INFROMATION SCIENCE AND ENGINEERING

SCHEME and SYLLABUS

OF

V and VI SEMESTER B.E.

FOR THE A.Y: 2024-25

Vision of the College:
To develop thoughtful and creative young minds in a learning environment of high academic ambience by synergising spiritual values and technological competence.

Mission of the College:
1. To continuously strive for the total development of students by educating them in state-of-the-art-technologies and managerial competencies providing best in class learning experience with emphasis on skills, values and learning outcomes and helping them imbibe professional ethics and societal commitment.
2. To create research ambience that promotes interdisciplinary research catering to the needs of industry and society.
3. To collaborate with premier academic and research institutions and industries to strengthen multidisciplinary education, applied research, innovation, entrepreneurship and consulting ecosystems.

Vision of the Department:
To be a centre for quality education and research in Information Science and Engineering to create high quality professionals for catering to the need of the society.

Mission of the Department:
1) To enable students to acquire strong fundamental concepts related to the Information Science and Engineering through experiential learning.
2) To educate students towards state-of-the-art-technologies and multidisciplinary practices for a successful career by creating learning-teaching-learning ambience.
3) To inculcate life-long learning through innovation and research attitudes among students related to Information Science and Engineering.

Program Educational Objectives (PEOs):

The objectives of Information Science and Engineering degree program are to prepare students to meet the academic excellence, professionalism, and ability to solve a broad range of problems in rapidly changing technological, economic and social environment.

Graduates of the program will:
1. Pursue career as software engineer, project manager, data scientist, entrepreneur and pursue higher studies and research in Information Science and Engineering domains.
2. Apply mathematical, scientific and Information Science and Engineering knowledge with multidisciplinary approaches to solve real world problems.
3. Possess professionalism, ethical and societal responsibilities and engage in life-long learning through pursuit of skill development and certification courses in Information Science and Engineering.

Programme Outcomes (POs):

To achieve the above objectives, Information Science and Engineering degree programme strives to obtain the following outcomes which should be achieved by all graduates at the time of their graduation.

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Programme Specific Outcomes (PSOs):

1) **Computing System:** Demonstrate the knowledge of evolving hardware and/or software to develop solutions to real life computational problems with a focus on performance optimization.

2) **Communication and Security:** Design and develop solutions for providing efficient transmission, storage, security and privacy of data in diverse computing environment.

3) **Information management:** Apply tools and techniques for management of information system, data analysis and knowledge discovery in the process of decisionmaking.

SCHEME and SYLLABUS

OF

V SEMESTER B.E.

INFROMATION SCIENCE AND ENGINEERING

FOR THE A.Y: 2024-25

SCHEME OF TEACHING AND EXAMINATION (2022 Scheme) : V Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs.				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	HSMS	HSIS01	Software Engineering and Project Management	Dept.	42	0	0	48	3	50	50	100	3
2.	IPCC	S5ISI01	Artificial Intelligence and Machine Learning (Integrated)	Dept.	42	0	28	50	3	50	50	100	4
3.	IPCC	S5ISI02	Database Management System (Integrated)	Dept.	42	0	28	50	3	50	50	100	4
4.	PCCL	S5ISL01	Design Thinking and User Experience Lab	Dept.	0	0	28	02	3	50	50	100	1
5.	PEC	S5PEC01	Professional Elective Course-I	Dept.	42	0	0	48	3	50	50	100	3
6.	PROJ	S6ISMP	Mini Project / Extension Survey Project	Dept.	0	0	56	04	3	100	-	100	2
7.	AEC	SHS04	Research Methodology and IPR **(Board: IEM)**	ME, IM, CH	42	0	0	48	3	50	50	100	3
8.	HSMS	HS06	Environmental Studies **(Board: CV)**	CV	28	0	0	32	3	50	50	100	2
9.	NCMC	HS	Soft Skills (Additional Course offered by SIT)	T&P	0	28	0	00	-	100	-	100	0
10	NCMC	SMC01	National Service Scheme (NSS)	NSS CO	0	0	28	00		100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga	PED									
			Total							**550**	**350**	**900**	**22**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **HSMS:** Humanity and Social Science and management Course **IPCC**: Integrated Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course**; PROJ**: Project/Mini Project; **AEC**: Ability Enhancement Course; **NCMC**: Non-Credit Mandatory Course, **L**: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Professional Elective Course (PEC) (Offered by the Department)			
S5ISPEC011	Data Communication	S5ISPEC013	Computer Vision
S5ISPEC012	Data Science	S5ISPEC014	Industrial Internet of Things and Applications

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2022-23 may please be referred.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Software Engineering and Project Management

Contact Hours/ Week:	3L	Credit:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	HSIS01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Comprehend Software Development Life Cycle for software development.
2.	Discuss an idea of using various process models in the software industry according to given circumstances.
3.	Realize how Analysis, Design, Implementation and Maintenance processes are conducted in a software project.
4.	Explore the basics of software project management concepts, principles and practices.
5.	Apply different methods of estimation for software project development and management.

UNIT I

Software And Software Engineering: The Nature of Software, Software Engineering, The Software Process, Software Engineering Practice.

The Software Process: Process Models: A Generic Process Model, Defining a Framework Activity, Identifying a Task Set, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Prototyping Process Model, Evolutionary Process Model, Unified Process Model, Product and Process.

Agility And Process: What Is Agility? Agility and the Cost of Change, What Is an Agile Process? Agility Principles The Politics of Agile Development, Scrum, Scrum Teams and Artifacts, Sprint Planning Meeting, Daily Scrum Meeting, Sprint Review Meeting, Sprint Retrospective.

Self-Study Components: Other Agile Frameworks, The XP Framework, Kanban, DevOps.

9 Hours

UNIT II

Understanding Requirements: Definition of Requirements Engineering, Establishing the Groundwork, Requirements Gathering, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Analysis Model, Elements of the Analysis Model, Analysis Patterns, Negotiating Requirements, Requirements Monitoring and Validating Requirements.

Requirements Modeling: Requirements Analysis, Overall Objectives and Philosophy, Analysis Rules of Thumb, Analysis Rules of Thumb, Requirements Modeling Principles, Scenario-Based Modeling, Actors and User Profiles, Creating Use Cases, Documenting Use Cases, Class-based Modelling Identifying Analysis Classes, Defining Attributes and Operations, UML Class Models, Class-Responsibility-Collaborator Modeling.

9 Hours

UNIT III

Design Concepts: Definition of software design, Design Within the Context of Software Engineering, The Design Process- Software Quality Guidelines and Attributes, The Evolution of Software Design, Design Concepts- Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Stepwise Refinement, Refactoring, Design Classes, Design Model- Design Modeling Principles, Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Deployment-Level Design Elements.

Architectural Design: Software Architecture, Agility and Architecture, Architectural Styles, Architectural Considerations.
Component-Level Design: What Is a Component, What Is a Component?, An Object-Oriented View, The Traditional View, A Process-Related View, Designing Class-Based Components- Basic Design Principles, Component-Level Design Guidelines, Cohesion, Coupling.
8 Hours

UNIT IV
Software Quality Metrics: **Software Metrics And Analytics:** Software Measurement, Measures, Metrics, and Indicators, Attributes of Effective Software Metrics, Software Analytics, Product Metrics, Metrics for the Requirements Model.
Project Management Concepts: The Management Spectrum, The People, The Product, The Process, The Project, People, The Stakeholders Team Leaders, The Software Team, Coordination and Communications Issues, Product Software Scope, Problem Decomposition, Process, Melding the Product and the Process, Process Decomposition, Project, The W5HH Principle, Critical Practices.
8 Hours
UNIT V
Creating A Viable Software Plan: Comments on Estimation, The Project Planning Process, Software Scope and Feasibility, Resources, Human Resources, Reusable Software Resources, Environmental Resources, Data Analytics and Software Project Estimation, Decomposition and Estimation Techniques, Software Sizing, Problem-Based Estimation, An Example of LOC-Based Estimation, An Example of FP-Based Estimation, An Example of Process-Based Estimation, An Example of Estimation Using Use Case Points, Reconciling Estimates, Estimation for Agile Development. **Project Scheduling:** Basic Principles, The Relationship Between People and Effort, Defining a Project Task Set, A Task Set Example, Refinement of Major Tasks, Defining a Task Network Scheduling Time-Line Charts, Tracking the Schedule.
8 Hours

TEXT BOOKS		
1	Roger. S. Pressman, Bruce R. Maxim	Software Engineering-A Practitioners approach. 9th Edition, Tata-McGraw Hill. 2020,

REFERENCE BOOKS		
1	Pankaj Jalote	An Integrated Approach to Software Engineering. Narosa Publications, 2019.
2	Ilene Burnstein	Practical Software Testing: A Process-Oriented Approach, Springer International Edition, 2016.
3	Paul C. Jorgensen, Byron DeVries	Software Testing, A Craftsman's Approach, 5th Edition, Auerbach Publications, 2021.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Describe and Apply** Software Development Life Cycle and its different phases of software process.
CO2.	**Apply** the Requirements Engineering Techniques to paraphrase the actual requirements of applications.
CO3.	**Apply** the fundamental concepts and principles of Software Design in development of software.
CO4.	**Describe** the basics of software project management concepts, principles and practices.
CO5.	**Apply** and **Analyze** the different methods for estimation of software projects.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	3		3									3		
	CO2		3	3		2				2	2		3		
	CO3			3									3		
	CO4			3									2		
	CO5			3									2		
	AVG	3	3	3		2				2	2		3		

1: Low association 2: Moderate association 3: High association

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Integrated)

Contact Hours/ Week:	3L+2P	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	26	SEE Marks:	50
Sub. Code:	S5ISI01		

Course objectives:

This course will enable students to:

1.	Understand fundamental concepts in Artificial Intelligence.
2.	Explore basic principles of AI such as problem solving, searching, knowledge representation and learning.
3.	Explain the role of agents in AI and structure of the agents.
4.	Analyze and identify significant characteristics of data sets for measurements.
5.	Understand and implement the training, testing, and validation phases of supervised and unsupervised learning algorithms.

