ v) Minimum length of password: 6 vi) Maximum length of password:

8) Write a Python program to validate mobile number.

Year: I DISCIPLINE CENTRIC ELECTIVE COURSE 1 Semester: I

Code: 2. DATABASE TECHNOLOGY Credits: 4
(Theory)

Course Objectives: After completing this course, students will be able to:

1. Learn and practice data modelling using the entity-relationship and developing database designs.
2. Understand the use of Structured Query Language (SQL) for accessing database.
3. To provide insights into distributed and parallel database designing.
4. To learn advanced representations of databases suited for real-time applications.
5. Understand different types of NoSQL databases

UNIT - I: Introduction to database systems: Data models, architecture of a database, Challenges in building a DBMS. Entity Relationship Model, Extended Entity Relationship Model: Specialization, Generalization and Aggregation.

UNIT - II: Relational Data Model: Introduction to the Relational Model and concept of keys, Mapping the ER to the Relational Model. Relational Algebra: Relational Algebra Operations and Relational algebra queries.

UNIT - III: Relational Database Design: Importance of a good schema design, functional dependencies. 1NF, 2NF, 3NF, BCNF, 4NF, 5NF.
Overview of SQL: SQL statements (commands) – DDL, DML, DTL and DCL. Integrity Constrains, set and string operations, aggregate function, views, Joins, Nested and Complex queries

UNIT - IV: Parallel Database, Distributed Database and ORDBMS: Architecture for Parallel Databases, Types of Distributed Databases, Distributed DBMS Architecture, Storing Data in a Distributed DBMS, ORDBMS- Structured Data
Types, Operations on Structured Data, Objects, OIDs and Reference Types, Object oriented versus Object relational database.

UNIT - V: Introduction to NoSQL Databases: NoSQL database concepts: NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system. Types of NoSQL databases: Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties. PL SQL Concepts, Cursors, Stored Procedures, Stored Function, Database Triggers.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Korth, Slberchatz, Sudarshan, "Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson education.

Reference Books:

1. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publication.
2. Dr. P.S. Deshpande, "SQL and PL/SQL for Oracle" 10g, Black Book, Dreamtech Press.
3. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley Publication.
4. Ozsu, M. Tamer, Valduriez, Patrick, "Principles of Distributed Database Systems", 3rd Edition, Pearson Education.

Course Outcome: Upon successful completion of the course, students will be able to

CO 1: Understand the fundamentals of database systems and design ER for the real-life problem.

CO 2: Convert conceptual model to relational model, formulate relational algebra queries.

CO 3: Analyze and apply concept of normalization to relational database design.

CO 4: Design and querying database using SQL.

CO 5: Design advanced databases like parallel, distributed and object relational databases.

Year: I

**DISCIPLINE CENTRIC ELECTIVE
PRACTICAL 1**

Semester: I

Code:

**2. DATABASE TECHNOLOGY LAB
(Practical)**

Credits: 2

List of Practical:

1. Creating and Manipulating Database objects and Applying Constraints (DDL)
2. Manipulating Data with Database Objects (DML)
3. Retrieving, Restricting and Sorting Data (DRL)
4. SQL Single Row Functions
5. SQL Multiple Row Functions (Aggregate Function)
6. Displaying Data from Multiple Tables (Join)
7. Using Commit and Rollback show Transaction ACID Property.
8. Securing data using Views and Controlling User Access (DCL)
9. PL/SQL Block Syntax and DML Operation through PL/SQL Block
10. Control Structures in PL/SQL
11. Working with Cursor
12. Creating Procedures and Functions in PL/SQL
13. Creating Database Triggers

Year: I

GENERIC ELECTIVE COURSE 1

Semester: I

Code:

**1. MATHEMATICAL FOUNDATION
FOR ARTIFICIAL INTELLIGENCE
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Build foundational mathematical knowledge essential for understanding AI methodologies.
2. Develop students' ability to formulate and solve problems using concepts from linear algebra, matrices, optimization, and logic.
3. Enhance logical reasoning, set theory, and graph-theoretical thinking relevant to data structures, algorithms, and modeling.
4. Introduce optimization techniques and their applications in data fitting, machine learning, and algorithmic design.
5. Provide a strong mathematical base to support advanced courses in data analytics, machine learning, and statistical modeling.

UNIT – I: LINEAR ALGEBRA – VECTORS AND VECTOR SPACES: Introduction to vectors: geometric and algebraic views, Vector operations: addition, scalar multiplication, dot and cross product, Vector spaces, subspaces, Linear combinations, span, basis, and dimension, Linear dependence and independence, Linear transformation, its rank and nullity, , Applications to data representation in high-dimensional space

UNIT – II: MATRICES AND SYSTEM OF EQUATIONS: Types of matrices and basic operations, Determinants, rank, and inverse of a matrix, Systems of linear equations: consistency and solution sets, Methods of solution: Gaussian elimination, Gauss-Jordan method, Matrix inversion, Applications in data transformation and feature engineering

UNIT – III: OPTIMIZATION TECHNIQUES: Formulation of optimization problems in data science, linear programming – graphical solution method, convex functions – basic properties, unconstrained optimization – classical methods, Hessian matrix and positive definiteness,, Search methods :Golden Section Search, , Gradient descent method – basic concept and application to model fitting, Newton's method for 2D optimization – two iterations.

UNIT – IV: SET THEORY AND LOGIC: Sets: definitions, operations, Venn diagrams, Relations and functions, Logic: propositions, truth tables, logical connectives, Predicate logic, quantifiers,, Applications in database queries, , rule-based systems, and algorithm design

UNIT – V: GRAPH THEORY AND ITS APPLICATIONS: Basics of graphs: vertices, edges, types of graphs, Degree, path, cycle, connectedness,, Directed and undirected graphs, Trees, spanning trees, and applications, , Adjacency matrix and incidence matrix, , Applications in networks, social graphs, and recommendation systems

Unit – VI: Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Text Book(s):

1. Gilbert Strang, Introduction to Linear Algebra, 6th ed., Wellesley-Cambridge Press, U.S.,
2. David C. Lay, Linear Algebra and Its Applications, Pearson,
3. Kenneth H. Rosen, Operations Research: An Introduction, 10th ed., Pearson / Prentice Hall India,

References:

1. S.D. Sharma, Operations Research, Nath Publishing House, Meerut,
2. Singiresu S. Rao, Engineering Optimization: Theory and Practice, 4th ed., Wiley,

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

CO1: Perform vector and matrix operations and apply them to data transformation and representation tasks.

CO2: Analyze linear dependence and independence in high-dimensional data contexts.

CO3: Solve systems of linear equations using matrix-based techniques such as Gaussian elimination and matrix inversion.

CO4: Apply classical and numerical optimization methods (e.g., gradient descent, Newton's method) to real-world data problems

CO5: Understand graph theory and its applications

Year: I

GENERIC ELECTIVE COURSE 1

Semester: I

Code:

**2. BIOLOGICAL DATABASES
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Develop basic knowledge on the available online biological databases
2. Create, integrate and mine of all kinds of nucleotide and protein databases
3. Analyze latest tools and technologies for biological data analysis and processing
4. Understand Protein structure databases
5. Explore various aspects of cloud based biological data processing techniques and biological big data handling

UNIT – I: Sequence Submission Tools- Introduction, relational database, motivation of biological database; Central dogma of life - Submission of sequences to the database, sequence formats, Interconversion of molecular sequences.

UNIT – II: Biological Data Integration and Mining -General data integration; Major areas in biological data integration; Biological data mining General and biological data mining; Case study of biological pattern discovery, Case study in biological data mining.

UNIT – III: Nucleotide and Protein Sequence Databases - European molecular biology laboratory (EMBL), NCBI GenBank DNA Data Bank of Japan (DDBJ), Genes and genetic disorders: COSMIC, Clinvar - SNP database (DbSNP), UniProt Knowledgebase - SwissProt and TrEMBL - Protein Information Resource (PIR).

UNIT – IV: Protein Structure Databases -Protein data bank (PDB), SCOP - Structural classification of proteins, CATH – Protein structure classification database.

UNIT – V: Cloud-based Biological Data Processing -Biological data processing in general, data processing in the cloud; Role of cloud computing in handling the huge biological data.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Book(s)

1. Bioinformatics Database Systems, By Kevin Byron, Katherine G. Herbert, Jason T. L. Wang, 2017, 1st Edition, CRC Press, USA.

Reference Books

1. Biological Database Modeling 1st Edition, by Jake Chen, Amandeep S., Amandeep S, Sidhu, 2012, Artech House Publishers, UK.
2. Bioinformatics: Methods and Applications, by Dev Bukhsh Singh, Rajesh Kumar Pathak, 1st Edition, 2021, Oxford, UK.

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

C01: Discuss concepts of biological data and database creations

C02: Infer the process of biological data integration and mining

C03: Distinguish among biomolecular sequence databases and structural databases

C04: Identify various databases employed to determine protein functions, interactions and pathways

C05: Correlate genomic and transcriptomic databases with microarray data

Year: I

GENERIC ELECTIVE COURSE 1

Semester: I

Code:

**3. DESIGN THINKING
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Infer design thinking basic concepts
2. Understand Design Thinking Process
3. Explore the art of innovation
4. Analyze product design
5. Apply Design Thinking in Business Processes

UNIT – I: Introduction to Design Thinking: Introduction to elements and principles of Design, basics of design - dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

UNIT – II: Design Thinking Process: Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT – III: Innovation: Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT – IV: Product Design: Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies. Activity: Importance of modelling, how to set specifications, Explaining their own product design

UNIT – V: Design Thinking in Business Processes: Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Start-ups. Defining and testing Business Models and Business Cases. Developing & testing prototypes. Activity: How to market our own product, about maintenance, Reliability and plan for startup.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Book(s):

1. Tim Brown, Change by design, 1st Ed., Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1st Ed., Adams Media, 2014

References:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1st Ed., Norton Press, 2018.
3. William lidwell, Kritinaholden, & Jill butter, Universal principles of design, 2nd Ed., Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

E-Resources & other Digital Material

1. <https://nptel.ac.in/courses/110/106/110106124/>
2. <https://nptel.ac.in/courses/109/104/109104109/>
3. https://swayam.gov.in/ndl_noc19_mg60/preview
4. https://onlinecourses.nptel.ac.in/noc22_de16/preview

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

CO1: Define the concepts related to design thinking.

CO2: Explain the fundamentals of Design Thinking and innovation.

CO3: Apply the design thinking techniques for solving problems in various sectors.

CO4: Analyze to work in a multidisciplinary environment.

CO5: Evaluate the value of creativity.

Year: I

SKILL ENHANCEMENT COURSE 1

Semester: I

Code:

**SOFT SKILLS
(Theory)**

Credits: 2

Course Objectives: At the end of the course the student will be able to:

1. Develop communicative competence among the Students.
2. Enhance the learner's soft skills by giving adequate exposure in LSRW and sub skills.
3. Apply Interpersonal skills
4. Develop Corporate skills
5. Enable learners to put the life skills into practice with confidence.

UNIT – I: KNOW THYSELF / UNDERSTANDING SELF: Introduction to Soft skills-Self discovery-Developing positive attitude-Improving perceptions- Forming values.

UNIT – II: INTERPERSONAL SKILLS/ UNDERSTANDING OTHERS: Developing interpersonal relationship-Team building-group dynamics- Networking- Improved work relationship

UNIT – III: COMMUNICATION SKILLS / COMMUNICATION WITH OTHERS: Art of listening –Art of reading –Art of speaking –Art of writing-Art of writing e-mails e mail etiquette.

