

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF COMPUTER APPLICATIONS



MASTER OF COMPUTER APPLICATIONS **CURRICULUM AND SYLLABI**

REGULATION 2023

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation : 2023

Curriculum and Syllabi

MCA Programme

DEPARTMENT OF COMPUTER APPLICATIONS

MCA - MASTER OF COMPUTER APPLICATIONS

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and in still in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

FACULTY OF INFORMATION AND COMPUTER ENGINEERING

DEPARTMENT OF COMPUTER APPLICATIONS

Vision

The department of Computer Applications aims to prepare the students technically competent, **be industry-ready and achieve academic excellence by continuous learning** to meet the current challenges of computing industry.

Mission

- To provide quality education to meet the global needs and challenges of profession and society.
- To provide necessitate based quality training in the field of computer applications.
- To provide technical solution to the real time application requirement for the local society.
- To provide theoretical and practical knowledge across recent developments in computer science in software development.

Description of the programme

MCA stands for Master of Computer Applications, and it is a postgraduate degree course in the field of computer applications. The course is designed to provide students with a comprehensive understanding of computer programming languages, software development, database management, and other related subjects. The MCA course is highly regarded in the IT industry and provides students with a wide range of career opportunities. Graduates of the MCA course can work in various roles, such as software developers, web designers, system analysts, database administrators, and more.

PROGRAMME EDUCATIONAL OBJECTIVES - PEO	
PEO-01	Graduates will demonstrate strong technical skills in software development, data management, and system design, enabling them to solve complex problems in various domains.
PEO-02	Graduates will apply analytical and critical thinking skills to analyze real-world problems and develop innovative solutions using modern technologies.
PEO-03	Graduates will engage in continuous professional development, adapting to evolving technologies and methodologies in the field of computer applications.
PEO-04	Graduates will effectively collaborate in diverse teams and take on leadership roles, contributing to project success and fostering a positive work environment.
PEO-05	Graduates will understand the ethical implications of technology and will demonstrate a commitment to social responsibility in their professional practice.
PEO-06	Graduates will be equipped with the skills to identify opportunities, innovate, and potentially start their own ventures in the field of information technology.

Graduate Attributes-GA	
GA-01	Advanced Computing Knowledge Master core and advanced concepts in computer applications, including algorithms, software development, database management, and networking, to build robust and scalable systems for diverse industries.
GA-02	Software Design and Development Exhibit proficiency in designing and developing efficient, user-friendly software applications using modern programming languages, frameworks, and tools, meeting the specific needs of businesses and organizations.
GA-03	Data Analytics and Machine Learning Utilize data analytics, machine learning algorithms, and artificial intelligence to interpret complex data sets, derive meaningful insights, and implement intelligent, data-driven solutions.
GA-04	Mobile and Web Application Development Develop expertise in mobile and web application development, using state-of-the-art technologies and methodologies to create responsive, secure, and high-performing applications for a global audience.
GA-05	Cybersecurity and Information Assurance Demonstrate knowledge of cybersecurity principles and practices, implementing security measures to protect data, software, and networks from potential threats and vulnerabilities.
GA-06	Cloud Computing and Distributed Systems Gain proficiency in cloud computing, virtualization, and distributed systems, leveraging these technologies to build flexible, scalable, and cost-effective IT solutions.

GA-07	Ethics and Professional Responsibility in Computing Uphold ethical principles and professional responsibility in software development and data handling, ensuring that technological solutions prioritize security, privacy, and fairness.
GA-08	Entrepreneurship and Innovation in Technology Foster an entrepreneurial mindset, identifying opportunities for innovation in computer applications and translating them into technology-driven products and services that address real-world challenges.
GA-09	Collaborative Teamwork and Leadership Work effectively in teams, collaborating on software projects, and demonstrating leadership skills to manage multidisciplinary teams and deliver successful IT solutions in complex environments.
GA-10	Lifelong Learning and Technological Adaptability Embrace continuous learning and adaptability, staying up-to-date with the latest technologies, programming languages, and industry trends to remain competitive and innovative in the dynamic IT field.