UNIT I

Introduction: What is AI? Acting humanly: The Turing Test approach, Thinking humanly: The cognitive modelling approach, Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach.

Intelligent Agents: Agents and Environments, Rationality, Omniscience, learning, and autonomy, The nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents; Agent programs, Simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents.

Solving Problems By Searching: Problem-solving agents; Well-defined problems and solutions, Formulating problems, Example problems; Toy problems, Real-world problems.

9 Hours

UNIT II

Solving Problems By Searching (Contd.): Searching for solution; Infrastructure for search algorithms, Measuring problem-solving performance, Uninformed search strategies, Uniform-cost search, Depth-limited search.

Adversial Search: Games, Optimal Decisions in Games; The minimax algorithm.

Constraint Satisfaction Problems: Defining Constraint satisfaction problems; Example problem: Map coloring, Example problem: Job-shop scheduling.

9 Hours

UNIT III

Introduction: If Data had Mass, The Earth Would Be A Black Hole, Learning; Machine Learning, Types of Machine Learning, Supervised Learning; Regression, Classification, The Machine Learning Process.

Preliminaries: Some Terminology; Weight Space, The Curse of Dimensionality, Knowing What You Know; Overfitting, Training, Testing, and Validation Sets, The Confusion Matrix, Accuracy Metrics, The Receiver Operator Characteristic (ROC) Curve, Unbalanced Datasets, Measurement Precision,: Testing Machine Learning Algorithms, Turning Data into Probabilities; Some Basic Statistics.

8 Hours

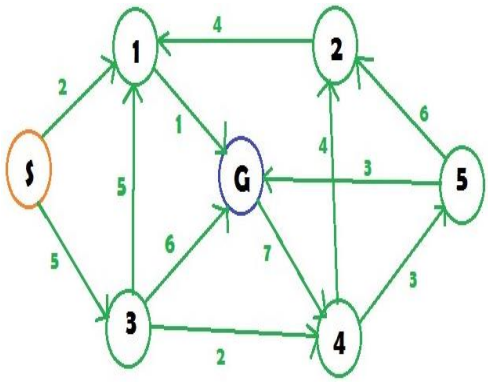
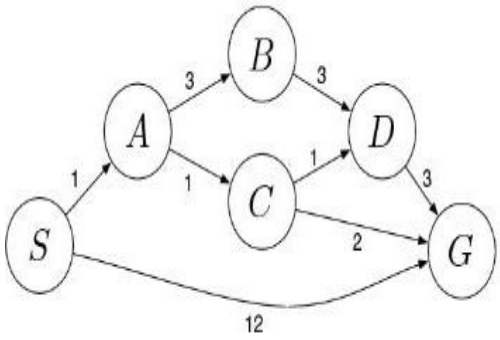
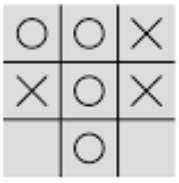
UNIT IV
Dimensionality Reduction: Linear Discriminant Analysis (LDA), Principal Components Analysis (PCA), Relation with the Multi-layer Perceptron, Kernel PCA, Methods Comparisons.
LEARNING WITH TREES: Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART); Gini Impurity, Regression in Trees, Classification Examples and Problems.
8 Hours

UNIT V
Probabilistic Learning: Nearest Neighbour Methods **Unsupervised Learning-Clustering:** Introduction, Hierarchical Clustering, Agglomerative Clustering, The single Linkage Algorithm, The complete linkage Algorithm, The Average Linkage Algorithm, Partitional Clustering, Forgy's Algorithm, The k-means Algorithm, Vector Quantization, The *K*-Means Algorithm.
8 Hours

TEXT BOOKS		
1	Stuart J. Russell and Peter Norvig	Artificial Intelligence, A Modern Approach, 3rd Edition, Pearson India Education Services, 2015 (UNIT I and II).
2	Stephen Marsland	Machine Learning, An Algorithmic Perspective, 2nd Edition, CRC Press, 2015 (UNIT III, IV and V).

REFERENCE BOOKS		
1	Elaine Rich, Kevin Knight:	Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2009.
2	Christopher Bishop	Pattern Recognition and Machine Learning, CBS Publishers & Distributors- New Delhi.2006.
3	Tom M Mitchell	Machine Learning, McGraw-Hill, Inc. New York, NY, USA. 2013.

Sl. No.	**Lab Programs /Topics Covered**
1	a) Write a Python Program to perform Linear Search. b) Write a Python Program to perform Binary Search. c) Write a python program to read from lists and merge the two lists to contain only unique numbers. d) Write python programs for the following tasks: Reading text and Text manipulations e) Write the python programs: Read and print Matrix and Operations on it.
2	Write a python program to implement the following Uninformed search algorithms: • Breadth First Search algorithm • Depth First Search Algorithm

3	Write a python program to implement the following Uninformed Uniform Cost Search Algorithm for the following graphs. a) b)  
4	Write a python program to implement the Tic-Tac-Toe game and demonstrate the steps. Consider 3X3 board and minimum of two players. 
5	Write a python program to implement Map coloring problem using either Constraint Satisfaction problem method or by applying Graph coloring algorithm. Also apply the same algorithm to the following Map and validate the answers. a) Australian Map with three colors 
6	Demonstrate the implementation of the supervised probability based naïve Bayesian classifier and demonstrate the performance of the model with clear interpretation of confusion matrices and other performance metrics. Use IRIS dataset for demonstration of the Model performance.
7	Implement a Simple supervised Linear Regression model using the training data set. Assume the appropriate dependent and independent variables for regression analysis. Predict the scores on the test data. Print the MSE and R Squared Score (Coefficient of determination). Interpret the results. Consider Diabetes dataset downloaded from sklearn repository.
8	Implement a supervised Logistic Regression model using the training data set. Assume the appropriate dependent and independent variables for regression analysis. Predict the scores on the test data. The output should include Confusion Matrix, Accuracy, Error rate, Interpret the results. Consider an USER-DATA dataset downloaded from Kaggle repository.
9	Demonstrate the implementation of Linear discriminant analysis (LDA) technique for dimensionality reduction. Consider IRIS dataset from Kaggle repository.
10	Demonstrate the implementation of Principal component analysis (PCA) technique for dimensionality reduction. Consider IRIS dataset from Kaggle repository.

11	Demonstrate the implementation of the decision tree based ID3 algorithm. Consider the data set of your choice. Demonstrate the performance of the model. Interpret the significance of Entropy and Information gain on model performance. Plot the complete tree constructed.
12	Demonstrate the implementation of the k-Means algorithm. Use IRIS dataset for demonstration. Use appropriate metrics to analysis of model performance. Interpret the results.
13	Demonstrate the implementation of k-Nearest Neighbor algorithm to classify the IRIS data set. Use appropriate metrics to analysis of model performance. Interpret the results.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Identify** and **Apply** the knowledge representation techniques and problem-solving strategies to common Artificial Intelligence (AI) applications.
CO2.	**Describe** the structure of the agents and different types of agents commonly used in AI.
CO3.	**Describe** machine learning algorithms based on learning criteria and parameter employed for applications.
CO4.	**Apply** and **illustrate** the significances of dimensionality reduction techniques for supervised and unsupervised problem solving.
CO5.	**Design** applications to solve real world problems by **applying** machine learning algorithms such as classification, regression, and clustering.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	2													2
	CO2	2	2												2
	CO3			2		3				2	3				2
	CO4			2	2										2
	CO5	2													2
AVG		2	2	2	2	3				2	3				2

1: Low association 2: Moderate association 3: High association

Database Management Systems
(Integrated)

Contact Hours/ Week:	3L+2P	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours	26	SEE Marks:	50
Sub. Code:	S5ISI02		

Course objectives:
This course will enable students to:

1.	Explore the basic concepts of database and database management systems.
2.	Understand the fundamentals of relational system that includes data models, database architectures and ER diagram.
3.	Comprehend Structured Query Language (SQL) and design the queries in SQL.
4.	Describe the need of Normalization and use different types of Normalization while designing the databases.
5.	Explain and adopt the concepts of transaction management for the database management.

UNIT I

Databases and Database Users: Introduction, an example, characteristics of database approach. Actors on the screen, workers behind the scene. Advantages of using DBMS approach. A brief history of database applications, When not to use a DBMS.

Database System – Concepts and Architecture: Data models, schemas and instances, three-schema architecture and data independence. Database languages and interfaces. The database system environment. Centralized and client-server architectures. Classification of database management systems.

9 Hours

UNIT II

Entity-Relationship Model: Using high-level conceptual data models for database design, an example database application. Entity types, entity sets, attributes and keys, relationship types, relationship sets, roles and structural constraints, weak entity types, refining the ER design for the company database. ER diagrams, naming conventions and design issues.