UNIT – IV: CORPORATE SKILLS / WORKING WITH OTHERS : Oral Presentation – Memos- Note taking - Note making and preparing Minutes- Reports, Proposals, Abstracts - Technical Writing.

UNIT – V: SELLING SELF / JOB HUNTING Writing resume/cv-interview skills- Group discussion- Mock interview-Mock GD – Goal setting - Career planning

UNIT – VI: CURRENT CONTOURS: (for continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Meena.K and V.Ayothi (2013) A Book on Development of Soft Skills (Soft Skills: A Road Map to Success), P.R. Publishers
2. N. Krishnasamy, Manju Dhariwel and Lalitha Krishnasamy(2015). Mastering
3. Communication Skills and Soft Skills – Bloomburg.
4. Meera Banerjee and Krishna Mohan: Developing Communication Skills, Trinity
5. Publishers- (Lakshmi Publications.
6. Alex K. (2012) Soft Skills – Know Yourself & Know the World, S.Chand & Company LTD, Ram Nagar, New Delhi- 110 055.

COURSE OUTCOMES:

Upon successful completion of this Course, the student will be able to

C01: Develop listening, speaking, reading and writing skills in English.

C02: Enhance soft skills and engage in a range of communicative tasks and activities

C03: Comprehend a text and identify specific and global information

C04: Promote communicative ability in both spoken and written form of the language

C05: Develop corporate skills to promote leadership qualities and team spirit

Year: I	VALUE ADDED COURSE 1	Semester: I
Code:	FULL STACK DEVELOPMENT (Theory)	Credits: 2*

Course Objectives: After completing this course, students will be able to:

1. Understand the basics of Angular JS.
2. Develop Forms, inputs and Services.
3. Explore Directives and Databases.
4. Explore AngularJS Component
5. Construct Angular application with other Javascript libraries such as Node.js

UNIT – I: Introduction to JavaScript : JavaScript - Introduction, Variable, Value, Data type, Operators and Expressions, Arrays, Decision making and Loops, Functions, Variable Scope and Objects, The Browser Environment – BOM & DOM, Events and Event Handling.

UNIT – II: Full Stack Development Core Concepts: Basics of AngularJS. Advantages of Angular, AngularJS MVC, Introduction to SPA, Setting up the environment, First App using MVC architecture, Understanding ng attributes, Expression and Data Binding, Working with directives, Angular Modules , Controller, Scope and View ,Create Controller and Module, scope hierarchy.

UNIT – III: Filter, Forms and Ajax :Filters - Built-in filters - upper case and lower case filters, date ,currency and number formatting ,orderBy, filter ,custom filter, Angular JS Forms – Working with AngularJS forms, model binding, form controller ,Using CSS classes, form events ,custom model update triggers ,custom validation ,\$http service ,Ajax implementation using \$http

UNIT – IV: Introduction to Node.js: Basics of Node.js, Features of Node.js, Setup Development Environment- Installing Node.js, Working with REPL, Node.js Console, Node.js Module, Node Package Manager,Node.js Basics, File System ,HTTP and HTTPS, Creating Web Server- Handling http request, Node.js Callbacks, Node.js Events, introduction to react.

UNIT – V: Database Connectivity: Promises, Express.js, Database Connectivity – Connecting to RDBMS and NoSQL database, Performing CRUD operations.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Book:

1. Brad Dayley, “Node.js, MongoDB, and AngularJS Web Development”, Addison – Wesley, 2017.

Reference Books:

1. Mastering HTML, CSS & Javascript Web Publishing Paperback – 15 Jul 2016, Laura Lemay, Rafe Colburn, Jennifer Kyrnin

2. Web Design with HTML, CSS, JavaScript and jQuery Set Paperback, Jon Duckett, 2014.
3. Angular J S, Programming by Example, Agus Kurniawan
4. Adam Freeman - ProAngular JS, Apress, First Edition, 2014.
5. AgusKurniawan, "AngularJS Programming by Example", First Edition, PE Press, 2014

Course Outcome:

Upon successful completion of the course, students will be able to

C01: Create and bind controllers with Javascript.

C02: Apply filter in AngularJS application.

C03: Summarize Client Side MVC and SPA.

C04: explore AngularJS Component and develop an AngularJS Single Page Application from scratch.

C05: Create Forms, validate and use filters, CRUD functions using AngularJS form.soft

Year: I

CORE COURSE 3

Semester: II

Code:

**MACHINE LEARNING TECHNIQUES
(Theory)**

Credits: 4

Course Objectives: After completing this course, students will be able to:

1. Understand the basic concepts of machine learning.
2. Understand and build supervised learning models.
3. Understand and build unsupervised learning models.
4. Explore feature engineering
5. Understand Ensemble Learning

UNIT – I: INTRODUCTION – MODEL PREPARATION – EVALUATION:

Introduction to Machine Learning: Human Learning and its Types; Machine Learning and its types; Well-Posed Learning Problem; Applications of Machine Learning; Issues in Machine Learning. Preparing To Model: Basic Data Types; Exploring Numerical Data; Exploring Categorical Data; Exploring Relationship Between Variables; Data Issues and Remediation; Data Pre-Processing. Modelling And Evaluation: Selecting A Model; Training Model – Holdout, K-Fold Cross-Validation, Bootstrap Sampling; – Under-Fitting, Over-Fitting, Bias Variance Tradeoff – Model Performance Evaluation – Classification, Regression, Clustering – Performance Improvement.

UNIT – II: FEATURE ENGINEERING – REVIEW OF PROBABILITY – CONCEPT LEARNING:

Feature Engineering, Feature Construction – Feature Extraction – Feature Selection. Brief Review of Probability: Basic Concept Of Probability – Random Variables – Discrete Distributions – Binomial, Poisson – Bernoulli - Continuous Distribution – Uniform, Normal, Laplace; Central Theorem; Monte Carlo Approximation. Concept Learning: Find – S algorithm – Version Space and Candidate Elimination algorithm – Inductive Bias.

UNIT – III: SUPERVISED LEARNING: Supervised Learning – Regression: Simple Linear Regression; Other Regression Techniques. Supervised Learning – Classification: Basics of Supervised Learning – Classification; Logistic Regression – k-Nearest neighbor – Decision Tree Learning. Neural Networks: Introduction – Perceptron – Multi Layer Perceptron- Back Propagation Algorithm. Linear Discriminant Analysis - Support Vector Machine. Bayesian Concept Learning: Bayes Theorem – Prior and Posterior Probability, Likelihood; Bayesian Belief Network.

UNIT – IV: UNSUPERVISED LEARNING: Unsupervised Learning: Basics of Unsupervised Learning – Clustering Techniques; Association Rules. Mixture Models – EM algorithm – PCA.

UNIT – V: ENSEMBLE LEARNING – PUBLIC DATASETS AND CASE STUDIES :

Concept of Ensemble Learning – Bagging and Boosting and its impact on bias and variance – Random Forest – Adaboost Classifier – Gradient Boosting

Machines – XG Boost. Exploring UCI Machine Learning Repository – Kaggle Data Sets – Analyzing Data Sets – Case Studies

UNIT – VI: Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson Education India, January 2018
2. Tom Mitchell, Machine Learning, McGraw Hill Education, First Edition, 2017

Reference Books:

3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, First edition, 2010.
4. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2015.

Course Outcome: Upon successful completion of the course, students will be able to

CO1: Understand the fundamentals of machine learning, model preparation and evaluation

CO2: Learn probability theory and its application in data understanding

CO3: Apply supervised learning algorithms and unsupervised learning algorithms on real data

CO4: Apply ensemble classifiers on data and compare the model performance

CO5: Explore data repositories and apply Machine Learning Algorithms on case studies

Year: I

CORE COURSE 4

Semester: II

Code:

**BLOCKCHAIN TECHNOLOGIES
(Theory)**

Credits: 4

COURSE OBJECTIVES: After completing this course, students will be able to:

1. Understand the basics of blockchain technology and its components.
2. Comprehend the working principles of Bitcoin and other cryptocurrencies.
3. Identify various consensus mechanisms used in blockchain networks.
4. Apply the concepts of Hyperledger Fabric and Ethereum for decentralized applications.
5. Analyze the structure and functionality of smart contracts and decentralized applications (DApps).

UNIT – I: INTRODUCTION TO BLOCKCHAIN: Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT – II: BITCOIN AND CRYPTOCURRENCY: A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT – III: BITCOIN CONSENSUS: Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW, monopolyproblem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT – IV: HYPERLEDGER FABRIC & ETHEREUM: Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT – V: BLOCKCHAIN APPLICATIONS: Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

Unit – VI Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS

1. Nakamoto, S., "Bitcoin: A Peer-to-Peer Electronic Cash System", Self-published, 2024.
2. Mougayar, W., "The Business Blockchain: Promise, Practice, and the Next Big Thing", Wiley, 2024.
3. Tapscott, D., & Tapscott, A., "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World", Penguin, 2023.
4. Hitzig, D., "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications", Wiley, 2024.

5. Wesselbaum, D., "Blockchain and Cryptocurrency: The Next Digital Goldmine", Routledge, 2023

REFERENCE BOOKS

1. Buterin, V., "Mastering Ethereum: Building Smart Contracts and DApps", O'Reilly Media, 2023.
2. Croman, K., et al., "On-Chain and Off-Chain in Blockchain Systems", Springer, 2024.
3. Baur, D., & Muller, D., "Blockchain Applications and Use Cases in Finance", Springer, 2023.
4. Xu, X., & Chen, X., "Hyperledger Fabric: Introduction and Implementation", Springer, 2023.
5. Antonopoulos, A. M., "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media, 2023

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

1. Demonstrate an understanding of blockchain technology and its key components.
2. Identify and explain the functioning of cryptocurrencies, including Bitcoin.
3. Apply consensus mechanisms such as Proof of Work and Proof of Stake in blockchain networks.
4. Analyze and implement solutions using Hyperledger Fabric and Ethereum.
5. Evaluate and develop smart contracts and DApps using blockchain platforms.

Year: I

CORE PRACTICAL 2

Semester: II

Code:

**MACHINE LEARNING TECHNIQUES LAB
(Practical)**

Credits: 2

1. Write a program to implement the Linear Regression for a sample training data set stored as a .CSV file. Compute Mean Square Error by considering few test data sets.
2. Write a program to implement the Non-linear Regression for a sample training data set stored as a .CSV file. Compute Mean Square Error by considering few test data sets.
3. Write a program to implement the Logistic Regression for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier.
4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
5. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.
6. Write a program to implement Support Vector Machine algorithm to classify the iris data set. Print both correct and wrong predictions. 1
7. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
8. Write a program to demonstrate the working of the decision tree based CART algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
9. Write a program to construct a Regression tree for cost estimation by assuming any numerical dataset.
10. Write a program to calculate the accuracy, precision, and recall for your data set. Assume a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.

Year: I	DISCIPLINE CENTRIC ELECTIVE COURSE 2	Semester: II
Code:	1. FUZZY LOGIC AND NATURE INSPIRED COMPUTING (Theory)	Credits: 4

Course Objectives: After completing this course, students will be able to:

- 1 Understand the basic concepts of Fuzzy set theory
- 2 Apply the concepts of Genetic algorithm
- 3 Explore feature selection using ACO
- 4 Analyze real world problems using PSO
- 5 Understand feature selection using ABC

UNIT – I: Fuzzy Systems - Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification. Theoretical Foundations of Rough Set theory, Knowledge Base, Equivalence, Generalization and Specialization of Knowledge, Introduction to Rough Sets, Definition of Rough Sets.