Programme Outcome – PO	
PO-A	Apply the knowledge of mathematics and computing fundamentals to various real life applications for any given requirement.
PO-B	Analyze and review literatures to invoke the research skills to design, interpret and make inferences from the resulting data.
PO-C	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects
PO-D	Design and develop applications to analyze and solve all computer science related problems.
PO-E	Involve in perennial learning for a continued career development and progress as a computer professional.
PO-F	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO-G	Function effectively both as a team leader and team member on multi-disciplinary projects to demonstrate computing and management skills.
PO-H	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO-I	Utilize the computing knowledge efficiently in projects with concern for societal, environmental, and cultural aspects.
PO-J	Create and design innovative methodologies to solve complex problems for the betterment of the society.
PO-K	Function competently as an individual and as a leader in multidisciplinary projects

PO-L	Communicate effectively and present technical information in oral and written reports
PO-M	Apply the inherent skills with absolute focus to function as an successful entrepreneur

Mapping of Graduate Attributes (GAs) and Programme Educational Objectives(PEOs)

GAs PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PEO-01	H	A	H	A	H	H	H	A	H	H
PEO-02	H	H	A	H	A	H	H	A	H	A
PEO-03	H	A	H	H	A	H	H	A	H	H
PEO-04	H	H	A	H	A	A	H	H	A	A
PEO-05	A	H	H	A	A	H	A	H	A	A
PEO-06	H	A	H	H	A	H	H	A	H	H

H- Highly Associated

A- Associated

Not – Not Associated

Mapping of Graduate Attributes (GAs) and Programme Outcomes (PO)

GAs POs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PO-A	H	A	H	A	H	A	H	H	A	A
PO-B	H	H	A	H	A	H	A	H	H	A
PO-C	A	H	A	H	A	H	A	A	H	A

PO-D	H	H	A	H	A	A	A	H	H	A
PO-E	A	H	H	A	A	H	A	H	A	A
PO-F	A	H	A	A	H	A	A	H	H	A
PO-G	A	H	A	A	A	H	A	A	A	A
PO-H	A	H	A	A	A	H	A	H	H	H
PO-I	A	H	A	H	H	H	A	A	H	A
PO-J	A	H	A	H	A	H	A	A	H	A
PO-K	A	H	A	A	A	H	A	H	H	H
PO-L	A	H	A	H	H	H	A	A	H	A
PO-M	A	H	A	H	A	H	A	A	H	A

H- Highly Associated

A- Associated

Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05	PEO-06
PO-A	H	A	H	A	H	A
PO-B	A	H	A	H	H	H
PO-C	H	H	H	A	H	A
PO-D	H	A	A	A	H	A
PO-E	A	A	A	H	A	H
PO-F	H	A	H	A	H	H

PO-G	H	H	H	H	H	A
PO-H	H	A	A	H	H	A
PO-I	A	H	H	A	A	H
PO-J	H	A	A	H	A	H
PO-K	H	H	H	H	H	A
PO-L	H	A	A	H	H	A
PO-M	A	H	H	A	A	H

H- Highly Associated

A- Associated

Not – Not Associated

Duration of the Programme : 2 years (4 semesters)

Total : 89

CURRICULUM & SYLLABI**SEMESTER – I**

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CA4501	Problem Solving Techniques and Programming in C	3	1	0	4
2.	CA4502	Data Structures and Algorithms	3	1	0	4
3.	CA4503	Relational Database Management System	3	1	0	4
4.	MS45D1	Fundamentals of Accounting	4	0	0	4
5.	MA4504	Applied Probabilistic and Statistics	3	1	0	4
PRACTICAL						
6.	CA4571	Relational Database Management System Laboratory	0	0	2	2
7.	CA4572	Data Structures and Algorithms Using C Laboratory	0	0	2	2
8.	EG4571	Communication Skill Lab –I	0	0	1	1
TOTAL						25