8 Hours

UNIT III

SQL-The Relational Database Standard: SQL data definition and data types, schema and catalog concepts in SQL, the create table command in SQL, attribute data types and domains in SQL. Specifying attribute constraints and attribute defaults, specifying key and referential integrity constraints. Specifying basic constraints in SQL: giving names to constraints, specifying constraints on tuples using check. Schema change statements in SQL: the drop command, and the alter command. Basic queries in SQL: the select-from-where structure of basic SQL queries, ambiguous attribute names, aliasing, and tuple variables, unspecified where clause and use of the asterisk, tables as sets in SQL, substring pattern matching and arithmetic operators, ordering of query results. More complex SQL queries: comparisons involving null and three-valued logic, nested queries, tuples, and set/multi-set comparisons, correlated nested queries, the exists and unique functions in SQL. Explicit sets and renaming of attributes in SQL, joined tables in SQL, aggregate functions in SQL. Grouping: the group by and having clauses, discussion and summary of SQL queries. Insert, delete statements in SQL, delete and update statements in SQL, additional features of SQL, specifying general constraints as assertion and views (virtual tables) in SQL.

9 Hours

UNIT IV
Database Design: Informal design guidelines for relation schemas semantics of the attributes, reducing the redundant information in tuples. Informal design guidelines for relation schemas reducing the null values in tuples, disallowing the possibility of generating spurious tuples. Definition of functional dependencies, inference rules for functional dependencies. Functional dependencies, equivalence of sets of functional dependencies, minimal sets of functional dependencies. Normal forms based on primary keys, normalization of relations, practical use of normal forms. General definitions of first and second normal forms with examples. General definitions of third normal form with examples. Boyce-codd normal form with examples.
8 Hours

UNIT V
Transaction Processing Concepts: Introduction to transaction processing single-user versus multi-user transactions, read and write operations and DBMS buffers. Need of concurrency control and recovery. Transaction and system concepts transaction states and additional operations, system log and commit point. Desirable properties of transactions – ACID properties and characterizing schedules based on recoverability.
8 Hours

TEXT BOOKS		
1	Elmasri and Navathe	Fundamentals of Database Systems, 7th Edition, McGraw Hill, 2017.

REFERENCE BOOKS		
1	Silberschatz, Korth and Sudharshan	Data Base System Concepts, 7th Edition, McGraw Hill, 2019.
2	Raghu Ramakrishnan and Johannes Gehrke.	Database Management Systems, 3rd Edition, McGraw-Hill, 2022.

List of Problems for Laboratory	
1	Consider the following schema for a Library Database: BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Publisher_Name, Address, Phone) BOOK_COPIES (Book_id, Branch_id, No-of-Copies) BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) BORROWER (Card_no, Name, Address, Phone) Write SQL queries to a) Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. b) Get the particulars of borrowers who have borrowed more than 3 books from Jan 2018 to Jan 2019. c) Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. d) Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. e) Create a view of all books and its number of copies that are currently available in the Library.

2	Consider the following schema for Order Database: SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id,Salesman_id) Write SQL queries to a) Count the customers with grades above Bangalore's average. b) Find the name and numbers of all salesmen who had more than one customer. c) List all salesmen and indicate those who have and don't have customers in their cities (Use UNION operation). d) Create a view that finds the salesman who has the customer with the highest order of a day. e) Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.
3	Consider the schema for Movie Database: ACTOR (Act_id, Act_Name, Act_Gender) DIRECTOR (Dir_id, Dir_Name, Dir_Phone) MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST (Act_id, Mov_id, Role) RATING (Mov_id, Rev_Stars) Write SQL queries to a) List the titles of all movies directed by 'XYZ'. b) Find the movie names where one or more actors acted in two or more movies. c) List all actors who acted in a movie before 2020 and also in a movie after 2022 (use JOIN operation). d) Find the title of movies and number of stars for each movie that has at least one rating. Sort the result by movie title. e) Update rating of all movies directed by 'ABC' to 4.
4	Consider the schema for College Database: STUDENT (USN, SName, Address, Phone, Gender) SEMSEC (SSID, Sem, Sec) CLASS (USN, SSID) SUBJECT (Subcode, Title, Sem, Credits) IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to a) List all the student details studying in fourth semester 'C' section. b) Compute the total number of male and female students in each semester and in each section. c) Create a view of Test1 marks of student USN '1SI24IS001' in all subjects. d) Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students. e) Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA< 12 then CAT = 'Weak' Give these details only for 8th semester A, B, and C section students.
5	Consider the schema for Company Database: EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate) DLOCATION (DNo,DLoc) PROJECT (PNo, PName, PLocation, DNo)

WORKS_ON (SSN, PNo, Hours)

Write SQL queries to

a) Make a list of all project numbers for projects that involve an employee whose last name is 'raj', either as a worker or as a manager of the department that controls the project.

b) Show the resulting salaries if every employee working on the 'AI' project is given a 10 percent raise.

c) Find the sum of the salaries of all employees of the 'IS' department, as well as the maximum salary, the minimum salary, and the average salary in this department

d) Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).

e) For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs. 60,00,000.

Instructions for Open Ended Project Execution:

Develop a database application using Oracle/MySQL

Please note the following conditions.

1. Mini project should give proper idea about the application for which it is developed.
2. Maximum 3/4 students per team. No team is allowed to do the same project.
3. The front end has to be created with any programming language with proper design.
4. Students must:
   a. Create schema and insert the records for each table. Add appropriate database constraints.
   b. Implement, analyze and evaluate the project developed for an application.
   c. Create, update, delete and query on the database.
   d. Demonstrate the working of different concepts of DBMS.
5. Must be able to generate reports.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1.	**Describe** database concepts, architecture and applications.
CO2.	**Analyze and Design** ER diagram and Schema based on customer/application's requirements.
CO3.	**Create** SQL queries for a given schema.
CO4.	**Apply** normalization techniques for the given database application.
CO5.	**Describe** and **Adopt** the transaction processing concepts for a given database.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	3											3		
	CO2		3	3									3		
	CO3			3									3		
	CO4			3									3		
	CO5		2	2									1		
AVG		3	3										3		

1: Low association 2: Moderate association 3: High association

Design Thinking and User Experience Laboratory

Contact Hours/ Week:	2P	Credits:	1.0
Total Practical Hours:	26	CIE Marks:	50
Sub. Code:	S5ISL01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the standardized innovation process to develop creative solutions to the identified problems.
2.	Think creatively and develop decision-making capability while design and developing the identified problem.
3.	Create user experiences that truly resonate with the users and deliver high business impact.

Activity based learning:
Form a group (4-5 students in each group)
Assign a problem statement for each group (considering different domains)

Some of the examples of problem statements are

- Development of chatBot.
- Touch Screen Based Home Automation System
- Wireless Electronic Notice Board Using GSM
- Wireless message Communication Between Two Computers
- Train Collision Avoidance System
- Ultrasonic Sensor Based Parking Guidance System
- Mobile Charger Design Using Solar Power
- Animation creation
- Image generation

Introduction: Design thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success. The five major phases of design thinking are:

1. **Empathize**: Understand the needs of users.
2. **Define**: Clearly articulate the problem that needs to be solved.
3. **Ideate**: Brainstorm a wide range of possible solutions.
4. **Prototype**: Build tangible representations for a subset of ideas.
5. **Test**: Test solutions with users to get feedback and iterate.

For each lab session common to all groups, map the activities to these phases as follows:

Lab Session 1: Introduction to Design Thinking

- **Empathize**: Introduction to understanding user needs through interviews and observations.
- **Define**: Initial discussions on how to frame the problems based on user insights.

Lab Session 2: User Research

- **Empathize**: Conducting user interviews, surveys, and obser vations to gather deep insights.
- **Define**: Begin to identify patterns in user needs and behaviors.

Lab Session 3: Problem Definition

- **Define**: Refining and synthesizing research findings into a clear problem statement.
- **Ideate**: Initial brainstorming on possible solutions based on the problem statement.

Lab Session 4: Brainstorming Solutions

- **Ideate**: Intensive brainstorming sessions to generate a wide array of potential solutions.
- **Prototype**: Select a few promising ideas to start sketching and planning prototypes.

Lab Session 5: Prototyping

- **Prototype**: Create low-fidelity prototypes (e.g., paper prototypes, wireframes) of selected ideas.
- **Test**: Informal testing of prototypes within the group to get initial feedback.

Lab Session 6: Feedback and Iteration

- **Test**: Conduct user testing sessions with prototypes to gather feedback.
- **Empathize**: Re-evaluate user needs based on feedback.
- **Define**: Refine the problem statement if necessary.
- **Ideate**: Adjust and generate new ideas if the initial ones were not effective.
- **Prototype**: Iterate on the prototypes based on feedback.

Lab Session 7: Advanced Prototyping

- **Prototype**: Develop higher-fidelity prototypes (e.g., functional models, detailed wireframes).
- **Test**: Plan for more extensive user testing sessions.