UNIT – II: Genetic Algorithm - Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization. GA based Backpropagation Networks: GA based Weight Determination, K - factor determination in Columns.

UNIT – III: Ant Colony Optimization - Introduction to Swarm Intelligence – Essence of an Algorithm, Algorithms and Self –Organization, Links between Algorithms and Self Organization, Characteristics of Metaheuristics; Swarm Intelligence based algorithms; Ant Colony Optimization (ACO) - Theoretical Considerations, Combinatorial optimization and metaheuristic, Stigmergy, Convergence Proofs, ACO Algorithm, ACO and Model Based Search

UNIT – IV: Particle Swarm Optimization: Principles of Bird Flocking and Fish Schooling, Evolution of PSO, Operating Principles, PSO Algorithm, Neighbourhood Topologies, Convergence Criteria, Variations of PSO. Applications.

UNIT – V: Artificial Bee Colony (ABC) Optimization - Behaviour of real bees, ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS

1. Swarm Intelligence Algorithms: Modifications and Applications; Adam Slowik, CRC Press, 2022.
2. Xin-SheYang, Zhihua Cui, Renbin Xiao, Amir Hossein Gandomi, Mehmet Karamanoglu, “Swarm Intelligence and Bio-Inspired Computation, Theory and Applications”, Elsevier 2013.

REFERENCE Books:

1. Rough Sets: Theoretical aspects of Reasoning about Data. Pawlak Z., Kluwer Academic Publishing, Dordrecht. 1991.
2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, John Wiley and Sons, Second Edition, 2004

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

CO1: Employ the concepts of Fuzzy set theory and Rough set theory in AI

CO2: Apply the concepts of Genetic algorithm in AI

CO3: Perform feature selection using ACO

CO4: Solve real world problems using PSO

CO5: Perform feature selection using ABC

Year: I

**DISCIPLINE CENTRIC ELECTIVE
PRACTICAL 2**

Semester: II

Code:

**1. FUZZY LOGIC AND NATURE INSPIRED
COMPUTING LAB
(Practical)**

Credits: 2

Write a program to (Using C/Python)

1. Implement of Fuzzy Operations.
2. Implement of Fuzzy Relations
3. Implement artificial neural network with back propagation.
4. Implement Bitwise Operations in GA
5. Implement mutation techniques.
6. Implement ACO Algorithm
7. Implement ABC (Artificial Bee Colony) optimization Technique.

Year: I	DISCIPLINE CENTRIC ELECTIVE COURSE 2	Semester: II
Code:	2. CRYPTOGRAPHY AND NETWORK SECURITY (Theory)	Credits: 4

Course objectives: After completing this course, students will be able to:

1. Understand basics of Cryptography and Network Security.
2. Secure a message over insecure channel by various means.
3. Learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. Understand various protocols for network security to protect against the threats in the networks.
5. Explore Web and System security

UNIT – I: Introduction to Cryptography and Block Ciphers : Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon’s theory of confusion and diffusion - fiestal structure - data encryption standard(DES) - strength of DES – differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.

UNIT – II: Confidentiality and Modular Arithmetic: Confidentiality using conventional encryption - traffic confidentiality - key distribution – random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat’s and Euler’s theorem - primality testing - Euclid’s Algorithm - Chinese Remainder theorem - discrete algorithms.

UNIT – III: Public key cryptography and Authentication requirements: Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffie-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.

UNIT – IV: Integrity checks and Authentication algorithms: MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.

UNIT – V: IP Security and Key Management: IP Security: Architecture - Authentication header - Encapsulating security payloads – combining security associations - key management. (Web and System Security) Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems.

UNIT – VI: Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester
Concerned

Text Books

1. William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI.
2. Wade Trappe, Lawrence C Washington, “ Introduction to Cryptography with coding theory”, Pearson.

Reference Books

1. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

OUTCOMES:

Upon successful completion of the course, students will be able to

1. Provide security of the data over the network.
2. Do research in the emerging areas of cryptography and network security.
3. Implement various networking protocols.
4. Protect any network from the threats in the world.
5. Understand Web security and System security

Year: I

**DISCIPLINE CENTRIC ELECTIVE
PRACTICAL 2**

Semester: II

Code:

**2. CRYPTOGRAPHY AND NETWORK SECURITY
LAB
(PRACTICAL)**

Credits: 2

1. Perform encryption, decryption using the following substitution techniques
(i) Ceaser cipher (ii) playfair cipher (iii) Hill Cipher (iv) Vigenere cipher
2. Perform encryption and decryption using following transposition techniques
(i) Rail fence (ii) row & Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
7. Calculate the message digest of a text using the SHA-1 algorithm.
8. Implement the Digital Signature Standard.

Year: I

GENERIC ELECTIVE COURSE 2

Semester: II

Code:

**1. STATISTICAL COMPUTING
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Provide a conceptual foundation in descriptive statistics for organizing and summarizing data effectively.
2. Introduce the fundamental principles of probability and random variables for modelling uncertainty.
3. Familiarize students with important discrete and continuous probability distributions and their applications.
4. Develop understanding of sampling techniques and sampling distributions for data-based generalization.
5. Equip students with basic tools of statistical inference, including estimation and hypothesis testing.

UNIT – I: INTRODUCTION & DESCRIPTIVE STATISTICS: Types of data: umerical, categorical, ordinal; Scales of measurement; Measures of central tendency: mean, median, mode; , Measures of dispersion: quartile deviation, inter-quartile range (IQR), variance, standard deviation; , Summarizing datasets: frequency tables, quartiles, deciles, percentiles, Data visualization: histograms, boxplots, scatterplots; Understanding the significance of different plots and statistical summaries in the context of data science

UNIT – II: BASICS OF PROBABILITY & RANDOM VARIABLES: Sample space, events, and probability axioms; Counting principles: permutations and combinations; Conditional probability and independence;, Bayes' theorem; Introduction to random variables: discrete and continuous;, Probability mass and density functions; Cumulative distribution function (CDF);, Mathematical Expectation: Expected value, variance, and higher-order moments for discrete and continuous random variables

UNIT – III: PROBABILITY DISTRIBUTIONS: Discrete distributions: Bernoulli, Binomial, Poisson, Negative binomial and Geometric distributions; , Geometric distributions;, Continuous distributions: Uniform, Normal, Exponential distributions; , Applications of distributions in real-world problems

UNIT – IV: SAMPLING AND SAMPLING DISTRIBUTIONS: Population vs. Sample; Sampling techniques: simple random, stratified, cluster sampling; Concept of sampling distribution, Standard error, Distribution of sample mean and sample proportion; Estimation: Point Estimation, Properties of good estimators, Interval Estimation: Confidence intervals for population mean and proportion (known and unknown variance),, interpretation, Central Limit Theorem and its applications

UNIT – V: STATISTICAL INFERENCE: Hypothesis testing: concepts of null and alternative hypotheses, Type I and Type II errors, p-values and significance levels;,

Tests for means and proportions: z-test, t-test (one-sample and two-sample); Introduction to chi-square test for independence., F-test: test for equality of variances between two populations

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbook(s):

1. Sheldon Ross, A First Course in Probability, 10th ed., Pearson Education,
2. Robert V. Hogg, Allen T. Craig, Introduction to Mathematical Statistics, 8th ed., Pearson Education,
3. George Casella & Roger L. Berger , Statistical Inference, 2nd ed., Cengage Learning,
4. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons 9788180540042,

Reference(s):

1. Joseph K. Blitzstein and Jessica Hwang, Introduction to Probability, CRC Press (Taylor & Francis Group),

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

1. Classify types of data and apply descriptive statistical techniques to summarize and visualize datasets.
2. Apply foundational probability rules, including Bayes' theorem, and understand the role of random variables and distributions.
3. Identify and use key discrete and continuous probability distributions to solve real-world problems.
4. Apply sampling methods and the Central Limit Theorem to derive sampling distributions and compute standard error.
5. Perform point estimation, construct confidence intervals, and conduct hypothesis tests for means and proportions.

Year: I

GENERIC ELECTIVE COURSE 2

Semester: II

Code:

**2. BUSINESS INTELLIGENCE
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Understand the nature of data, statistical Modelling and visualization.
2. Learn concepts of Business Intelligence and Data Warehousing.
3. Gain knowledge on Data mining process and SNA, text & Web analytics.
4. Understand Prescriptive Analytics
5. Explore Predictive Analytics

UNIT – I: An Overview of Business Intelligence: Analytics, Data Science, and AI: Changing Business Environments and Evolving Needs for Decision Support and Analytics, Decision-Making Processes and Computerized Decision Support Framework, Evolution of Computerized Decision Support to Analytics/Data Science, A Framework for Business Intelligence, Analytics Overview.

UNIT – II: Descriptive Analytics I: Nature of Data, Big Data, and Statistical Modeling: The Nature of Data in Analytics, A Simple Taxonomy of Data, The Art and Science of Data Preprocessing, Definition of Big Data, Fundamentals of Big Data Analytics, Big Data Technologies, Big Data and Stream Analytics, Statistical Modeling for Business Analytics, Regression Modeling for Inferential Statistics

UNIT – III: Descriptive Analytics II: Business Intelligence Data Warehousing, and Visualization: Business Intelligence and Data Warehousing, Data Warehousing Process, Data Warehousing Architectures, Data Management and Warehouse Development, Data Warehouse Administration, Security Issues, and Future Trends, Business Reporting, Data Visualization, Different Types of Charts and Graphs, The Emergence of Visual Analytics, Information Dashboards.

UNIT – IV: Prescriptive Analytics: Optimization and Simulation: Model-Based Decision-Making, Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Decision Modeling with Spreadsheets.

UNIT – V: Predictive Analytics: Text, Web, and Social Media Analytics: Text Analytics and Text Mining Overview, Natural Language Processing (NLP), Text Mining Applications, Text Mining Process, Sentiment Analysis and Topic Modeling, Web Mining Overview, Search Engines, Web Usage Mining (Web Analytics), Social Analytics. Suggested Learning Resources.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbook:

1. Ramesh Sharda, Dursun Delen and Efraim Turban, “Business Intelligence, Analytics, Data Science and AI – A Managerial Perspective”, 5th edition, Global Edition, Pearson Education Limited, 2024.

Reference Books:

1. Steve Williams, Business Intelligence Strategy and Big Data Analytics - A General Management Perspective, Morgan Kaufmann (Elsevier), 2016.
2. Vincent Charles, Pratibha Garg, Neha Gupta and Mohini Agarwal, Data Analytics and Business Intelligence - Computational Frameworks, Practices, and Applications, CRC Press, 2023.
3. Ira J. Haimowitz, DATA ANALYTICS FOR BUSINESS - Lessons for Sales, Marketing, and Strategy, Routledge (Taylor & Francis), 2023.

Web links and Video Lectures (e-Resources):

- <https://www.tableau.com/business-intelligence/what-is-business-intelligence>
- https://onlinecourses.nptel.ac.in/noc24_cs65/preview
- https://onlinecourses.nptel.ac.in/noc21_cs45/preview
- <https://cloud.google.com/learn/what-is-business-intelligence>
- <https://www.geeksforgeeks.org/what-is-data-analytics/>

Course outcomes:**Upon successful completion of the course, students will be able to**

1. Understand the role of business intelligence and analytics in a dynamic business environment.
2. Apply modern tools for Statistical Modelling and Visualization.
3. Demonstrate descriptive analytics for Business Intelligence and Data Warehousing.
4. Implement algorithms for data mining techniques and processes.
5. Develop scripts for Text & Web mining and social network analysis.