SEMESTER - II

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CA4504	Advanced Python Programming	3	1	0	4
2.	CA4505	Full Stack Web Development	3	1	0	4
3.	CA4506	Data Science and Cloud Computing	3	0	0	3
4.	CA45**	Elective – I	3	0	0	3
5.	CA45**	Elective – II	3	0	0	3
PRACTICAL						
6.	CA4573	Python Programming Laboratory	0	0	2	2
7.	CA4574	Full Stack Web Development Laboratory	0	0	2	2
8.	EG4572	Communication Skill lab - II	0	0	1	1
TOTAL						22

SEMESTER - III

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CA4507	Advanced Java Programming	3	1	0	4
2.	CA4508	Machine Learning Techniques	3	0	0	3
3.	CA45**	Elective - III	3	0	0	3
4.	CA45**	Elective - IV	3	0	0	3
5.	CA45**	Elective - V	3	0	0	3
PRACTICAL						
6.	CA4575	Advanced Java Programming Laboratory	0	0	2	2
7.	CA45P1	Project Work - I	0	0	12	6
TOTAL						24

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45P2	Project Work – II	0	0	36	18
TOTAL			0	0	36	18

ELECTIVE - I

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45A1	Software Project Management	3	0	0	3
2.	CA45A2	Professional Ethics in IT	3	0	0	3
3.	CA45A3	Software Quality and Testing	3	0	0	3
4.	CA45A4	Software Reuse	3	0	0	3
5.	CA45A5	Agile Methodologies	3	0	0	3

ELECTIVE - II

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45A6	Advances in Networking	3	0	0	3
2.	CA45A7	Wireless Networking	3	0	0	3
3.	CA45A8	Network Programming	3	0	0	3
4.	CA45A9	Cryptography and Network Security	3	0	0	3
5.	CA45B1	Mobile Communication Techniques	3	0	0	3

ELECTIVE - III

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45B2	Digital Image Processing	3	0	0	3
2.	CA45B3	Digital Forensics	3	0	0	3
3.	CA45B4	Soft Computing	3	0	0	3
4.	CA45B5	Artificial Intelligence	3	0	0	3
5.	CA45B6	Block Chain Technology	3	0	0	3

ELECTIVE - IV

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45B7	Information Retrieval Techniques	3	0	0	3
2.	CA45B8	Data Mining and Data Warehousing	3	0	0	3
3.	CA45B9	Data Visualization	3	0	0	3
4.	CA45C1	Big Data Analytics	3	0	0	3
5.	CA45C2	Knowledge Engineering	3	0	0	3

ELECTIVE - V

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45C3	Management Information System	3	0	0	3
2.	CA45C4	Digital Marketing	3	0	0	3
3.	CA45C5	Organizational Behaviour	3	0	0	3
4.	CA45C6	Information System Security	3	0	0	3
5.	CA45C7	Ethical Management	3	0	0	3

SEMESTER – I

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CA4501	Problem Solving Techniques and Programming in C	3	1	0	4
2.	CA4502	Data Structures and Algorithms	3	1	0	4
3.	CA4503	Relational Database Management System	3	1	0	4
4.	MS45D1	Fundamentals of Accounting	4	0	0	4
5.	MA4504	Applied Probabilistic and Statistics	3	1	0	4
PRACTICAL						
6.	CA4571	Relational Database Management System Laboratory	0	0	2	2
7.	CA4572	Data Structures and Algorithms Using C Laboratory	0	0	2	2
8.	EG4571	Communication Skill Lab –I	0	0	1	1`
TOTAL						25

CA4501	PROBLEM SOLVING TECHNIQUES AND PROGRAMMING IN C	L	T	P	C
		3	1	0	4

OBJECTIVES

- To learn the fundamentals of PST and methodologies which are essential for building good programs
- Choose a suitable C-construct to develop C code for a given problem.
- Recognize the bugs in the C program.
- Apply the C-language syntax rules to correct the bugs in the C program.
- Develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.