Lab Session 8: Final Testing and Presentation

- **Test**: Conduct final round of user testing.
- **Empathize**: Final reflections on user needs and how well the solutions address them.
- **Define**: Final adjustments to the problem statement based on comprehensive feedback.
- **Ideate**: Any last-minute brainstorming if new insights are discovered.
- **Prototype**: Final refinements to prototypes.
- **Presentation**: Prepare and present the final solutions, documenting the design thinking process.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1.	**Develop** ideas/problem identification skills to respond to user needs with appropriate and creative solutions.
CO2.	**Apply** the Design Thinking methodology to solve the identified/given problems.
CO3.	**Analyze** an identified/given ideas/problem to gather the required information for design and development.
CO4.	**Apply** analytical, critical and creative thinking to transform ideas/problems into visuals and prototypes.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	3													2
	CO2	3	2			2									2
	CO3	3		2											2
	CO4			2						2					2
	CO5			2											2
AVG		3	2	2		2				2					2

1: Low association 2: Moderate association 3: High association

Research Methodology and IPR (SHS04)

Contact Hours/ Week	:	3(L)+0(T)+0(P)	Credits:	3
Total Lecture Hours	:	42	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

RESEARCH METHODOLOGY: Objectives and motivation of research - Types of research - Research approaches - Significance of research - Research methods verses methodology - Research and scientific method - Importance of research methodology - Research process - Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations- Criteria of good research. Defining the research problem: Definition of research problem - Problem formulation - Necessity of defining the
problem - Technique involved in defining a problem.

8-Hours

Unit-II

LITERATURE SURVEY AND DATA COLLECTION: Importance of literature survey - Sources of information - Assessment of quality of journals and articles
- Information through internet. Effective literature studies approaches, analysis,
plagiarism, and research ethics. Data - Preparing, Exploring, examining and displaying. Referencing methods

8-Hours

Unit-III

RESEARCH DESIGN AND ANALYSIS: Meaning of research design - Need of research design - Different research designs - Basic principles of experimental design - Developing a research plan - Design of experimental set-up - Use of standards and codes. Overview of Univariate/Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using
written reports and oral presentation.

9-Hours

Unit-IV

INTELLECTUAL PROPERTY RIGHTS (IPR): Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. Role of WIPO and WTO ni IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR
maintenance.

8-Hours

Unit-V
PATENT RIGHTS (PR): Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. Licenses, Licensing of related patents, patent agents, Registration of patent agents.
9-Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Describe the research process & formulate research problem
CO2	:	Perform literature review, manage data & practice research ethics
CO3	:	Practice basic principles of experimental design, use standard codes and carry out research analysis
CO4	:	Distinguish between types of innovation, describe patenting procedure, maintenance and role of IPR establishments
CO5	:	Identify the significance of patent rights, licensing, technology transfer & manage patenting system

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3	2									2				
CO2		3	2					3				2				
CO3		3	3									2				
CO4		3	2									2				
CO5		3	2									2				

Text Books:

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Prof. Kothari C. R.	"Research methodology: Methods and techniques", New Age International, 5th Edition, 2023. ISBN- 13: 978-9389802559
2.	R. Ganesan	"Research Methodology for Engineers", MJP Publishers, Chennai, 2011.

Reference Book:		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Cooper Donald R, Schindler Pamela S and Sharma JK	"Business Research Methods", Tata McGraw Hill Education, 11th Edition, 2012.
2.	Catherine J. Holland	"Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3.	David Hunt, Long Nguyen, Matthew Rodgers	"Patent searching: tools &techniques", Wiley, 2007.
4.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament	"Professional Programme Intellectual Property Rights, Law and practice", September 2013.
5.	Peter S. Menel Mark A. Lemley, Robert P. Merges	"Intellectual Property in the New Technological-Vol. I Perspectives, 2021.
6.	Laura R. Ford	"The Intellectual Property of Nations: Sociological and Historical Perspectives on a Modern Legal Institution Paperback -2021.

Data Communication

(Professional Elective Course -1)

Contact Hours/ Week:	3L	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S5PEC011	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Understand the basic concepts of data communications for real-world.
2.	Analyze and comprehend the layered architecture of TCP/IP protocol and OSI model for Internet.
3.	Understand physical layer characteristics and usage in communication networks.
4.	Learn the importance of data link layer and services offered for reliable communication in the Internet.
5.	Explore the data link control and medium access control protocols for real world scenario.

UNIT I

Data Communications and Network Models

Data Communications: Components, Data Representation, Data Flow. Networks: Network Criteria, Physical Structures. Network types: LAN, WAN, Internet.

Network Models

Protocol Layering: Scenarios, Principles of Protocol Layering, Logical Connections. TCP/IP Protocol Suite: Layered Architecture, Layers In the TCP/IP Protocol Suite, Description of Each Layer, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing. The OSI model: OSU versus TCP/IP, Lack of OSI model's success.

9 Hours

UNIT II

Introduction To Physical Layer

Data and Signals: Analog and Digital Data, Analog and Digital Signals, Periodic and non-periodic. Periodic Analog signals: Sign wave, phase, wavelength, Time and frequency domains, composite signals, Bandwidth. Digital signals: Bit rate, bit length, Digital signal as a composite analog signal, Transmission of Digital signals. Transmission Impairment: Attenuation, Distortion, Noise.

9 Hours

UNIT III

Introduction To Physical Layer

Data rate limits: Noiseless channel, noisy channel. Performance: Bandwidth, throughput, latency, bandwidth-delay product and jitter.

Digital Transmission

Digital–to-digital conversion: line coding, Line coding schemes. Analog to digital conversion: PCM, DM. Transmission modes: Parallel Transmission and serial transmission.

Switching

Introduction: Three methods of switching, Switching and TCP/IP layers. Packet switching: Datagram networks and virtual circuit networks.

8 Hours

UNIT IV

Introduction to Data link Layer

Introduction: Nodes and links, services, Two categories of links, Two sub layers.

Error Detection & Correction

Introduction: Types of Errors, Redundancy, Detection Versus Correction. Cyclic Codes: Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials. Checksum: Concept.

8 Hours

UNIT V

Data link Control (DLC)

DLC Services**:** Framing, Flow and Error Control, Connectionless and Connection-Oriented. Data-link layer Protocols: Simple protocol, Stop-and-wait protocol, piggybacking.

Media Access Control (MAC)

Random Access: Aloha, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing. Channelization: FDMA, TDMA, CDMA.

8Hours

TEXT BOOKS

1	Behrouz A. Forouzan	Data Communications and Networking, Tata McGraw-Hill, 5th Edition, 2017.

REFERENCE BOOKS

1	Alberto Leon Garcia	Communication Networks: Fundamental Concepts & key Architectures, Tata McGraw – Hill, 10th Edition, 2004.
2	William Stallings	Data and Computer Communication, Pearson Education, 10th Edition, 2017.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Describe** and **Analyze** the basics of data, signal types with transmission principles, topologies and layered architecture with internet protocol suits.
CO2.	**Analyze** the physical layer characteristics, its performance and associated problems in caring data in networks.
CO3.	**Apply** and **Demonstrate** error detection and correction coding techniques, with adoption of modulation, and multiplexing techniques for real-world applications.
CO4.	**Analyze** digital and analog transmission of data and different types of switching.
CO5.	**Describe** and **Apply** medium access control and data link control protocols for the given real world scenario.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	2	3											3	
	CO2		3											3	
	CO3		2											2	
	CO4		3											3	
	CO5	3												2	
AVG		3	3											3	

1: Low association 2: Moderate association 3: High association

Data Science

(Professional Elective Course -2)

Contact Hours/ Week:	3L	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S5PEC012	SEE Marks:	50

Course objectives:	
This course will enable students to:	
1.	Explain the concept of data science, its scope in business and available techniques.
2.	Analyze Predictive modeling and supervised segmentation models for churn and tree induction problems.
3.	Explore the concept of Classification to classify a given data set.
4.	Describe the concept of similarity, neighbors and clustering for apply it to any real world data.
5.	Apply the concepts of mining text and other data science tasks and techniques.

UNIT I

Business Problems and Data Science Solutions: From Business Problems to Data Mining Tasks, Supervised Versus Unsupervised Methods, Data Mining and Its Results, The Data Mining Process, Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment, Other Analytics Techniques and Technologies: Statistics, Database Querying, Data Warehousing, Regression Analysis, Machine Learning and Data Mining.
Textbook 1: Chapter 1,2

9 Hours

UNIT II

Introduction to Predictive Modeling: From Correlation to Supervised Segmentation Models, Induction, and Prediction, Supervised Segmentation, Selecting Informative Attributes Example: Attribute Selection with Information Gain, Supervised Segmentation with Tree- Structured Models, Visualizing Segmentations, Trees as Sets of Rules, Probability Estimation, Example: Addressing the Churn Problem with Tree Induction.
Textbook 1: Chapter 3

9 Hours

UNIT III

Fitting a Model to Data: Classification via Mathematical Functions: Linear Discriminant Functions, Optimizing an Objective Function, An Example of Mining a Linear Discriminant from Data, Linear Discriminant Functions for Scoring and Ranking Instances, Support Vector Machines briefly, Regression via Mathematical Functions, Class Probability Estimation and Logistic "Regression".
Logistic Regression: Some Technical Details. Example: Logistic Regression versus Tree Induction, Non Linear Functions, Support vector machines and Neural Networks
Over fitting and Its Avoidance: Fundamental Concepts, Exemplary Techniques, Regularization, Genaralization, Over fitting, Over fitting Examined.
Textbook 1: Chapter 4,5

8 Hours

UNIT IV
Similarity, Neighbors, and Clusters: Similarity and Distance, Nearest-Neighbor Reasoning, Example: Whiskey Analytics, Nearest Neighbors for Predictive Modeling, How Many Neighbors and How Much Influence? Geometric Interpretation, Overfitting, and Complexity Control. Issues with Nearest-Neighbor Methods. Some important Technical Details Relating to Similarities and neighbors. Clustering, Example: Whiskey Analytics Revisited, Hierarchical Clustering, Nearest Neighbors Revisited: Clustering Around Centroids. Understanding the Results of Clustering. Textbook 1: Chapter 6
8 Hours

UNIT V
Decision Analytic Thinking I: What is a Good Model? Evaluating Classifiers Plain Accuracy and its Problems, The confusion matrix, Problems with unbalanced Classes, Problems with Unequal Costs and Benefits. **Representing and Mining Text:** Why Text Is Important? Why Text Is Difficult? Representation, Bag of Words, Term Frequency, Measuring Sparseness: Inverse Document Frequency, Combining Them: TFIDF, Example: Jazz Musicians **Other Data Science Tasks and Techniques:** Co-occurrences and Associations: Finding Items That Go Together, Measuring Surprise: Lift and Leverage, Example: Beer and Lottery Tickets, Associations Among Facebook Likes, Profiling: Finding Typical Behaviour, Link Prediction and Social Recommendation. Textbook 1: Chapter 7,10,12
8 Hours

TEXT BOOKS		
1	Foster Provost and Tom Fawcett	Data Science for Business, O'Reilly Media, 1st Edition, 2013.