Year: I

GENERIC ELECTIVE COURSE 2

Semester: II

Code:

**3. RESEARCH METHODOLOGY
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Explore basics of Research
2. Explore formulating the research problems
3. Understand Methods of data collection
4. Infer quantitative methods
5. Understand ethical issues

UNIT – I: INTRODUCTION TO RESEARCH: Introduction to research; Definitions and characteristics of research; Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Main components of any research work.

UNIT – II: PROBLEM FORMULATION AND DESIGN: Defining and formulating the research problem: Selecting the problem - Necessity of defining the problem, Literature review: Importance of literature review in defining a problem, Primary and secondary sources –reviews, treatise, and monographs-patents – web as source – searching in the web - Critical literature review – Identifying gap areas from literature review. Essentials of Research Design, Need for Research Design, Classifications of Research Design: causations and Experimental Design, Errors in Research Design, Types of Research Errors.

UNIT – III: DATA COLLECTION: Observation and Collection of data, Methods of data collection, Different types of variables, Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages, Hypothesis-testing, Generalization and Interpretation

UNIT – IV: QUANTITATIVE METHODS: Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis

UNIT – V: ETHICS AND REPORT WRITING: Ethical issues - Copy right - Intellectual property rights and patent law - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Ranjit Kumar," Research Methodology: A Step-by-Step Guide for Beginners", SAGE Publications Ltd; Fourth edition, 2014.

2. C.R. Kothari, " Research Methodology: Methods and Techniques", NEW AGE; Second Edition, 2014.
3. Peter Pruzan, "Research Methodology: The Aims, Practices and Ethics of Science", Springer; First Edition, 2016

Reference Books:

1. Andries P. Engelbrecht "Computational Intelligence: An Introduction", Wiley-Blackwell; 2nd Edition, 2007.
2. Anthony J. Hayter "Probability and Statistics for Engineers and Scientists", CENGAGE Learning Custom Publishing; 4th edition, 2011.
3. Bernard C. Beins and Maureen A. McCarthy "Research Methods and Statistics" Pearson, 2011
4. Colin Neville "The Complete Guide to Referencing and Avoiding Plagiarism", Open University Press, 2007.
5. Dinesh Kumar, Research Methods for Successful PhD, River Publishers Series in Innovation and Change in Education- Cross Cultural Perspective, 2017 (ISBN: 9788793609181).
6. Marc van Dongen, LaTeX and Friends, Springer, Feb. 29, 2012 (ISBN 978-3-642-23815-4)

Course Outcome (CO) Upon successful completion of the course, students will be able to

- CO1:** Critically evaluate current research and propose possible alternate directions for further work
- CO2:** Develop hypothesis and methodology for research
- CO3:** Comprehend and deal with complex research issues
- CO4:** Acquire the knowledge of data collection methods and quantitative methods
- CO5:** Understand the ethical values to be followed during research and learn how to write the research report

Year: I

SKILL ENHANCEMENT COURSE 2

Semester: II

Code:

**DATA ANALYTICS USING R
PROGRAMMING
(Theory)**

Credits: 2

Course Objectives: After completing this course, students will be able to:

1. Understand fundamentals of R
2. Explore different programming constructs
3. Apply Vectors , Lists, Matrices and Arrays
4. Understand Data Frames
5. Apply Data Visualization techniques

UNIT – I: INTRODUCTION TO R: Scope of R – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: `installed.packages()`, `packageDescription()`, `help()`, `find.package()`, `library()` - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and -inf.

UNIT – II: VARIABLES AND DATA TYPES – DECISION MAKING AND LOOPS: R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – R - Variables: Variable assignment, Data types of Variable, Finding Variable `ls()`, Deleting Variables - R Operators- R Decision Making - R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.

UNIT – III: FUNCTIONS – STRINGS – VECTORS – LISTS – MATRICES AND ARRAYS: R-Function : function definition, Built in functions: User defined function , calling a function, calling a function without an argument, calling a function with argument values - R-Strings – Manipulating Text in Data - R Vectors – Lists - Matrices - Arrays.

UNIT – IV: WORKING WITH DATA FRAMES: Data Frames –Create Data Frame, Data Frame Access, Understanding Data in Data Frames - Extract Data from Data Frame, Merging Data frames `merge()` – Melting and Casting data

UNIT – V: DATA VISUALIZATION: Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode - Standard Deviation – Correlation - R –Pie Charts: 3D Pie Chart – R Histograms – Density Plot - R – Bar Charts: Bar Chart Labels, Title and Colors.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Reference Books:

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017, ISBN : 978- 93-5260-455-5.

2. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260- 524-8.

Reference Books:

1. Tutorials Point (I) simply easy learning, Online Tutorial Library (2018), R Programming, Retrieved from https://www.tutorialspoint.com/r/r_tutorial.pdf.
2. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8

Course Outcome (CO): Upon successful completion of the course, students will be able to

- CO1 Understand the R programming constructs and simple functions
- CO2 Write simple programs using decision statements and looping statements
- CO3 Create user defined functions and work on vectors – lists – matrices
- CO4 Handle data using data frames
- CO5 Explore various visualization techniques to understand data Skill

Year: I

NON-MAJOR ELECTIVE COURSE 1

Semester: II

Code:

**DATA ANALYSIS USING EXCEL
(Theory)**

Credits: 2

Course Objectives: After completing this course, students will be able to:

1. Understand basics of Excel
2. Explore functions in Excel
3. Apply What-if Analysis
4. Understand data validation techniques in excel
5. Learn VBA concepts

UNIT – I: INTRODUCTION: Introduction to Excel – Various Selection techniques – customizing excel – using basic functions – formatting and proofing.

UNIT – II: FUNCTIONS IN EXCEL: Mathematical functions – Protecting excel – text functions – date and time functions – advanced features – sorting and filtering text data – sorting and filtering numbers and colors – other sorting options.

UNIT – III: WHAT-IF ANALYSIS: What-if Analysis: Goal seek – scenario analysis – Data tables – solver tool. Logical functions.

UNIT – IV: DATA VALIDATION: Number, date and time validation – customizing validations based on formula for cell – dynamic drop down list creation using data validation – dependency list – Lookup Functions – Pivot Tables – Charts and Slicers

UNIT – V: VBA: Introduction to VBA – variables in VBA – decisions in VBA – loops in VBA – Worksheet operations using VBA

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text / Reference Books:

1. Manisha Nigam (2019). Data Analysis with Excel. BPB Publications.
2. Brian Moriarity, Bernd Held and Theodor Richardson (2019). Microsoft Excel Functions and Formulas. Stylus Publishing LLC.

Course Outcome (CO) Upon successful completion of the course, students will be able to

- CO1 Learn the excel operations in data
- CO2 Apply various functions on data and analyse results
- CO3 Learn to create pivot tables and analyse results
- CO4 Perform various data validation techniques in excel
- CO5 Create VBA programs to perform advance data operations

Year: II

CORE COURSE 5

Semester: III

Code:

**DEEP LEARNING TECHNIQUES
(Theory)**

Credits: 4

COURSE OBJECTIVES: After completing this course, students will be able to:

1. Introduce the fundamental concepts of neural networks, including learning mechanisms, activation functions, optimization strategies, and regularization techniques.
2. Explore the architecture and working principles of convolutional neural networks and their variants for feature extraction and sequential modeling.
3. Implement recurrent neural network architectures, including LSTM, GRU, and attention-based encoder-decoder models, for sequence learning tasks.
4. Analyze advanced deep learning architectures such as autoencoders, generative models, transformers, and large language models based on their characteristics and limitations.
5. Evaluate the effectiveness of deep learning models and transfer learning approaches in modern real-world application domains.

UNIT – I: INTRODUCTION: Feed forward Neural networks – Gradient descent and the back propagation algorithm - Activation function and Unit Saturation – Optimization Algorithm: SGD & Adaptive Gradient Algorithm - Regularization – Dataset Augmentation.

UNIT – II: CONVOLUTION NEURAL NETWORK: Convolution Neural Network - ConvNet Architecture -CNN operation – Pooling – Types of CNN architecture: LeNet - Alex Net - ResNet - EfficientNet – Comparison of CNN & RNN - Sequential Modelling.

UNIT – III: RECURRENT NEURAL NETWORKS: Recurrent Neural Network – LSTM - GRU - BiRNN - Limitations of RNN and transition to Attention Model - Encoder Decoder architectures - Auto encoders - DBM – Attention model - memory models - Dynamic Memory Models – Vanishing Gradient

UNIT – IV: ADVANCED NEURAL NETWORKS: Transfer Learning – Transfer Learning model -Variational Auto encoders - Generative Adversarial Network - CycleGAN – StyleGAN - Transformer model – BERT – GPT – LLM, Introduction to RAG.

UNIT – V: MODERN AND REAL-WORLD APPLICATIONS OF DEEP LEARNING : Generative AI Applications – Image, Text, Audio and Video Generation using GANs and Diffusion Models – Large Language Models (BERT, GPT, LLaMA) for NLP Tasks – Conversational AI and Intelligent Assistants - Deep Learning for Healthcare and Biomedical Applications- Autonomous Systems and Robotics using Deep Learning and Reinforcement Learning

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS

1. F. Chollet, "Deep Learning with Python (2nd edition)", Manning Publications Co., USA, 2021
2. A.Zhang, Z. C.Lipton, M.Li, and A.J.Smola, —Dive into Deep Learning, 2020
3. Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2023

REFERENCE BOOKS

1. Deep Learning Step by Step with Python, N D Lewis, 2016
2. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017
3. Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Umberto Michelucci, Apress, 2018
4. Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccane, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.
5. Amit kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan Chakrabarti —Deep Learning", Pearson Education, 2022.

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

CO1: Describe the fundamentals of deep learning, including feed-forward neural networks, backpropagation, optimization, and regularization techniques.

CO2: Implement and evaluate Convolutional Neural Network (CNN) architectures for image classification and computer vision tasks.

CO3: Model and examine sequential data using RNN, LSTM, GRU, and attention-based architectures for text and time-series applications.

CO4: Develop advanced deep learning models such as Autoencoders, GANs, Diffusion models, Transformers, and Large Language Models.

CO5: Assess transfer learning, pretrained foundation models, Retrieval-Augmented Generation, and multimodal approaches to solve real-world problems.

Year: II

CORE COURSE 6

Semester: III

Code:

**QUANTUM COMPUTING
FUNDAMENTALS
(Theory)**

Credits: 4

COURSE OBJECTIVES: After completing this course, students will be able to:

1. Identify the differences between Quantum Computing and conventional computing
2. Understand the different quantum computing mechanics.
3. Know the indepth of quantum computation theory.
4. Understand Quantum algorithms, and their advantages over classical algorithms.
5. Get the knowledge about quantum cryptography

UNIT – I: INTRODUCTION OF QUANTUM COMPUTING AND OVERVIEW:

History of quantum computation and quantum information, Quantum bits, Multiple qubits, Quantum computation, Single qubit gates, Multiple qubit gates, Measurements in bases other than the computational basis, Quantum circuits, Qubit copying circuit.

UNIT – II: Quantum Circuits: Quantum Algorithms – Classical computations on a quantum computer, Quantum parallelism, Deutsch’s algorithm, The Deutsch-Jozsa algorithm-Universal Quantum Gates – Quantum Circuit Model of Computation – Simulation – Quantum Fourier Transform and Applications – Quantum Search Algorithms – Quantum Computers.

UNIT – III: QUANTUM INFORMATION - Quantum Noise and Quantum Operations: Classical Noise and Markov processes – Quantum Operations – Examples – Applications – Distance Measures for Quantum Information – Quantum Error Correction – Entrop.