Course Outcome		Cognitive Skill
CO-01	To learn the basics of different types of programming	R, U, A, An
CO-02	To understand the syntax and building blocks of the C- program.	R, U, A
CO-03	To learn to solve a problem using the C Program.	R, U, A, E, An
CO-04	Understand 'C' language constructs like Iterative statements, Array processing, Pointers, etc.	R, U, A, E, An
CO-05	To generate an executable file from program.	R, U, A, E, An

R- Remember, U-Understand, A-Appl, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	S	M	S	S	S	M	L	S	S	S	M
CO-02	S	S	S	M	S	S	M	L	L	S	S	S	M
CO-03	S	M	S	S	S	S	M	S	M	S	S	S	M
CO-04	S	M	S	M	S	S	M	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	S	S	S	S	S	S	M

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Problem Solving

9

Algorithms – Building blocks of algorithms (Statements- control flow- functions) – Notation (Pseudo code- Flow Chart) – Algorithmic problem solving for socio economic conditions in global perspectives – Simple strategies for developing algorithms (Iteration- Recursion) – Efficiency of algorithms

Unit II: Basics of C

9

History of C Structure of C Program- Compiling C Program- Link and Run C Program- Character set- Tokens- Keywords- Identifiers- Constants- Variables- Instructions- Data types- Standard Input/Output- Operators and expressions - Conditional Program Execution: if- if-else- and nested if-else statements- Switch statements

Unit III: Loops and Iteration

9

for- while and do-while loops- Nested loops- Assignment operators- break and continue statement- Functions: Introduction- Types- Declaration of a Function - Function calls- Defining functions- Function Prototypes- Passing arguments to a function Return values and their types - Calling function by value- Recursive functions - Arrays: Declaring one-dimensional array- Initializing arrays- Accessing array elements- Manipulating array elements- Two-dimensional arrays- Multidimensional arrays

Unit IV: Pointers and Structures

9

Introduction- Characteristics- * and & operators- Pointer type declaration and assignment- Pointer arithmetic- Call by reference- Passing pointers to functions- array of pointers- Pointers to functions- Pointer to pointer - Structure: Introduction- Initializing- defining and declaring structure- Accessing members- Operations on individual members- Operations on structures- Structure within structure- Array of structure- Pointers to structure

Unit V: Union and File Handling

9

Introduction- Declaring union- Usage of unions- Operations on union- Enumerated data types- Storage classes: Introduction- Types- automatic- register- static and external - Dynamic Memory Allocation- Introduction- Library functions – malloc- calloc- realloc and free- Basics- File types- File operations- File pointer- File opening modes- File handling functions- File handling through command line argument- Record I/O in files – Exception Handling

L: 45 + T: 15, TOTAL: 60 HOURS

REFERENCES:

1. E Balagurusamy, “Programming in ANSI C”, Tata McGraw-Hill publications.
2. Brian W Kernighan and Dennis M Ritchie, “The ‘C’ Programming language”, Pearson publications.
3. Ashok N Kamthane, “Programming with ANSI and Turbo C”, Pearson Edition Publications.
4. Yashavant Kanetkar, “Let Us ‘C’”, BPB Publications
5. Jeri R Hanly Elliot B Koffman, “Problem solving and program design in C”, Person Addison Wesley 2006

CA4502	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	1	0	4

OBJECTIVES

- Analyze step by step and develop algorithms to solve real world problems.
- Implementing various data structures, Stacks, Queues, Linked Lists, Trees and Graphs.
- Understanding various searching and sorting techniques.
- Define the basic concepts of algorithms and analyse the performance of algorithms.
- Discuss various algorithm design techniques for developing algorithms.