REFERENCE BOOKS		
1	Rachel Schutt & Cathy O'Neil,	Doing Data Science O'Reilly Media, 1st Edition, 2013.
2	Hector Cuesta	Practical Data Analysis, Packt, 1st Edition, 2013.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1. **Apply** the knowledge of mathematics to describe the concept of data science.

CO2. **Analyze** the given data set, and solve a problem by performing Classification using the basics of mathematics and data science methods.

CO3. **Apply** the concepts of linear regression, logistic regression and other concepts on a given problem.

CO4. **Develop** solutions to the problems related to supervised and unsupervised learning.

CO5. **Analyze** the importance of data mining and formulate the association rules based on market basket analysis.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	2													2
	CO2	2		2											2
	CO3	2	2	2											2
	CO4		2	2		2									2
	CO5		2	2											2
AVG		2	2	2		2									2

1: Low association 2: Moderate association 3: High association

Computer Vision

(Professional Elective Course -3)

Contact Hours/ Week:	3L	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S5PEC013	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Explore the image processing techniques for computer vision.
2.	Explain Hough Transform and its applications to detect lines, circles, ellipses.
3.	Understand the shapes and region analysis.
4.	Explore three-dimensional image analysis techniques, motion analysis and applications of computer vision algorithms.

UNIT I

Introduction:

Cameras: Pinhole Cameras, Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases, Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo.

Inter reflections: Global Shading Models, Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

9 Hours

UNIT II

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge **Detection:** Noise, Estimating Derivatives, Detecting Edges, Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids.

Application: Synthesis by Sampling Local Models, Shape from Texture.

9 Hours

UNIT III

The Geometry of Multiple Views: Two Views, Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation?, **Human Vision:** Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering.

8 Hours

UNIT IV

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.

8 Hours

UNIT V
Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations. Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An **Application:** Mobile Robot Localization **Model- Based Vision:** Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification Application: Registration In Medical Imaging Systems Curved Surfaces and Alignment.
8 Hours

TEXT BOOKS		
1	David A Forsyth, Jean Ponce	Computer Vision – A Modern Approach, PHI Learning (Indian edition), 2nd Edition, 2015.

REFERENCE BOOKS		
1	E. R. Davies	Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th Edition, 2013.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Describe** fundamental image processing techniques required for computer vision.
CO2.	**Apply** shape analysis and **Implement** boundary tracking techniques to recognize objects.
CO3.	**Apply** chain codes and other region descriptors.
CO4.	**Apply** Hough Transform for line, circle, and ellipse detections.
CO5.	**Describe** the geometric camera elements, parameters and projections.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	2	3											3	
	CO2		3											3	
	CO3		2											2	
	CO4		3											3	
	CO5	3												2	
AVG		3	3	3										3	

1: Low association 2: Moderate association 3: High association

Industrial Internet of Things and Applications

(Professional Elective Course -4)

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S5PEC014	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the significance of IoT in general to Industries.
2.	Gain insight into the IoT as a game changer with integrated value in industries.
3.	Apply the concept of IoT to develop solutions to different domains.
4.	Describe different IoT protocols and its significance in cloud platforms.
5.	Describe Digital Twin and its significance in emerging scenarios.

UNIT I

Introduction: Introduction to IoT, IoT Vs. IIoT, History of IIoT, Components of IIoT -Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends& future Real life examples, Key terms of IoT–IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges and Benefits in implementing IIoT.

9 Hours

UNIT II

Architectures: Overview of IoT components: Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet -Reference Architecture; IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT.

9 Hours

UNIT III

Sensors And Interfacing:

Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACnet, Current, M2M etc.

8 Hours

UNIT IV

Protocols And Cloud:

Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, BACnet, BLE, Modbus, SPI, I2C, IIoT protocols –COAP, MQTT, 6LoWPAN, LWM2M, AMPQ IIoT cloud platforms: Overview of COTS cloud platforms, Predix, PTC Thing Worx, Microsoft Azure etc. Data analytics, cloud services, Business models: SaaS, PaaS, IaaS.

8 Hours

UNIT V
Digital Twin: Introduction to Digital Twin, need for Digital Twin, Elements of Digital Twin, Digital Twin process design and information requirements, Digital twin conceptual architecture -create, communicate, Aggregate, Analyze, Insight, Act, driving business value through digital twin.
8 Hours

TEXT BOOKS		
1	Daniel Minoli, BerndScholz-Reiter, Florian	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Wiley Publication, 2013.
2	Farsi, M., Daneshkhah, A., Hosseinian-Far, A., Jahankhani, H	Digital Twin Technologies and Smart Cities Springer International Publishing, 2020.
3	Michahelles	Architecting the Internet of Things, Springer, 2011.

REFERENCE BOOKS		
1	Hakima Chaouchi	The Internet of Things Connecting Objects to the Web, Wiley Publications, 2010.
2	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley Publications, 2012.
3	Ovidiu, Peter	Internet of Things-From Research and Innovation to Market Deployment, River Publishers Series, 2014.

Sl.No	**Internet resource/Web links**
1	Phil Waine, Wright-Kevin Ashton, Five thoughts from the Father of the Internet of Things.
2	Red Lion, How Protocol Conversion Addresses IIoT Challenges: White Paper.
3	https://www.ge.com/digital/applications/digital-twin
4	https://www2.deloitte.com/us/en/insights/focus/industry-4-0/digital-twin-technology-smart-factory.html

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Apply** the elements of IoT to build a total control plane in an Industry.
CO2.	**Describe** M2M protocols for the development of IoT Applications.
CO3.	**Apply** the concept of digitalization and data acquisition to develop the interface.
CO4.	**Illustrate** how to build smart factory based on the concepts of IoT.
CO5.	**Describe** and **apply** Industrial Digital Twins.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1		3											3	
	CO2		3											3	
	CO3		3											2	
	CO4		3	2										3	
	CO5		3											2	
AVG			3	2										3	

1: Low association 2: Moderate association 3: High association

SCHEME and SYLLABUS

OF

VI SEMESTER B.E.

INFROMATION SCIENCE AND ENGINEERING

FOR THE A.Y: 2024-25

SCHEME OF TEACHING AND EXAMINATION (2022 Scheme) : VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs.				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	IPCC	S6ISI01	Big Data Analytics(Integrated)		42	0	28	50	3	50	50	100	4
2.	PCC	S6IS01	Computer Networks		42	28	0	50	3	50	50	100	4
3.	PEC	S6IS02	Professional Elective Course-II		42	0	0	48	3	50	50	100	3
4.	OEC	OECX	Open Elective Course-I		42	0	0	48	3	50	50	100	3
5.	PROJ	S6ISMP-I	Major Project Phase I		0	0	56	04	3	100	-	100	2
6.	PCCL	S6ISL01	Computer Networks Laboratory		0	0	28	02	3	50	50	100	1
7.	AEC	ARAS	Aptitude Related Analytical Skill		0	0	28	02	1½	50	50	100	1
8.	NCMC	SMC01	National Service Scheme (NSS)	NSS CO	0	0	28	00		100	-	100	0
		SMC02	Physical Education (PE) (Sports and Athletics)	PED									
		SMC03	Yoga	PED									
			Total							**500**	**300**	**800**	**18**
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **IPCC**: Integrated Professional Core Course, **PCC**: Professional Core Course; **PEC**: Professional Elective Course**;**
OEC: Open Elective Course; **PROJ:** Project Phase –I; **PCCL**: Professional Core Course laboratory;
AEC: Ability Enhancement Course, **SEC**: Skill Enhancement Course; **NCMC**: Non Credit Mandatory Course;
L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Professional Elective Course (PEC) (Offered by the Department)			
S6ISPEC011	AWS Cloud	S6ISPEC013	Neurocomputing and Deep Learning
S6ISPEC012	Generative AI and Prompt Engineering	S6ISPEC014	File Structures

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2022-23 may please be referred.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Big Data Analytics
(Integrated)

Contact Hours/ Week:	3 +2 (3L+2P)	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	26	SEE Marks:	50
Sub. Code:	S6ISI01		

Course Objective

This course will enable students to:

1.	Understand the types of digital data, the characteristics of big data, and the challenges confronting the enterprises embracing big data.
2.	Explore the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
3.	Learn programming tool PIG in Hadoop echo system for storage, analysis and manipulation of data.
4.	Develop skills to solve complex real-world problems for decision support.