UNIT – IV: QUANTUM ERROR-CORRECTION - The three-qubit bit flip code, the Three-qubit phase flip code, The Shor code, the Theory of quantum error correction Discretization of the errors, Independent error models, Degenerate codes, The quantum Hamming bound.

UNIT – V: QUANTUM CRYPTOGRAPHY: Private key cryptography, Privacy amplification and information reconciliation, Quantum key distribution, Privacy, and coherent information, and security of quantum key distribution.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS:

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

2. Wong, H. Y. (2024). Introduction to quantum computing: From a layperson to a programmer in 30 steps (2nd ed.)

REFERENCE BOOKS:

1. Scott Aaronson, “Quantum Computing since Democritus”, Cambridge, 2013.
2. Riley Tipton Perry, “Quantum Computing from the Ground Up”, World Scientific Publishing Ltd 2012.
3. V.K Sahni, Quantum Computing (with CD), TATA McGraw-Hill, 2007.
4. Thapliyal, H., & Humble, T. (Eds.). (2024). Quantum computing: Circuits, systems, automation and applications
5. Hidary, J. D. (2021). Quantum computing: An applied approach (2nd ed.).

WEB REFERENCES:

1. <https://fivebooks.com/best-books/quantum-computing-chris-bernhardt/>
2. <https://philpapers.org/browse/quantum-computation>
3. https://link.springer.com/referenceworkentry/10.1007/978-1-4020-8265-8_1230
4. <https://www.fi.muni.cz/usr/gruska/qbook1.pdf>
5. <https://library.oapen.org/handle/20.500.12657/48236>
6. <https://freecomputerbooks.com/Quantum-Computing-for-the-Quantum-Curious.html>
7. https://www.open.edu/openlearn/science-maths-technology/introduction-quantum-computing?utm_source=chatgpt.com
8. https://www.researchgate.net/publication/329818131_Open_source_software_in_quantum_computing?utm_source=chatgpt.com
9. https://www.reddit.com/r/opensource/comments/1k2cr9e?utm_source=chatgpt.com

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

1. Analyze the performance of data transmission between the systems using quantum computing algorithms.
2. Identify suitable technique to minimize complexity of different computational problems.
3. Apply quantum search algorithms of find quantum information for speeding up the solutions of NP-complete problems.
4. Apply three-qubit phase flip code & shor code to discretize and correct the errors.
5. Identify suitable cryptography algorithms to provide security for quantum information

Year: II

CORE PRACTICAL 3

Semester: III

Code:

**DEEP LEARNING TECHNIQUES LAB
(Practical)**

Credits: 2

1. Build a fully connected Feed Forward Neural Network using appropriate datasets
2. Implement backpropagation algorithm and compute weight gradients.
3. Implement a CNN with two convolution layers for handwritten digit recognition using MNIST.
4. Design and implement a CNN for multi-class image classification using CIFAR-10 and analyze performance across epochs.
5. Implement image classification using a ResNet-based deep learning model.
6. CNN-based medical image classification using transfer learning for healthcare applications.
7. Implement sentiment analysis using LSTM/GRU models on movie review datasets.
8. Implement text generation using LSTM for character-level or word-level prediction.
9. Implement sentiment analysis using a pre-trained BERT model.
10. Develop a simple Chatbot using LLMs

Course Objectives: After completing this course, students will be able to:

1. Expertise in big data concepts.
2. Acquire the knowledge in Hadoop
3. Explore MapReduce paradigms
4. Apply various features of Hive.
5. Expertise in Big data.

UNIT – I: Introduction to Big Data - Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of Big Data – Definition of Big Data – Challenges with Big Data – 3Vs of Big Data – Non-Definitional traits of Big Data – Business Intelligence vs. Big Data – Data warehouse and Hadoop environment – Coexistence. Big Data Analytics: Classification of analytics – Data Science – Terminologies in Big Data – CAP Theorem – BASE Concept.

UNIT – II: Hadoop: Introduction to Hadoop: Features – Advantages – Versions – Overview of Hadoop Eco systems – Hadoop distributions – Hadoop vs. SQL – RDBMS vs. Hadoop – Hadoop Components – Architecture – HDFS – Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

UNIT – III: Databases: No SQL databases: Mongo DB: Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export. Cassandra: Introduction – Features – Data types – CQLSH – Key spaces – CRUD operations – Collections – Counter – TTL – Alter commands – Import and Export – Querying System tables.

UNIT – IV: Hadoop Eco systems: Hive – Architecture – data type – File format – HQL – SerDe – User defined functions – Pig: Features – Anatomy – Pig on Hadoop – Pig Philosophy – Pig Latin overview – Data types – Running pig – Execution modes of Pig – HDFS commands

UNIT – V: Overview of Big Data and Spark: Gentle Overview of Big Data and Spark: What is Apache Spark-History of Spark-The Present and Future of Spark-Downloading Spark Locally-A Gentle Introduction to Spark:Spark's Basic Architecture-Spark Applications-Spark API's-The SparkSession- Partitions-Lazy Evaluation-DataFrames and SQL.

Text Books

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2016, ISBN: 9788126554782.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013, ISBN: 978118504222.

Reference Books

1. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011. ISBN: 9781935182870.
2. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.
3. Russell Bradberry, Eric Blow, "Practical Cassandra A Developers Approach", Pearson Education, 2014, ISBN: 9780321933942.DIGITAL SCIENCES (2023)

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

1. Summarize the fundamental of Big Data.
2. Expertise in big data techniques/tools.
3. Acquire knowledge in Hadoop.
4. Illustrate the role of MapReduce programming in various scenarios.
5. Develop solutions to problems using Big Data.

Year: II DISCIPLINE CENTRIC ELECTIVE COURSE 3 Semester: III

Code: 2. NATURAL LANGUAGE PROCESSING Credits: 4
(Theory)

COURSE OBJECTIVES: After completing this course, students will be able to:

1. Learn the fundamentals of natural language processing.
2. Understand word level and syntactic analysis.
3. Analyze the syntax analysis and parsing.
4. Understand the role of information retrieval and lexical resources.
5. Explore various applications of NLP.

UNIT – I: OVERVIEW OF NLP AND LANGUAGE MODELLING:

Overview: History of NLP – Generic NLP System – Levels of NLP – Stages in NLP – Processing Indian Languages – Challenges of NLP – Applications of NLP. Basics of Language Modelling: Various Grammar- based Language Models - Statistical Language Model.

UNIT – II: WORD LEVEL ANALYSIS AND MORPHOLOGY : Unsmoothed N-grams, Evaluating N-grams, Smoothing – Laplace Smoothing; Part-of-Speech Tagging – Tag Set - Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging; Hidden Markov and Maximum Entropy models - Morphological analysis and generation using Finite State Automata and Finite State transducer.

UNIT – III SYNTACTIC ANALYSIS:

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing - Ambiguity in Natural Language - Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CKY, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

UNIT – IV: INFORMATION RETRIEVAL AND LEXICAL RESOURCES:

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net - Frame Net – Stemmers -POS Tagger - Research Corpora.

UNIT – V: APPLICATIONS IN NLP: Question Answering with SQUAD – Dependency Parsing – Machine Translation – Coreference Resolution – Text Summarization - PropBank – FrameNet - Brown Corpus - British National Corpus (BNC).

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXTBOOKS

1. Sharvari Govilkar, Sagar Kulkarni and Dhiraj Amin, —Natural Language Processing, Staredu Solutions, ISBN Number: 9789386765383, 2022.
2. Daniel Jurafsky, James H. Martin, —Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Second Edition, Pearson Publication, 2014
3. Christopher Manning, —Foundations of Statistical Natural Language Processing, MIT Press, 2009

REFERENCE BOOKS

1. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman & Hall/CRC Press, 2010.
2. Deepti Chopra, Nisheeth Joshi, I. Mathur, —Mastering Natural Language Processing with Python, First Edition, Packt Publishing Limited, 2016.
3. Mohamed Zakaria Kurdi, —Natural Language Processing and Computational Linguistics 1: Speech, Morphology and Syntax, First Edition, ISTE Ltd. Wiley, 2016.
4. Atefeh Farzindar, Diana Inkpen, —Natural Language Processing for Social Media, Second Edition, Morgan and Claypool Life Sciences, 2015.

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

- CO1 Comprehend the basics of Natural Language Processing and analyze its challenges
- CO2 Implement techniques to extract information from text using NLP concepts and language models.
- CO3 Examine the syntax, and semantics of a natural language statement
- CO4 Evaluate Information Retrieval models to retrieve relevant information effectively.
- CO5 Assess diverse applications of NLP across real-world scenarios.

Year: II

**DISCIPLINE CENTRIC ELECTIVE
PRACTICAL 3**

Semester: III

Code:

**1. BIG DATA TECHNOLOGIES LAB
(Practical)**

Credits: 2

LIST OF EXERCISES

1. Installation of Hadoop.
2. Develop file management tasks in hadoop.
3. Perform word count program using map reduce.
4. Design map reduce program that mines weather data.
5. Perform NoSQL database using mongodb.
6. Create queries using hive.
7. Develop pig scripts to sort, group, join, project, and filter your data.
8. Create DDL & DML comments using Cassandra

Year: II

**DISCIPLINE CENTRIC ELECTIVE
PRACTICAL 3**

Semester: III

Code:

**2. NATURAL LANGUAGE PROCESSING LAB
(Practical)**

Credits: 2

LIST OF EXERCISES

1. (i) Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers. (ii) Check how many words are there in any corpus. Also check how many distinct words are there?
2. Write a program to implement both user-defined and pre-defined functions to generate (a) Uni-grams (b) Bi-grams (c) Tri-grams (d) N-grams
3. Write a program to calculate the highest probability of a word (w2) occurring after another word(w1).
4. (i) Write a program to identify the word collocations. (ii) Write a program to print all words beginning with a given sequence of letters. (iii) Write a program to print all words longer than four characters.
5. Write a program to identify the mathematical expression in a given sentence.
6. Write a program to identify different components of an email address.
7. Write a program to identify all antonyms and synonyms of a word.
8. Write a program to find all the stop words in any given text.
9. Write a function that finds the 50 most frequently occurring words of a text that are not stopwords.
10. Write a program to implement various stemming techniques and prepare a chart with the performance of each method.

Year: II

GENERIC ELECTIVE COURSE 3

Semester: III

Code:

**1. DATA SCIENCE IN BIO
INFORMATICS
(Theory)**

Credits: 3

Course Objectives:

1. Introduce data science concepts and their relevance in biology and healthcare.
2. Understand genomic and proteomic data and their computational processing techniques.
3. Apply structural bioinformatics methods to predict protein structures and perform drug discovery.
4. Utilize AI, statistical, and graph-based algorithms for biological data analytics
5. Explore advanced deep learning models and their role in modeling complex biological systems

UNIT – I: DATA SCIENCE IN BIOLOGY AND HEALTHCARE:

Need for Data Science in Biology and Healthcare, Visualization tools for biological, bioinformatics datasets, data handling, transformations of data

UNIT – II: DATA SCIENCE IN GENOMICS: Data Science in genomics, from genetics to genomes, Alignment, and phylogenetic trees. Data Science in genomics, from genetics to genomes, Alignment, and phylogenetic trees. , Data Science in genomics, from genetics to genomes, Alignment, and phylogenetic trees. , Data Science in genomics, from genetics to genomes, Alignment, and phylogenetic trees.