Course Outcome		Cognitive Skill
CO-01	Understand basic data structures such as arrays and stacks.	R, U
CO-02	Understand basic linear data structures such as queues and linked list.	R, U, A
CO-03	Ability to have knowledge of tree and graphs concepts.	R, U, A, An
CO-04	Be able to compare functions using asymptotic analysis and describe the relative Merits of worst-, average-, and best-case analysis.	R, U, A, E, An
CO-05	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data	R, U, A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	S	M	S	S	S	M	M	S	S	S	S
CO-02	S	S	S	M	S	S	S	M	S	S	S	S	S
CO-03	S	S	S	L	S	S	S	S	M	S	S	M	S
CO-04	S	S	S	M	S	S	S	L	M	S	S	M	S
CO-05	S	S	S	L	S	S	S	L	S	S	S	L	S

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Data Structure

9

Data Management Concepts – Data Types – Primitive and Non primitive – Types of Data Structures: Linear and Non linear Data Structures. Linear Data Structures: Representation of Arrays – Applications of Arrays – Sparse matrix and its Representation- Linear Data Structures: Stack: Definition and Concepts – Operations on Stack – Polish Notation – Reverse Polish Notation – Polish Expression and their Compilation – Recursion.

Unit II: Linear And Nonlinear Data Structures

9

Queue – Circular Queue – Priority Queue – Double Ended Queue. Linked List - Singly Linked List – Doubly Linked List – Circular Linked List – Applications of Linked List - Nonlinear Data Structures: Tree – Definitions and Concepts – Representation of Binary tree – Binary tree traversal – Threaded binary tree – Binary Search tree – Conversion of general trees to binary

trees – Applications of trees – Some Balanced tree mechanism

Unit III: Graphs And File Structures **9**

Matrix Representation of Graphs: Elementary Graph Operations (BFS, DFS, Spanning trees, Shortest Path, Minimal Spanning tree) – Hashing – The symbol Table – Hashing Functions – Collision – Resolution Techniques – File Structure: Concepts of fields, records and files – Sequential, Indexed and relative/ random file organization – Indexing structure for index files – Hashing for direct files – Multi Key file organization and access methods.

Unit IV: Algorithm Introduction **9**

Algorithm – Pseudo code for expressing algorithms - Performance analysis – Space complexity – Time complexity – Asymptotic notation – Big Oh – Omega – Theta notation – Probabilistic Analysis – Amortized Analysis. Divide and Conquer: Binary Search – Finding the Maximum and Minimum – Merge Sort – Quick Sort.

Unit V: Greedy Method, Dynamic Programming And Backtracking **9**

Greedy Method: The general method – 0/1 Knapsack problem – Job sequencing with deadlines – Multi stage graphs – Dynamic Programming: All pairs shortest paths – Single source shortest paths – Travelling salesman problem – Backtracking: General method – N queen problem – Sum of subsets – Graph Colouring.

L: 45 + T: 15, TOTAL: 60 HOURS

REFERENCES:

1. Jean-Paul Tremblay & Paul G ,“An Introduction to Data Structures with Applications”, Sorenson Publisher-Tata McGraw Hill.
2. Yedidyah Langsam, “Data Structures using C & C++”, Prentice-Hall International.
3. Horowitz, Sahni, “Fundamentals of Computer Algorithms”,Galgotia Publications.
4. Sartaj Sahani, “Fundamentals of Data Structures in C++”, W.H.Freeman & Co Ltd.
5. Richard F. Gilberg& Forouzan, “Data Structures: A Pseudo-code approach with C”,Cengage India Private Limited Publishers.

CA4503	RELATIONAL DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To learn the fundamentals of data models, Conceptualize and depict a database system using ER diagram.
- To study the principles to be followed to create an effective relational database and write SQL queries to store / retrieve data to / from database systems.
- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To learn about the internal storage structures using different file and indexing techniques and the basis of query processing and optimization.
- To study the basics of distributed databases semi structured and unstructured data models.