UNIT I

Getting An Overview Of Big Data: What is Big Data? History of Data Management- Evolution of Big Data, Structuring Big Data-Types of Data, Elements of Data, Big Data Analytics: Advantages of Big Data Analytics, Careers in Big Data, Future of Big Data.

Big Data Analytics: Introducing Technologies for Handling Big Data, Distributed and Parallel Computing for Big Data, Introducing Hadoop, Cloud Computing and Big Data: Features of Cloud Computing, Cloud Deployment Models, Cloud Delivery Models, Cloud Services for Big Data, Cloud Providers in Big Data Market, In-Memory Computing Technology for Big Data.

9 Hours

UNIT II

Understanding Hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, MapReduce, Hadoop YARN, Introducing HBase- HBase Architecture, Regions, Storing Big Data with HBase, Interacting with the Hadoop Ecosystem, HBase in Operation-Programming with HBase, Combining HBase with HDFS.

9 Hours

UNIT III

Understanding Mapreduce Fundamentals And Hbase: The MapReduce Framework: Exploring the features of MapReduce, working of MapReduce, Exploring Map and Reduce Functions, Techniques to optimize MapReduce Jobs: Hardware/ Network Topology, Synchronization, File System, Uses of MapReduce, Role of HBase in Big Data Processing: Characteristics of HBase, Installation of HBase.

8 Hours

UNIT IV

Analysing Data With Pig: Introducing Pig: The Pig Architecture, Benefits of Pig, Properties of Pig, running Pig, Getting Started with Pig Latin, Working with Operators in Pig, Debugging Pig, Working with Functions in Pig, Error Handling in Pig.

Introducing Hive, Getting Started with Hive: Hive Variables, Hive Properties, Hive Queries, Data Types in Hive, Built-in Functions in Hive, Hive DDL, Data Manipulation in Hive, Data Retrieval Queries, Using JOINS in Hive
8 Hours
UNIT V
Nosql Data Management: Introducing to NoSQL, Types of NoSQL Data Models, Characteristics of NoSQL, Schema-less Databases, Materialized Views, Distribution Models, CAP theorem, Sharding. **Introduction To Mongodb:** What is MongoDB? Why MongoDB? Terms used in RDBMS and MongoDB, Data types in MongoDB, MongoDB query language.
8 Hours

TEXT BOOKS		
1	DT Editorial Services	Big Data: Black Book, Dream Tech Press, 2016.
2	Seema Acharya, Subhashini Chellappan, Infosys Limited	Big Data and Analytics, Wiley India Private Limited, 1st Edition 2015.

REFERENCE BOOKS		
1	Alex Holmes	Hadoop in Practice, Manning Publications Co. 2nd Edition, Sep. 2014.
2	Alan Gates	Programming Pig, O'Reilly, Kindle Publication. 2nd Edition, Nov. 2016.
3	Dean Wampler	Programming Hive, O'Reilly, Kindle Publication, 1st Edition, Sep. 2012.

List of Experiments:	
1	Conduct the following experiments using MapReduce in Apache Hadoop frameworks: a. Installation of Apache Hadoop b. Develop a MapReduce program to calculate the frequency of a given word in a given file. c. Develop a MapReduce program to find the maximum temperature in each year. d. Develop a MapReduce program to find the grades of student's. e. Develop a MapReduce program to implement Matrix Multiplication. f. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year. g. Develop a MapReduce to analyze the weather data set and print whether the day is shinny or cool.
2	Prepare an "input" folder containing multiple text files. i) Create a program using MapReduce that would accept the path to the "input" folder and generate an "output" folder having a text file containing the total number of occurrences of each single word present in text document. ii) Write a program for Matrix Vector Multiplication using MapReduce. iii) Write a program to perform Union, Intersection and Difference operation iv) MapReduce on following files. Input files: a) Content of file 1 (apple, orange, mango, apple, banana) b) Content of file 2 (apple, apple, plum, kiwi, kiwi, mango, mango) c) Content of file 3 (orange, orange, plum, grapes, kiwi, mango, apple)
3	i) Implement the following operations using Pig Operators/Functions:

	LOAD, DUMP, FOREACH, GROUP, DISTINCT, LIMIT, ORDER BY, JOIN, UNION, SPLIT, SAMPLE, AVG, MAX, COUNT, TUPLE, MAP, PIGGY BANK, PARAMETER SUBSTITUTION, DESCRIBE ii) Write a PIG script to load and store "Student data". (Student file contains Roll no, Name, Marks and GPA). a. Filter all the students who are having GPA>5. b. Display the name of all Students in Uppercase. c. Group tuples of students based on their GPA. d. Remove duplicate tuples of Student list. e. Display first three tuples from "student" relation. f. Display the names of students in ascending order. g. Join two relations namely Student and department (Rno, DeptNo, DeptName) based on the values contained in the roll no column. h. Merge content of two relations Student and department. i. Partition a relation based on the GPA's acquired by students.
4	Perform Social media analysis using Cassandra.
5	Implement a Buyer event analytics using Cassandra on suitable product sales data.
6	Implement and Perform Streaming Data Analysis using flume for data capture HIVE for data analysis of twitter data, chat data, weblog analysis etc.
7	Install and configure MongoDB to execute the following operations using NoSQL Commands. i) Create a Student Master database with a collection called "Student" containing documents with some or all of the following fields: StudentRollNo, StudentName, Grade, Hobbies, and DOJ. ii)Perform the following operations on the database: a) Insert 10 Records in the database. b) Find the document wherein the "StudName" has value "Ajay Rathod". c) Find all documents in proper format. (Without _Id field) d) Retrieve only Student Name and Grade. e) Retrieve Student Name and Grade of student who is having _id column is 1. f) Add new field "Address" in Student Collection. g) Find those documents where the Grade is set to 'VII'. h) Find those documents where the Grade is not set to 'VII'. i) Find those documents where the Hobbies is set to either 'Chess'or is set to 'Dancing". j) Find those documents where the Hobbies is set neither to 'Chess' nor is set to 'Dancing". k) Find those documents where the student name begins with 'M'.
8	Create a MovieMaker Database with a collection called "Movies "containing documents with some or all of the following fields: titles, directors, years, actors. Perform the following operations on the database (either in the console or using any programming language): a) Retrieve all documents b) Retrieve all documents with Director set to "Quentin Tarantino" c) Retrieve all documents where actors include "Brad Pitt". d) Retrieve all movies released before the year 2000 or after 2010. e) Add a synopsis to "The Hobbit: An Unexpected Journey": "A reluctant hobbit, Bilbo Baggins, sets out to the Lonely Mountain with a spirited group of dwarves to reclaim

	their mountain home - and the gold within it - from the dragon Smaug." f) Add a synopsis to "The Hobbit: The Desolation of Smaug": "The dwarves, along with Bilbo Baggins and Gandalf the Grey, continue their quest to reclaim Erebor, their homeland, from Smaug. Bilbo Baggins is in possession of a mysterious and magical ring."

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Describe** the different types of digital data, sources, challenges, elements and technologies for handling Big Data.
CO2.	**Demonstrate** the big data analytics operations using Hadoop Ecosystem, MapReduce Fundamentals and HBase.
CO3.	**Apply** PIG scripts with Hadoop Distributed File System to analyze stored Big Data.
CO4.	**Describe** and **apply** managing Hadoop jobs for handling big distributed data.
CO5.	**Create** NoSQL Databases and **analyze** MongoDB for real-time scenarios.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	2	3											3	
	CO2		3											3	
	CO3		2											2	
	CO4		3											3	
	CO5	3												2	
AVG		3	3	3										3	

1: Low association 2: Moderate association 3: High association

Computer Networks

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	-	SEE Marks:	50
Sub. Code::	S6IS01		

Course Objectives

This course will enable students to:

1.	Understand the working of network layer and routing algorithms.
2.	Comprehend and use the IPV4 and IPV6 protocols in Internet.
3.	Explore and Design subnet and different types of networks for any organization requirements
4.	Realize the transport layer protocols, services and segments in real world.
5.	Understand the application layer protocols, functionalities and usage.

UNIT-I

Introduction to Network Layer

Network-Layer Services: Packetizing, Routing and Forwarding, Other Services. Packet switching: Datagram Approach-Connectionless Service. Virtual-Circuit Approach-Connection-Oriented Service. Network layer performance: Delay, Throughput, Packet Loss, Congestion Control.

9 Hours

UNIT-II

Introduction to Network Layer

IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution (NAT).

Network Layer Protocols

Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams.

Next Generation IP

IPv6 Addressing: Representation, Address Space, Address Space Allocation, Auto configuration, Renumbering. The IPv6 Protocol: Packet Format, Extension Header. Transition from IPv4 to IPv6: Strategies.

9 Hours

UNIT-III

Unicast Routing

Introduction: General Idea, Least-Cost Routing. Routing Algorithms: Distance-Vector Routing, Link-State Routing, and Path-Vector Routing. Unicast Routing Protocols: Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), and Border Gateway Protocol Version 4 (BGP4).