UNIT – III: STRUCTURAL BIOINFORMATICS: Structural bioinformatics, Proteomics, Protein structure prediction, integrative structural modelling, and structure-based drug design., integrative structural modelling, and structure-based drug design, integrative structural modelling, and structure-based drug design, integrative structural modelling, and structure-based drug design

UNIT – IV: AI ALGORITHMS, STATISTICAL TOOLS: AI algorithms, statistical tools, graph algorithms for bioinformatics data analytics, graph algorithms for bioinformatics data analytics, graph algorithms for bioinformatics data analytics, AI algorithms, statistical tools, graph algorithms for bioinformatics data analytics

UNIT – V: DEEP LEARNING PERSPECTIVE OF BIOINFORMATICS APPLICATIONS: Deep learning perspective of bioinformatics applications, algorithms in GANs for biological applications, Whole-cell modelling approaches. , algorithms in GANs for biological applications, Whole-cell modelling approaches. , Deep learning perspective of bioinformatics applications, algorithms in GANs for biological applications, Whole-cell modelling approaches.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbook(s):

1. Arthur M. Lesk, "Introduction to Bioinformatics", , 5th ed., Oxford University Press),
2. Jeil Grus, , "Data Science from Scratch: First Principles with Python", 2nd ed., O'Reilly Media Inc,

Reference Books:

1. Vince Buffalo, , Bioinformatics Data skills", , O'Reilly Media Inc,
2. Neil C. Jones and Pavel A. Pevzner, , introduction to Bioinformatics Algorithms", , The MIT Press

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

1. Explain the role of data science in solving problems related to biology and healthcare.
2. Apply data science tools to analyze genomic sequences and build phylogenetic trees.
3. Analyze protein structures and demonstrate the use of bioinformatics in drug discovery
4. Evaluate the effectiveness of AI and statistical algorithms for biological data interpretation
5. Design deep learning models including GANs for biological applications and whole-cell simulations

Year: II

GENERIC ELECTIVE COURSE 3

Semester: III

Code:

**2. FOUNDATION OF REMOTE
SENSING
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Understand and be able to articulate the basics of how electromagnetic energy enables remote sensing
2. Able to explain the concepts of spatial, spectral, radiometric and temporal resolution.
3. Explore sensor Technology
4. Understand Orbital Elements of Satellite
5. Explore Remote Sensing Satellites

UNIT – I: Introduction: History of Remote Sensing; Physics of Remote Sensing: Electromagnetic Radiation (EMR), Characteristics; Electromagnetic Spectrum (EMS); Interactions Between Matter and Electro-Magnetic Radiation

UNIT – II: Energy Interaction in The Atmosphere: Energy Interactions with The Earth's Surface. Radiation Laws. Atmospheric Windows; Types of Remote Sensing with Respect to Wavelength Regions.

UNIT – III: Sensor and Platforms. Sensor Technology; Historical Development; Types of Platforms and Sensors– Airborne Remote Sensing; Space Borne Remote Sensing

UNIT – IV: Orbital Elements of Satellite; Sensor Types Characteristics: Active and Passive Remote Sensing; Imaging Systems; Non-Imaging Sensors; Across Track and Along Track Scanners; Framing and Scanning Systems; Characteristics of Optical Sensors; Resolution.

UNIT – V: Remote Sensing Satellites and Data Products: Overview of Different Satellite and Sensors for Earth Observations– Coarse; Medium and High-Resolution Missions (Landsat Series); SPOT; Ikonos; Quickbird; ASTER; Sentinel; Aqua and Terra (MODIS); SAR and Future Missions.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.
2. Rees, W. G. (2012). Physical Principles of Remote Sensing. Cambridge University Press.
3. Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective 2/E. Pearson Education India.

References Books:

1. Sabins, F. F. (2007). Remote Sensing: Principles and Applications. Waveland Press. "Digital Image Processing", Gonzalez and Woods, 3rd Edition, Pearson Education.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Understanding basic components of remote Sensing
2. Understand functioning, data acquisition and orbit operations of missions.
3. Analyze sensor Technology
4. Analyze Characteristics of Optical Sensors
5. Understand Remote Sensing Satellites

Year: II

GENERIC ELECTIVE COURSE 3

Semester: III

Code:

**3. DIGITAL MARKETING
(Theory)**

Credits: 3

COURSE OBJECTIVES: After completing this course, students will be able to:

1. Examine and explore the role and importance of digital marketing
2. Focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured
3. Understand search engine mechanism
4. Explore mail marketing
5. Understand digital transformation

UNIT – I: INTRODUCTION TO ONLINE MARKET: Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT – II: SEARCH ENGINE OPTIMISATION: Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors - On-Page Techniques - Off-Page Techniques. Search Engine Marketing How Search Engine works- SEM components- PPC advertising -Display Advertisement

UNIT – III: E- MAIL MARKETING: E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns- Profiling and targeting

UNIT – IV: SOCIAL MEDIA MARKETING: Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT – V: DIGITAL TRANSFORMATION: Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia; Publisher: Pearson Education; First edition , 2017;ISBN-10: 933258737X;ISBN-13: 978-9332587373.
2. Digital Marketing by VandanaAhuja; Publisher: Oxford University Press, 2015, ISBN-10: 0199455449. 3. Marketing 4.0: Moving from Traditional to Digital by

Philip Kotler; Publisher: Wiley; 1st edition, 2017; ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.

3. Ryan, D.,2014, Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited,2014.

4. Barker, Barker, Bormann and Neher, Social Media Marketing: A Strategic Approach,2E South-Western ,Cengage Learning,2017.

5. Pulizzi, J Beginner's Guide to Digital Marketing , Mcgraw Hill Education,2015.

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

CO1 Examine and explore the role and importance of digital marketing in today's rapidly changing business environment.

CO2 To know the key elements of a digital marketing strategy.

CO3 Focuses on how digital marketing can be utilized by organizations

CO4 Study how the effectiveness of a digital marketing campaign can be measured

CO5 Understand social media marketing. CO6 Demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

Year: II

NON-MAJOR ELECTIVE COURSE 2

Semester: III

Code:

**SOCIAL MEDIA CRIMES
(Theory)**

Credits: 2

Course Objectives: After completing this course, students will be able to:

1. Acquire knowledge of the needs, trends, and usage of social media on different platforms.
2. Identify the different kinds of social media crimes.
3. Develop best practices for privacy and understand the role of criminal justice system.
4. Understand Social Media Crimes against women and Children
5. Analyze the role of the criminal justice system in social media crimes

UNIT – I: Introduction to social media: Definitions – Social Media, Social Network, Social Networking Sites, Digital Identify, Types of Social Media, History of Social Media – Genesis of Internet, WWW, Trends in Social Media – Effects on the Society - Social Activism – Social Media's dark side – Civic engagement in the social world – Internet Vigilantism and Related Concepts – Digital Privacy and Privacy Issues - Types of social networking sites, - Profile, Content, White label, Mobile, Community-based SNS - Types and their vulnerabilities -

UNIT – II: Social Media Services: Types of services of social media – Usage of social media – Friending, Trending, Chatting, Wall Posts, Tweets, Selfies, Forwards, Community networking, Gaming, Memes, Talent displays - Use of social networking sites for small businesses – Use of social networking sites for large scale businesses – Use of social media in Politics – social media as other advertisement platforms – Different types of Promotions through social media.

UNIT – III: Social Media Crimes against women and Children: Types of Social Media Crimes against Women and Children - causes, consequences and countermeasures – Pornography – Child Pornography – Non-Consensual Pornography – Revenge Porn - Indecent Representation of Women – Insult to Modesty of Women - Online Violence – Cyber/virtual Rape - Online Harassment – Cyber Bullying – Cyber Stalking – Chat room based crimes – Emotional Targets – Toxic contents – Causing Disrespect - Online Predators – Abuse of Children online .

UNIT – IV: Other forms of Social Media Crimes: Online Frauds – Frauds targeting children, women, youngsters, and senior citizens – Business-related frauds – Hacking – Cyber Defamation – Cyber Terrorism – Financial Frauds – Fake News – Fake Memes – Online challenges, Selfie, Facebook, WhatsApp victimization – Digital Cloning Frauds – Morphing – Identity Theft – Data Theft – Human Flesh Search Engine

UNIT – V: Identity and Access Management: Identity and Access Management: Lifecycle for Identity and Access – Authentication – Authorization – Network Security: Concepts and Definitions – Sample Application.

UNIT – VI: Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Text Books

1. Catherine D. Marcum, George E. Higgins, “Social Networking as a Criminal Enterprise”, Routledge, 1 st Edition, 2016, ISBN: 9781138141902.
2. Adam Ali.Zare Hudaib, “Social media Cyber Crimes and XKeyscore Espionage Technologies”, LAP Lambert Academic Publishing, 2015, ISBN: 9783659636462.

Reference Books

1. Joshua Brunty, Katherine Helenek, “Social Media Investigation for Law Enforcement”, 1 st Edition, Anderson Publisher, 2012, ISBN: 9781455731626.DIGITAL SCIENCES (2023)
2. Venessa Garcia, Samantha G. Arkerson “Crime, Media, and Reality: Examining Mixed Messages About Crime and Justice in Popular Media”, Rowman & Littlefield Publishers, 2017, ISBN: 9781442260818.
3. Rebecca M. Hayes, Kate Luther, Crime: social media, Crime, and the Criminal Legal System (Palgrave Studies in Crime, Media and Culture)”, Palgrave Macmillan, 1st Edition, 2018, ASIN: B07GTH57P3

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

1. Acquire social media knowledge and differentiate between social networking sites.
2. Analyze the usage of social media on different platforms.
3. Identify the causes, consequences, and countermeasures of Social Media Crimes against Women and Children.
4. Categorize the other forms of social media crimes.
5. Design best practices for privacy on social networking sites.

Year: II

CORE COURSE 7

Semester: IV

Code:

**AGILE PROCESS AND DEVOPS
(Theory)**

Credits: 4

Course Objectives: After completing this course, students will be able to:

1. Understand the basic concepts of Agile
2. Explore Agility Requirements Engineering
3. Apply Agile Forecasting
4. Explore Sprint in Agile
5. Understand Agile Testing and Devops

UNIT – I: Introduction to Agile: Agile versus traditional method comparisons and process tailoring Software Process Models – overview, Introduction to Agile – Various Agile methodologies – Scrum, XP, Lean, and Kanban, Agile Manifesto, Scrum: Scrum process, roles – Product Owner – Scrum Master – Team, Project Manager, product manager, architect, events, and artefacts.

UNIT – II: Agility Requirements Engineering: Product Inception: Product vision, stakeholders, initial backlog creation; Agile Requirements - User personas, story mapping, user stories, 3Cs, INVEST, acceptance criteria, sprints, requirements, product backlog and backlog grooming; Tools: Agile tracking tools such as JIRA; Scaled agile frameworks: SAFe, Scrum@Scale, Disciplined Agile.

UNIT – III: Agile Forecasting and Project Management: Definition of Done, Definition of Ready; Estimation; Agile forecasting and project Management - Big visible information radiators, velocity, progress tracking, Track Done pattern, project forecasting, Ux Design, Control the Flow: Sprint Planning, Sprint Reviews, Sprint Retrospectives, Sprint Planning - Agile release and iteration (sprint) planning, Develop Epics and Stories, Estimating Stories, Prioritizing Stories (WSJF technique from SAFe), Create product roadmap.

UNIT – IV: Sprint in Agile: Sprints: Iterations/Sprints Overview. Velocity Determination, Iteration Planning Meeting, Iteration, Planning Guidelines, Development, Testing, Daily Stand-up Meetings, Progress Tracking, Velocity Tracking, Monitoring and Controlling: Burn down Charts, Inspect & Adapt (Fishbone Model), Agile Release Train.