Course Outcome		Cognitive Skill
CO-01	To learn the fundamentals of relational databases.	R, U
CO-02	To conceptualize and depict a database system using ER diagram.	R, U, An
CO-03	To know the fundamental concepts of transaction processing concurrency control techniques and recovery procedures.	A, An, E, S
CO-04	To understand the internal storage structures using different files and indexing techniques which will help in physical DB design.	A, An, E
CO-05	To study and understand the advanced concepts of databases.	A, An, E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	L	S	S	M	S	S	S	M	M	S	S	S	L
CO-02	M	L	S	M	S	S	S	M	S	S	S	S	M
CO-03	S	M	S	L	S	S	S	S	M	S	S	M	M
CO-04	M	M	S	M	S	S	S	L	M	S	L	M	S
CO-05	M	S	S	L	S	S	S	L	S	S	L	L	M

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Database System

9

Database and Users: Introduction (Basic Concepts: Data- Database- Database systems- Database Management Systems)- Characteristics of Database Approach- Actors on Scene- Workers behind the Scene- Advantages of using the DBMS approach Database System Concepts and Architecture: Data Models- Schemas- Instances- the three schema architectures and data independence- Database Languages and interfaces- Database System environment- Centralized and client / Server Architecture for DBMS- Classifications of Database Management Systems.

Unit II: Entity Relationship Diagram

9

Using high level conceptual data models for database design (Design Phases of database design)- Entity types- Entity Sets- Attributes and keys- Relationship Types- Relationship sets- Roles and structural constraints- Weak entity Types- Refining the ER diagram for company Database- Entity Relationship Diagram Naming conventions Design issues.

Unit III: Query Language

9

SQL Concepts :Basics of SQL- DDL-DML-DCL- structure – creation- alteration- defining constraints – Primary key- foreign key- unique- not null- check- IN operator- Functions - aggregate functions- Built-in functions –numeric- date- string functions- set operations- sub-queries- correlated sub-queries- Use of group by- having- order by- join and its types- Exist-Any- All - view and its types - Transaction control commands – Commit- Rollback- Save point.

Unit IV: Database Design**9**

Informal Design Guidelines for Relational Schema- Functional Dependencies- Normal Forms based on Primary keys- General definitions of 1NF- 2NF and 3NF- Boyce-Codd Normal Forms (BCNF)- Multi-valued Dependency and Fourth Normal Form.

Unit V: Transaction Processing**9**

Introduction to Transaction Processing Concepts: Introduction to Transaction Processing- Transaction and System concepts- Desirable properties of Transactions- characterizing Schedules based on recoverability and Serializability Relational Model concepts: Relational Model concepts- Relational Model constraints and Relational Database Schemas

L: 45 + T: 15, TOTAL: 60 HOURS**REFERENCES:**

1. Ramez Elmsari, Shamkant B Navathe, "Fundamentals of Database Systems", Pearson Education, 7th Edition
2. Silberschatz, Korth, Sudarshan, "Database System Concepts", McGraw Hill Publication. 5th Edition
3. S K Singh, "Database Systems : Concepts, Design and Applications", Pearson Education
4. Peter Rob, Carlos Coronel, "Database Systems : Design, Implementation and Management", Cengage Learning
5. C J Date, A Kannan, S Swaminathan, "An Introduction to Database Systems", Pearson Education, 8th Edition
6. Steve Suehring, Tim Converse, Joyce Park, PHP 6 and MySQL Bible, Wiley
7. Andrea Tarr, PHP and MySQL 24-Hour Trainer, Wiley
8. <https://docs.oracle.com/en/database/index.html>
9. <https://docs.oracle.com/database/121/SQLRF/toc.htm>

MS45D1	FUNDAMENTALS OF ACCOUNTING	L	T	P	C
		4	0	0	4

OBJECTIVES

- To develop a comprehensive understanding of the basic principles of accounting
- To comprehend the double-entry system and acquire skills in ledger preparation.
- To understand the significance and utilization of electronic accounting systems.
- To gain proficiency in preparing estimates for various business activities such as purchase, sale, production, and cash budgets.
- To enhance decision-making processes within an organization.