9 **Hours**

UNIT-IV

Introduction to Transport Layer

Introduction: Services, Port Numbers. User Datagram Protocol: User Datagram, UDP Services, UDP Applications. Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP connection.

7 Hours

UNIT-V

Standard Client Server Protocols

World Wide Web and HTTP: WWW, HTTP. FTP: Two connections, Control connection, Data Connection. Electronic Mail: Architecture, Web-Based Mail. Secure Shell (SSH): Components, Applications. DNS: Name Space, DNS as Internet.

8 Hours

TEXT BOOKS

1	Behrouz A. Forouzan	Data Communications and Networking, 5th Edition, McGraw-Hill, 2013.

REFERENCE BOOKS:

1	Larry L Peterson and Bruce S Davie	Computer Networks: A Systems Approach, 5th Edition, Elsevier, Elsevier, 2012.
2.	Alberto Leon-Garcia and Indra Widjaja	Communication Networks, 2nd Edition, McGraw-Hill, 2003.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1. **Analyze** the network services, configuration and performance of network layer.

CO2. **Design** subnets and calculate the IP addresses to fulfil network requirements of an organization.

CO3. **Analyze** and **Apply** various routing algorithms to find shortest paths for packet delivery.

CO4. **Analyze** the Transport Layer Protocols (UDP, TCP) for reliable and unreliable communication.

CO5. **Identify** the protocols, features and operations of various standard application layer protocols.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1		3											3	
	CO2		3	3										3	
	CO3		3	3										2	
	CO4		3											3	
	CO5	3	2											2	
AVG		3	3	3										3	

1: Low association 2: Moderate association 3: High association

Computer Network Laboratory

Contact Hours/ Week:	2P	Credits:	1
Total Practical Hours:	26	CIE Marks:	50
Sub. Code:	S6ISL01	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand resource requirements, packet loss and security in communication networks.
2.	Describe network configuration using different network devices.
3.	Implement various algorithms for routing, error detection, and correction.
4.	Design and apply client-server programs using the socket and IPC channel concepts.

	List of Laboratory Programs
1.	a) Study of basic network command and network configuration commands -IPconfig, ipconfig /flushdns, ipconfig /release, ipconfig /renew, ns lookup, Ping-IP/DNS, pathping, netstat, ARP, hostname, getmac, tracert, and resmom- for port number. b) Create and analyze static routing using min two routers using Cisco packet tracer.
2.	a) Configure and analyze the working of basic router/gateway setup using the Cisco packet tracer. b) Write program for error detecting code using CRC algorithm.
3.	a) Configure and analyze the network of 4 nodes and update the port security using the Cisco packet tracer. b) Using TCP/IP sockets, write a client – server program, the client sends the file name and the server sends back the content of requested text file if present.
4.	a) Configure and analyze VLAN on a small network of 4 switches using Cisco Packet Tracer. b) Write a program to implement Distance Vector routing algorithm to build a routing table for the given node.
5.	a) Write a client server echo program using UDP socket and analysis the UDP packets by capturing the data using Wireshark. b) Analyze the headers of all 5 layers of the Internet Protocol stack by capturing the packet in Wireshark.
6.	a) Capture the live packets using Wireshark. Monitor, analyze and visualize the characteristics of HTTP, TCP, FTP, UDP and DNS packet. b) Using TCP/IP sockets, implement concurrent server to handle multiple requests by client at a time.

Course Outcomes:
Upon completion of this course the student will be able to:

CO1.	**Analyze** the data from a live network or from captured file using Wireshark and utilize for different services.
CO2.	**Develop** the network algorithms such as routing and error correction using any programming language.
CO3.	**Analyze** and **demonstrate** network utilities to diagnose TCP/IP problems and security issues.
CO4.	**Analyze and Evaluate** the behavior of network topologies and protocols under different conditions.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1		3			2								3	
	CO2		3	3										3	
	CO3		3	3										2	
	CO4		3	3		3								3	
	CO5		3	3		3								3	
AVG			3			2								3	

1: Low association 2: Moderate association 3: High association

Aptitude Related Analytical Skills

Contact Hours/ Week:		Credits:	1
Total Lecture Hours:		CIE Marks:	50
Sub. Code:	ARAS	SEE Marks:	50

AWS Cloud

(Professional Elective Course-1)

Contact Hours/Week:	3	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Course Code:	S6PEC021	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the concepts, characteristics, delivery models and benefits of cloud computing.
2.	Describe the key security and compliance challenges of cloud computing.
3.	Differentiate between the technical and organizational challenges.
4.	Characterize the different properties of public, private and hybrid cloud deployment models.
5.	Explore the cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage.

UNIT I

Introduction: What is Cloud Computing? How Does Cloud Computing Work? What is AWS? AWS Free Tier
Compute Services: Amazon EC2, Elastic Load Balancing, Auto Scaling.

8 Hours

UNIT II

Networking Services: Amazon VPC, Amazon Route S3.

8 Hours

UNIT III

AWS Security: Shared Responsibility Model, AWS IAM and KMS.

8 Hours

UNIT IV

Storage Services:
Amazon S3, Amazon EBS, Amazon EFS, Amazon Glacier, AWS Storage Gateway, Amazon CloudFront.

9 Hours

UNIT V

AWS Database Services: Amazon RDS, Amazon DynamoDB, Amazon ElastiCache
Application Services: Amazon Simple Email Service (Amazon SES), Amazon Simple Notification Service (Amazon SNS), Amazon Simple Queue Service (Amazon SQS), Amazon Simple Workflow Service (Amazon SWF).

9 Hours

REFERENCE BOOKS		
1.	Kai Hwang, Geoffrey C. Fox and J. Dongarra	Distributed and Cloud Computing, 1st Edition, 2013.
2.	Stephen Baron	AWS: The Complete Beginner's Guide to Mastering Amazon Web Services, Kindle Edition, Feb 2020.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Analyze** the core concepts of the cloud computing paradigm: the characteristics, advantages and challenges.
CO2.	**Develop** the cloud infrastructure with power efficiency and low cost.
CO3.	**Describe** the security concepts and issues in cloud computing.
CO4.	**Illustrate** the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3.
CO5.	**Design** different types of cloud resources based on requirements.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	3		3										3	
	CO2		2	2		2								3	
	CO3			3										3	
	CO4			3										3	
	CO5			3										3	
AVG		3	2	3		2								3	

1: Low association 2: Moderate association 3: High association

Generative AI and Prompt Engineering

(Professional Elective Course-2)

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S6PEC022	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Explore prompt engineering, large language models for the generation of text and other multimedia content.
2.	Understand fundamental techniques and standard practices for text generation with LLM like ChatGPT
3.	Learn advanced techniques for generation of data using modern techniques like Langchain.
4.	Solve complex problems for Image generation using modern tools and techniques like diffusion.

UNIT I

Five Principles of Prompting: Overview of the principles of prompting

Introduction to Large Language Models for Text Generation: Text Generation Models, History Underpinnings, ChatGPT, GPT-4, Google's Gemini, Opensource, LoRA, Mistral, Claude, Comparison of Different Models.

9 Hours

UNIT II

Standard Practices for Text Generation with ChatGPT: Generating lists, Hierarchical List Generation, Generating JSON, YAML, Diverse Format generation with ChatGPT, Universal translation through LLMs, Identify and Generate new content with textual and extracted features, Summarization, Chunking Text, Strategies, Encodings, Sentimental Analysis, Role Computing: Benefits, Challenges, Usage, GPT Prompting Tactics, Classification with LLMs, Building a classification model, Meta Prompting..etc.

9 Hours

UNIT III

Advanced Techniques for Text Generation with LangChain: Introduction, Chat Models, Langchain Prompt templates, LCEL, Prompt template with Chat Models, Output Parsers, OpenAI & Parallel Function Calling, Function calling and Extracting Data with Langchain, Query planning, creating few-shot prompt templates, limitations with few-shot examples, saving and Loading LLM prompts, Document loaders, Prompt Chaining

8 Hours

UNIT IV

Autonomous Agents with Memory and Tools: Chain of Thought, Agents, Using LLMs as an API, Comparing OpenAI functions and react, Agent Toolkits, Customizing Standard agents, Custom Agents in LCEL, Understanding and using Memory, Memory in LangChain, Other Popular Memory Types in LangChain, OpenAI functions Agent with Memory, Advanced Agent frameworks, Callbacks

Introduction to Diffusion Models for Image Generation: OpenAI DALL-E, Stable diffusion, Google Gemini, Text to video, Model Comparison.