UNIT – V: Agile Testing and Devops: Testing: Functionality Testing, UI Testing, Performance Testing, Security Testing, Tools - Selenium Agile Testing: Principles of agile testers; The agile testing quadrants, Agile automation, Test automation pyramid DevOps: Continuous Integration and Continuous Delivery CI/CD: Jenkins Creating pipelines, Setting up runners Containers and container orchestration (Dockers and Kubernetes) for application development and deployment; Checking build status; Fully Automated Deployment; Continuous monitoring with Nagios; Introduction to DevOps on Cloud.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. Agile Project Management: Creating Innovative Products, Second Edition By Jim Highsmith Addison-Wesley Professional, 2009
2. Agile Project Management: Managing for Success, By James A. Crowder, Shelli Friess, Springer 2014
3. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, By Andrew Stellman, Jennifer Greene, 2015, O Reilly
4. DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive ... By Sricharan Vadapalli, Packt, 2018

Reference Books:

1. Agile Testing: A Practical Guide For Testers And Agile Teams, Lisa Crispin, Janet Gregory, Pearson, 2010
2. More Agile Testing: Learning Journeys for the Whole Team By Janet Gregory, Lisa Crispin, Addison Wesley, 2015.
3. DevOps: Puppet, Docker, and Kubernetes By Thomas Uphill, John Arundel, Neependra Khare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, Packt, 2017

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

CO1 Able to compare and contrast the differences between Agile and other project management methodologies

CO2 Familiarize with Agility requirement engineering process

CO3 Able to identify and use various tools for Agile development

CO4 Apply sprint in Agile

CO5 Able to understand and implement DevOps principles

Year: II

CORE COURSE 8

Semester: IV

Code:

**GENERATIVE AI AND LARGE
LANGUAGE MODELS
(Theory)**

Credits: 4

Course Objectives: After completing this course, students will be able to:

1. Understand the fundamentals of generative AI, differences between discriminative and generative models, applications of GenAI, and the architecture of GANs (Vanilla GAN, DCGANs, etc.).
2. Explore generative AI models for image synthesis (Autoencoders, VAEs, U-Net) and text generation (RNNs, LSTMs, Transformer models).
3. Implement language modelling techniques such as autoregressive and autoencoding models, data collection strategies, preprocessing methods, and the basics of neural networks for NLP.
4. Train LLMs using tokenization, transfer learning, fine-tuning, and apply meta-learning, few-shot learning, and masked language modelling techniques.
5. Develop LLM-based applications using LangChain, understand prompt engineering, and analyse the ethical implications and societal impact of AI-driven automation.

UNIT – I: INTRODUCING GENERATIVE AI: Overview of generative models, Discriminative vs. generative models, , Types of discriminative and generative models, Strengths and weaknesses, Applications., Designing Generative Adversarial Networks- Structure, Types of GANs available available-Architecture of a GAN, Vanilla GAN, Architecture of Deep Convolutional GANs.

UNIT – II: GENAI FOR IMAGES : Structure, Introduction to computer vision, Computer vision architectures, Convolution neural networks,, Representation learning, Autoencoders and variational autoencoders, Generate new faces, VAE variants. , GenAI for Text- Structure, Natural language processing, Natural language processing tasks, Sequence to sequence models, Recurrent neural network, Long-short term memory networks, Transformer architecture

UNIT – III: INTRODUCTION TO LANGUAGE MODELS:

Types of language Models, Autoregressive and Autoencoding language models and its Examples., Data Collection and Pre-processing for Language Models- Data Acquisition strategies, Data cleaning, Data annotation, Fundamentals of RNN, Types of RNN, Transformers architecture , Basics of Neural Networks for Language Models

UNIT – IV: TRAINING LLM: Building a Tiny Language Model, Improving model with word tokenization, Training on a larger dataset, Building transformers and transfer learning, Building effective LLMs., Advanced Techniques for Language Modeling: Meta-learning, Few-shot learning, Multi-modal language modeling, Masked language modeling, Self-supervised learning, GAN. , Top Large Language Models, BERT, RoBERTa, Falcon LLM, GPT-4, LLaMa2, PaLM2.

UNIT – V: BUILDING FIRST LLM APPLICATION : Introduction to LangChain, LangChain agent, creating and deploying LLM app., Prompt Engineering:

Understanding prompts, Role of prompts in NLP, Advanced techniques and Key concerns for prompt engineering, Applications, Ethical considerations and Impact, Conversational AI, Language Translation and Multilingual models, Retrieval augmented generation; Pillars of ethical framework, Impact of LLM on Jobs and Society.

UNIT – VI: Current Contours (For continuous internal assessment only):
Contemporary Developments Related to the Course during the Semester Concerned

Textbook(s):

1. Zonunfeli Ralte, Indrajit Kar, , “Learn Python Generative AI, BPB publications, 2024.
2. Karthikeyan Sabesan, Sivagamisundari, Nilip Dutta, , Generative AI for Everyone, BPB publications, 2025.
3. Sanket Subhash Khandare, , Mastering large Language Models- Advanced techniques, applications, cutting-edge, methods, and top LLM, BPB publications, 2024.

Reference(s):

1. Jay Alamar & Maarten Grootendorst, Hands-On Large Language Models: , 2024.

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

1. Explain the fundamentals of generative AI, including GANs, VAEs, and autoregressive models.
2. Apply GenAI techniques to computer vision and natural language processing tasks, including image generation and sequence modelling.
3. Analyse language model architectures (transformers, BERT, GPT-4) and preprocessing strategies for training large-scale NLP models.
4. Evaluate advanced LLM techniques, including transfer learning, meta-learning, and multi-modal modelling, for improving model performance.
5. Design and deploy LLM-based applications using LangChain while incorporating responsible AI practices and ethical considerations.

Year: II

CORE COURSE 9

Semester: IV

Code:

**PROMPT ENGINEERING
(Theory)**

Credits: 4

Course Objectives: After completing this course, students will be able to:

1. Provide foundational knowledge of Generative AI, LLMs, and the role of prompts in text generation.
2. Explain the principles, types, and construction of effective prompts in different application domains
3. Develop practical skills in designing and deploying prompts using frameworks like LangChain
4. Explore the integration of vector databases and retrieval-augmented generation with LLMs.
5. Instill awareness of ethical issues and best practices in prompt engineering.

UNIT – I: THE BASICS OF GENERATIVE ARTIFICIAL INTELLIGENCE:

Understanding AI, Machine Learning and Deep Learning,, role of prompts in Generative Artificial Intelligence, Understanding LLMs for Text generation, Extracting Text features, summarization, Chunking Text and strategies, Encoding, Sentimental analysis.

UNIT – II: INTRODUCTION TO PROMPTS: Definition of Prompts- Key features of prompts, Examples of Prompts, The Five principles of prompting, Prompt Engineering vs Fine Tuning, Types of prompts., Prompts in LLM: Role prompting-benefits and challenges, GPT prompting tactics, Meta prompting. , Introduction to Lang Chain: Chat models, Lang Chain prompt templates, Lang Chain Expression Language, using Prompt Template with chat models.

UNIT – III: APPLICATION SPECIFIC PROMPT ENGINEERING: Prompts for Creative Writing, Prompts for Business Applications,, prompts for educational uses, Prompts for coding and software Development, Exploring Prompts with Chat-GPT: Introduction to Chat-GPT,, How Prompts Play a Role in Chat-GPT, Use cases and Examples, Challenges and Areas of Improvement.

UNIT – IV: VECTOR DATABASES WITH FAISS AND PINECONE: Introduction about FAISS and Pinecone, , Retrieval Augmented Generation, Embedding and its popular models,, Document loading in Lang Chain,, RAG with Lang Chain.

UNIT – V: ETHICAL CONSIDERATIONS IN PROMPT ENGINEERING: understanding Bias in AI and Prompts, Strategies for reducing Bias in your Prompts, Ethical guidelines for Prompt Design, Prompts and Privacy Considerations, Future ethical challenges in Prompt Engineering.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbook(s):

1. John Berryman, Albert Ziegler, , Prompt Engineering for LLMs, O'Reilly Media , 2024.

2. James Phoenix, Mike Taylor, Prompt Engineering for Generative AI, O'Reilly Media , 2024.

Reference(s):

1. Ian Khan, Wiley,, The Quick Guide to Prompt Engineering, , 2024.

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

1. Explain the basics of Generative AI and the role of prompts in LLM-based text generation.
2. Compare and construct various types of prompts for applications like education, business, and coding.
3. Make use of prompt-based solutions using Lang-Chain, ChatGPT, and vector databases (FAISS, Pinecone)
4. Analyze how retrieval-augmented generation enhances LLM performance using embeddings and document indexing
5. Evaluate ethical concerns such as bias, privacy, and fairness in prompt engineering and recommend mitigation strategies

Year: II DISCIPLINE CENTRIC ELECTIVE COURSE 4 Semester: IV

Code: 1. CLOUD COMPUTING AND INTERNET OF THINGS Credits: 4
(Theory)

Course objectives: After completing this course, students will be able to:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To equip students with a solid foundation in Cloud Computing for practical use and adoption in real-world scenarios.
3. To understand building blocks of Internet of Things and characteristics
4. Students will be able to explain the core concepts, characteristics, benefits, and challenges of cloud computing models and services.
5. Students will be exposed to the revolution of Internet in Mobile Devices, Cloud & Sensor Networks

UNIT – I: Cloud Computing Cloud Computing Concepts, Principles of Parallel and Distributed Computing, Cloud Characteristics. Elasticity in Cloud, On-demand Provisioning.

UNIT – II: Cloud Architecture, Services and Storage Layered Cloud Architecture Design - NIST Cloud Computing Reference Architecture, Types of Cloud (Public, Private and Hybrid), Cloud services (IaaS, PaaS, SaaS). Architectural Design Challenges, Cloud Storage, Storage-as-a-Service, Cloud Storage Providers, S3, Resource Provisioning Methods in Cloud.

UNIT – III: Cloud Enabling Technologies and Security Service Oriented Architecture, REST and Systems of Systems, Web Services, Publish Subscribe Model, Basics Virtualization, Types of Virtualizations, Implementation Levels of Virtualization. Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtualization Support and Disaster Recovery. Security Overview, Cloud Security Challenges, Software-as-a-Service Security, Security Governance, Virtual Machine Security, IAM, Security Standards.

UNIT – IV: Internet of Things (IoT) and M2M IoT & Web Technology, IoT Applications, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization. Difference between IOT and M2M, M2M AND IoT Value Chains, ETSI M2M SCL resource structure, Security in ETSI M2M framework.

UNIT – V: IOT Architecture & Platforms IOT architecture and different layers, IOT standards (RFID, NFC; IEEE 802. 15. 4: ZigBee, Z-WAVE, THREAD; Bluetooth Low Energy) and protocols. IOT sensors (Temperature, Pressure, Proximity etc.), Microcontrollers, Microprocessors, SoC, Arduino, Pi, Spark, Intel Galileo.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Suggested readings/ references:

1. Cloud Computing: Concepts, Technology and Architecture- Thomas Erl and Zaigham Mahmood, Pearson Publication
2. Cloud Computing: Implementation, Management, and Security- John W. Rittinghouse and James Ransome, CRC Press F.
3. Cloud Computing Black Book- Kailash Jayaswal, DreamTech Press
4. The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are Changing the World-Michael Miller, Pearson
5. Internet of Things: A Hands-on Approach- Arshdeep Bahga and Vijay Madisetti, University Press
6. The Internet of Things- Oliver Hersent, David Boswarthick, and Omar Elloumy

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

1. Construct the cloud computing basics
2. Analyze the Cloud architectures
3. Identify Cloud Enabling Technologies
4. Understand IoT basic concepts
5. Analyze IoT standards

Course Objectives: After completing this course, students will be able to:

1. Understand the foundational concepts of Federated Learning (FL). □
2. Explore the different FL architectures and algorithms. □
3. Learn privacy-preserving techniques and their implementation in FL.
4. Apply FL methods to real-world scenarios. □
5. Evaluate and optimize FL models for performance and scalability.