8 Hours

UNIT V
Standard Practices for Image Generation with Midjourney: Format Modifiers, Art Style Modifiers, Reverse Engineering Prompts, Quality Boosters, Negative prompts, Weighted Terms, Prompting with an Image, Inpainting, Outpainting, Consistent characters, Prompt rewriting, Meme Unbundling, Meme mapping, prompt analysis **Advanced Techniques for Image Generation with Stable Diffusion:** Running Stable Diffusion, AUTOMATIC1111 Web user Interface, Img3Img, Upscaling images, Interrogate CLIP, SD Inpainting and Outpainting, ControlNet, SAM, DreamBooth Fine-Tuning, Stable Diffusion XL Refiner
8 Hours

TEXT BOOKS		
1	James Phoenix, Mike Taylor	Prompt Engineering for Generative AI, Publisher(s): O'Reilly Media, Inc, May 2024. (Chapters 1,2,3,4,6,7,8,9)

REFERENCE BOOKS		
1	Numa Dhamani, Maggie Engler	Introduction to Generative AI, Publisher(s): Manning Publications, February 2024.
2	Yaswanth Sai Palaghat	Prompt Engineering: The Art Of Asking: Master Generative AI Tools Like Chatgpt & Midjourney, Publisher: Notion Press

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Analyze** the fundamental and advanced concepts of Generative AI and Large Language Models.
CO2.	**Demonstrate** the implementation of fine-tuning and optimization of LLMs for various tasks using appropriate tools like Hugging face, Langchain, etc.
CO3.	**Design** effective prompts for diverse applications and understand the ethical implications of AI model design.
CO4.	**Illustrate** the potential risks associated with Generative AI and strategies for risk mitigation.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1	2												2	
	CO2		2											2	
	CO3			2										2	
	CO4			2										2	
	CO5		2											2	
AVG		2	2	2										2	

1: Low association 2: Moderate association 3: High association

Neuro-Computing and Deep Learning

(Professional Elective Course-3)

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hour:	42	CIE Marks:	50
Sub. Code:	S6PEC023	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Understand the evolution of artificial neural networks.
2. Summarize the different models of ANN.
3. Explore the philosophy and working of Deep Forward Neural Networks.
4. Discuss the salient features and benefits of Associative Neural Networks.
5. Acquire the knowledge of the significance of Competitive and SOFM nets.

UNIT I

Introduction To Neural Networks: Neural Processing, Overview of Neural Networks, The rise of neuro-computing, Definition of Neural Network, Introduction to Neural Networks, Historical Developments of Neural Networks, Biological Neural Networks, Comparison between the Brain and the computer, Comparison between Artificial and Biological Neural Networks, Basic Building Blocks of Artificial Neural Network. (Chapter 1, Text Book 1)

9 Hours

UNIT II

Fundamental Models of ANN: McCulloch-Pitts Neuron Mode: Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Competitive Learning Rule, Outstar Learning Rule, Boltzmann Learning Rule, Hebbian Network, Perceptron Networks: Architecture, Algorithm and Application Procedure, Adaline and Madaline Networks:

Feed Forward Networks: Structure, Delta rule, generalized Delta Rule, Architecture, Training extensions, Practical considerations, Generalization, Pruning Techniques, advantages and disadvantages, applications.

9 Hours

UNIT III

Deep Forward Neural Networks: Definition of Deep Forward Neural Networks, Brief Survey on Deep Neural Networks, Advantages and Disadvantages of Deep Neural Network, Applications of Deep Neural Networks, Deep Neural Network Architecture, Learning in Deep forward Neural Networks. (Chapter No.1 and Chapter No. 3 of Text Book 2)

8 Hours

UNIT IV

Associative Memory Neural Networks: Introduction, Algorithms for Pattern Associations, Hetero Associative Memory Neural Networks, Auto Associative Memory Neural Networks, Bi-Directional Associative Memory Neural Networks. (Chapter 6, Text Book 1)

8 Hours

UNIT V

Competitive And Self-Organizing Networks: Introduction: general clustering procedures, competitive learning architectures and algorithms, self-organizing feature maps. (Chapter 9, Text Book 1)

8 Hours

TEXT BOOKS

1	S. N. Shivanadam, S Sumathi, S N Deepa	Introduction to Neural Networks using MATLAB 6.0, TMH Publishing House, New Delhi, 2nd Reprint 2017.
2	Dr. Rajiv Chopra	Deep Learning-A Practical Approach using Python, Khanna Publisher, 2nd Edition, 2020.

REFERENCE BOOKS

1	James A. Freeman and David M. Skupura	Neural Networks: Algorithms, Applications and Programming Techniques, Pearson Education Publications, 2003.
2	Dr. Shivanandam and Deepa	Principles of Soft Computing, 3rd Edition, Wiley Publication, 2019.
3	Robert J Schalkoff	Artificial Neural Networks, Mc Graw Hill, International Edition, 1997.
4	B. Yegnanarayana	Artificial Neural Networks, PHI 1999.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1. **Describe** the fundamental concepts of ANN.

CO2. **Analyze** and **apply** the different ANN models to solve the real world problems.

CO3. **Describe** the fundamental issues with Deep Neural Networks.

CO4. **Analyze** and **Apply** training and testing algorithms to design Associative NN.

CO5. **Evaluate** the salient features and significance of Competitive and SOFM nets.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1		3	2										2	
	CO2	3	3	2										2	
	CO3		3	2										2	
	CO4		3	2										2	
	CO5	3	3	1										2	
AVG		3	3	2										2	

1: Low association 2: Moderate association 3: High association

File Structures

(Professional Elective Course-4)

Contact Hours/ Week:	3	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Sub. Code:	S6PEC024	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the fundamentals of file structures and their management.
2.	Evaluate the performance of different file structures.
3.	Organize different file structures in the memory.
4.	Demonstrate hashing and indexing techniques.
5.	Applying the techniques in the design of C++ programs for solving various file management problems.

UNIT I

Introduction: File Structures: The Heart of the file structure Design, A Short History of File Structure Design, A Conceptual Toolkit; Fundamental File Operations: Physical Files and Logical Files, Opening Files, Closing Files, Reading and Writing, Seeking, Special Characters, The Unix Directory Structure, Physical devices and Logical Files, File-related Header Files, UNIX file System Commands; Secondary Storage and System Software: Disks, Magnetic Tape, Disk versus Tape; CD-ROM: Introduction, Physical Organization, Strengths and Weaknesses; Storage as Hierarchy, A journey of a Byte, Buffer Management, Input /Output in UNIX. Fundamental File Structure Concepts, Managing Files of Records: Field and Record Organization, Using Classes to Manipulate Buffers, Using Inheritance for Record Buffer Classes, Managing Fixed Length, Fixed Field Buffers, An Object-Oriented Class for Record Files, Record Access, More about Record Structures, Encapsulating Record Operations in a Single Class, File Access and File Organization.

9 Hours

UNIT II

Organization Of Files For Performance, Indexing: Data Compression, Reclaiming Space in files, Internal Sorting and Binary Searching, Keysorting; What is an Index? A Simple Index for Entry-Sequenced File, Using Template Classes in C++ for Object I/O, Object-Oriented support for Indexed, Entry-Sequenced Files of Data Objects, Indexes that are too large to hold in Memory, Indexing to provide access by Multiple keys, Retrieval Using Combinations of Secondary Keys, Improving the Secondary Index structure: Inverted Lists, Selective indexes, Binding.

9 Hours

UNIT III

Consequential Processing And The Sorting Of Large Files: A Model for Implementing Cosequential Processes, Application of the Model to a General Ledger Program, Extension of the Model to include Mutiway Merging, A Second Look at Sorting in Memory, Merging as a Way of Sorting Large Files on Disk. Multi-Level Indexing and B-Trees: The invention of B-Tree, Statement of the problem, Indexing with Binary Search Trees; Multi-Level Indexing, B-Trees, Example of Creating a B-Tree, An Object-Oriented Representation of B-Trees, B-Tree Methods; Nomenclature, Formal Definition of B-Tree Properties, Worst-case Search Depth,

Deletion, Merging and Redistribution, Redistribution during insertion; B* Trees, Buffering of pages; Virtual BTrees; Variable-length Records and keys.

8 Hours

UNIT IV

Indexed Sequential File Access And Prefix B + Trees: Indexed Sequential Access, Maintaining a Sequence Set, Adding a Simple Index to the Sequence Set, The Content of the Index: Separators Instead of Keys, The Simple Prefix B+ Tree and its maintenance, Index Set Block Size, Internal Structure of Index Set Blocks: A Variable-order B- Tree, Loading a Simple Prefix B+ Trees, B-Trees, B+ Trees and Simple Prefix B+ Trees in Perspective.

8 Hours

UNIT V

Hashing: Introduction, A Simple Hashing Algorithm, Hashing Functions and Record Distribution, How much Extra Memory should be used?, Collision resolution by progressive overflow, Buckets, Making deletions, Other collision resolution techniques, Patterns of record access. Extendible Hashing: How Extendible Hashing Works, Implementation, Deletion, Extendible Hashing Performance, Alternative Approaches.

8 Hours

TEXT BOOKS		
1	Michael J. Folk, Bill Zoellick, Greg Riccardi	File Structures-An Object Oriented Approach with C++, 3rd Edition, Pearson Education, 2002. (Chapters 1 to 12 excluding 1.4, 1.5, 5.5, 5.6, 8.6, 8.7, 8.8)

REFERENCE BOOKS		
1	K. R. Venugopal, K.G. Srinivas, P.M. Krishnaraj	File Structures Using C++, Tata McGraw-Hill, 2008.
2	Dean Wampler	Programming Hive, O'Reilly, Kindle Publication, 1st Edition, 2012.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Describe** an appropriate file structure for file processing operations and storage representation.
CO2.	**Apply** object orientated concepts for manipulation of different types of records
CO3.	**Apply** concepts of sorting and merging on multiple files.
CO4.	**Analyze** the sequential and indexing file accessing techniques with appropriate data structures.
CO5.	**Illustrate** and **Apply** the hashing techniques to organize file structures.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
COs	CO1		3											2	
	CO2	3	3	2										2	
	CO3		2	2										2	
	CO4		2	2										2	
	CO5	3	3											2	
AVG		3	3	2										2	

1: Low association 2: Moderate association 3: High association