UNIT – I: Motivation: Federated Learning as a Solution, The Definition of Federated Learning, Categories of Federated Learning, Current Development in Federated Learning, Privacy Preserving Machine, PPML and Secure ML, Threat and Security Models, Privacy Threat Models, Adversary and Security Models, Privacy Preservation Techniques, Secure Multi Party Computation, Homomorphic Encryption, Differential Privacy

UNIT – II: Distributed Machine Learning: Introduction to DML , The Definition of DML , DML Platforms, Scalability- Motivated DML , Large-Scale Machine Learning , Scalability Oriented DML Schemes , Privacy-Motivated DML , Privacy-Preserving Decision Trees , Privacy-Preserving Techniques , Privacy-Preserving Gradient Descent , Vanilla Federated Learning , Privacy-Preserving Methods

UNIT – III: Horizontal Federated Learning: The Definition of HFL, Architecture of HFL, The Client Server Architecture, The Peer-to-Peer Architecture, Global Model Evaluation, The Federated Averaging Algorithm, Federated Optimization , The FedAvg Algorithm, The Secured FedAvg Algorithm, Communication Efficiency, Client Selection Vertical Federated Learning: The Definition of VFL, Architecture of VFL, Algorithms of VFL, Secure Federated Linear Regression, Secure Federated Tree-Boosting.

UNIT – IV: Heterogeneous Federated Learning: Federated Transfer Learning, The FTL Framework, Additively Homomorphic Encryption, The FTL Training Process, The FTL Prediction Process, Security Analysis, Secret Sharing-Based FTL Federated Learning for Vision, Language, and Recommendation, Federated Learning for Computer Vision Federated CV, Federated Learning for NLP, Federated NLP, Federated Learning for Recommendation Systems, Recommendation Model.

UNIT – V: Federated Reinforcement Learning:, Introduction to Reinforcement Learning, Policy, Reward, Value Function, Model of the Environment, Reinforcement Learning Algorithms, Distributed Reinforcement Learning, Asynchronous Distributed Reinforcement Learning, Synchronous Distributed Reinforcement Learning Finance, Healthcare, Education, Urban Computing and Smart City, Edge Computing and Internet of Things , Blockchain

Unit – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Textbook:

1. Qiang Yang, Yang Liu, Tianjian Chen, Yong Cheng, Yan Kang, Han Yu, “Federated Learning”, Morgan & Claypool Publishers, https://www.morganclaypoolpublishers.com/catalog_Orig/samples/9781681736983_sample.pdf

Reference Book(s):

1. Peter Kairouz, H. Brendan McMahan, et al., “Advances and Open Problems in Federated Learning,” arXiv:1912.04977, 2019.
2. Tan, A. Z., Yu, H., Cui, L., & Yang, Q. (2022). Towards personalized federated learning. IEEE Transactions on Neural Networks and Learning Systems. <https://ieeexplore.ieee.org/abstract/document/9743558>
3. Li, Q., Wen, Z., Wu, Z., Hu, S., Wang, N., Li, Y., ... & He, B. (2021). A survey on federated learning systems: Vision, hype and reality for data privacy and protection. IEEE Transactions on Knowledge and Data Engineering, 35(4), 3347-3366.

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

- CO1 Understand basic concepts, architecture, and applications of federated learning
- CO2 Implement and utilize various federated learning algorithms and architectures.
- CO3 Analyze privacy and security issues in federated learning systems.
- CO4 Solve in a team a real-world scenarios in the field of federated learning.
- CO5 Understand federated reinforcement learning

Year: II

**ENTREPRENEURSHIP /
INDUSTRY BASED COURSE**

Semester: IV

Code:

**ENTREPRENEURIAL DEVELOPMENT
(Theory)**

Credits: 3

Course Objectives: After completing this course, students will be able to:

1. Enable the students to understand the concept of Entrepreneurship and to learn the professional behavior expected of an entrepreneur.
2. Identify significant changes and trends which create business opportunities and to analyze the environment for potential business opportunities.
3. Provide conceptual exposure on converting idea to a successful entrepreneurial firm.
4. Explore Business Planning Process
5. Identify the funding sources

UNIT – I: Entrepreneurship Entrepreneur: Meaning of entrepreneurship – Types of Entrepreneurship – Traits of entrepreneurship – Factors promoting entrepreneurship- Barriers to entrepreneurship- the entrepreneurial culture- Stages in entrepreneurial process – Women entrepreneurship and economic development- SHG.

UNIT – II: Developing Successful Business Ideas: Recognizing opportunities – trend analysis – generating ideas – Brainstorming, Focus Groups, Surveys, Customer advisory boards, Day in the life research – Encouraging focal point for ideas and creativity at a firm level-Protecting ideas from being lost or stolen – Patents and IPR.

UNIT – III: Opportunity Identification and Evaluation: Opportunity identification and product/service selection – Generation and screening the project ideas – Market analysis, Technical analysis, Cost benefit analysis and network analysis- Project formulation – Assessment of project feasibility- Dealing with basic and initial problems of setting up of Enterprises.

UNIT – IV: Business Planning Process: Meaning of business plan- Business plan process- Advantages of business planning- preparing a model project report for starting a new venture .

UNIT – V: Funding Sources of Finance: Venture capital- Venture capital process- Business angles- Commercial banks- Government Grants and Schemes.

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

TEXT BOOKS:

1. Reddy, Entrepreneurship: Text & Cases - Cengage, New Delhi.
2. Kuratko/rao, Entrepreneurship: a south asian perspective.- Cengage, New Delhi.
3. Leach/Melicher, Entrepreneurial Finance – Cengage. , New Delhi.

4. K.Sundar – Entrepreneurship Development – Vijay Nicole Imprints private Limited
5. Khanka S.S., Entrepreneurial Development, S.Chand & Co. Ltd., New Delhi, 2001.
6. Sangeeta Sharma, Entrepreneurship Development, PHI Learning Pvt. Ltd., 2016.

REFERENCE BOOKS:

1. Barringer, B., Entrepreneurship: Successfully Launching New Ventures, 3rd Edition, Pearson, 2011.
2. Bessant, J., and Tidd, J., Innovation and Entrepreneurship, 2nd Edition, John Wiley & Sons, 2011.
3. Desai, V., Small Scale Industries and Entrepreneurship, Himalaya Publishing House, 2011.
4. Donald, F.K., Entrepreneurship- Theory, Process and Practice, 9th Edition, Cengage Learning, 2014.
5. Hirsch, R.D., Peters, M. and Shepherd, D., Entrepreneurship, 6th Edition, Tata McGraw-Hill Education Pvt.Ltd., 2006.
6. Mathew, J.M., Entrepreneurship Theory at Cross Roads: Paradigms and Praxis, 2nd Edition, Dream Tech, 2006.
7. Morse, E., and Mitchell, R., Cases in Entrepreneurship: The Venture Creation Process, Sage South Asia, 2008.
8. Nagendra and Manjunath, V.S., Entrepreneurship and Management, Pearson, 2010.
9. Reddy, N., Entrepreneurship: Text and Cases, Cengage Learning, 2010.
10. Roy, R., Entrepreneurship, 2nd Edition, Oxford University Press, 2011.
11. Stokes, D., and Wilson, N., Small Business Management and entrepreneurship, 6th Edition, Cengage Learning, 2010.

RESOURCES:

1. <http://inventors.about.com/od/entrepreneur/>
2. <http://learnthat.com/tag/entrepreneurship/>
3. www.managementstudyguide.com
4. www.quintcareers.com
5. www.entrepreneur.com

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

1. Understand on the basic concepts of entrepreneurship and business opportunities to familiars with knowledge about business and project reports for starting a new ventures on team based.
 2. Develop Successful Business Ideas
 3. Identification of Opportunities of Business
 4. Apply Business Planning Process
- Identify Funding Sources of Finance

Year: II

VALUE ADDED COURSE 2

Semester: IV

Code:

**DATA VISUALIZATION USING R &
PYTHON
(Theory)**

Credits: 2*

Course Objectives: After completing this course, students will be able to:

1. Understand the Context of data visualization
2. Analyze stages of data visualization
3. Explore Tools for Acquiring Data
4. Get familiar with data and its visualization using R and Python
5. Understand information aspects presented by using appropriate data visualization on given information

UNIT – I: Introduction Context of data visualization: Definition, Methodology, Visualization design objectives. Key Factors: Purpose, visualization function and tone, visualization design options:

UNIT – II: Data representation: Data Presentation, Seven stages of data visualization, widgets, data visualization tools. Visualizing Data Methods Mapping, Time series, Connections and correlations, Scatterplot maps, Trees, Hierarchies and Recursion, Networks and Graphs, Info graphics Visualizing and Acquiring data

UNIT – III: Finding Data: Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, using a Database, Dealing with a Large Number of Files.

UNIT – IV: Visualization using R: Basic plotting: Plots and Lines, Built-in Plot Types, Legends and Annotations, Other Built-in Plotting Functionalities, Histograms and Curves, Cleveland's Dot Plot, Axis, Titles, Subtitles and Panel Styles, The Notorious Pie Chart, WORKING WITH GGLOT2: Grammar of Graphics System, Mapping Aesthetics, Working with Geometries, Background Image, ENHANCING using GGLOT2

UNIT – V: Data Visualization using Python: Introduction to Matplotlib, Basic Plotting with Matplotlib, Line Plots, Area Plots, ,Bar Charts, Pie Charts, Box Plots, Scatter Plots, Bubble Plots, Waffle Charts, Word Clouds, Seaborn and Regression Plots ,Panda: Series, DataFrame Basics and Data Manipulation

UNIT – VI: Current Contours (For continuous internal assessment only): Contemporary Developments Related to the Course during the Semester Concerned

Text Books:

1. "Interactive data visualization for the web", Scott Murray, O'Reilly Media, Inc., 2013.
2. "Visualizing Data", Ben Fry, O'Reilly Media, Inc., 2007.
3. "Security Data Visualization: Graphical Techniques for Network Analysis", Greg Conti, No Starch Press Inc, 2007.

Reference Books:

1. Rahlf, T. (2017). Data Visualisation with R: 100 Examples. Germany: Springer International Publishing.
2. Raman, K. (2015). Mastering Python Data Visualization. United Kingdom: Packt Publishing.
3. Ware C and Kaufman M ,Visual thinking for design, Morgan Kaufmann Publishers, 2008.
4. Chakrabarti, S —Mining the web: Discovering knowledge from hypertext data —, Morgan Kaufman Publishers, 2003 P a g e 24

E-Resources:

1. <https://www.coursera.org/learn/jhu-data-visualization-r>
2. <https://www.coursera.org/learn/data-visualization-r>
3. <https://www.coursera.org/learn/python-for-data-visualization>

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

1. An understanding of the key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction.
2. Identify appropriate data visualization techniques given particular requirements imposed by the data.
3. Practical experience building and evaluating visualization systems.
4. Use of different tools to acquire data
5. Explore Data Visualization using R and Python