Course Outcome		Cognitive Skill
CO-01	Understand the basic concepts of accounting standards.	R, U
CO-02	Maintain accounts effectively within an organization.	R, U, A

CO-03	Calculate the financial position of an organization.	R, A, E
CO-04	Comprehend Financial Management concepts and their components.	U, A, An
CO-05	Recognize the importance of Bank Reconciliation Statement (BRS) and generate various financial reports.	R, U, A, An, E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	M	S	M	S	S	S	M	M	S	S	S	S
CO-02	S	L	S	M	S	M	S	M	S	S	S	S	S
CO-03	S	S	S	L	S	M	S	S	M	S	S	S	M
CO-04	S	S	S	M	S	S	S	L	M	S	S	M	M
CO-05	S	M	S	L	S	S	S	S	S	S	S	L	S

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Accounting

10

Introduction to Financial, Cost, and Management Accounting - Objectives of Financial Accounting - Accounting Principles, Concepts, and Conventions - Bookkeeping and Accounting – Case Studies - Practical exercise session using accounting software (e.g., Tally) - Company Creation and Creating Groups - Creation of Ledgers and Vouchers

Unit II: Management Accounting and Bookkeeping

15

Meaning and Objectives of Management Accounting - Accounting System - Preparation of Journal, Ledger, Cash Book, and Trial Balance - Errors disclosed and not disclosed by Trial Balance - Final Accounts - Ratio Analysis – Case Studies - Practical exercise session using accounting software (e.g., Tally) - Creating Contra, Journals, Credit and Debit Notes - Preparing Trial Balance and Final Accounts

Unit III: Budgets and Budgetary Control

12

Budgets and Budgetary Control - Types of Budgets: Sales Budget, Production Budget, Cost of Production Budget - Flexible Budgeting - Cash Budget - Master Budget - Zero Base Budgeting - Computerized Accounting with adjustments – Case Studies - Practical sessions using advanced tools in MS-Excel - Preparing Revenue Management and Portfolio Selection - Preparing Final Accounts with Adjustments

Unit IV: Financial Management

12

Objectives of Financial Management - Preparation of Suspense Account - Depreciation: Meaning, Types, Methods of Charging and Providing Depreciation – Inventory – Case Studies - Practical exercise session using accounting software (e.g., Tally) - Preparing Inventory Creation, Purchase Order, Sales Order - Preparing Sales Journal, Rejections, Delivery Note.

Preparing Bank Reconciliation Statement (simple problems) - Insurance Claim - Average Clause - Export and Import of Data - Data Security – Case Studies - Practical exercise session using accounting software (e.g., Tally) - Preparing the Bank Reconciliation Statement - Preparing the Trading, Profit and Loss Account, and Trial Balance.

TOTAL: 60 HOURS

REFERENCES:

1. S.N. Maheswari, "Financial and Management Accounting," Sultan Chand & Sons, Latest edition: 6th edition (2020)
2. I.M. Pandey, "Financial Management," Vikas Publishing House Pvt. Ltd., Latest edition: 14th edition (2022)
3. M.Y. Khan and P.K. Jain, "Financial Management: Text, Problems and Cases," Tata McGraw Hill, Latest edition: 7th edition (2021)
4. Reddy and Murthy, "Financial Accounting" by Margham Publications, 2015, Chennai
5. I.M. Pandey, "Management Accounting," Vikas Publishing House Pvt. Ltd., Latest edition: 4th edition (2021)
6. R.L. Gupta and P.K. Gupta, "Advanced Accounting," Sultan Chand, New Delhi, Latest edition: 13th edition (2022)

MA4504	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To encourage students to develop knowledge in the concepts of probability and random variables.
- To apply the small and large sample tests and solve problems through testing of hypothesis.
- To enable the students to understand the properties of standard distributions and solve simulation problems.

Course Outcome		Cognitive Skill
CO-01	Use the ideas of probability and random variables in solving engineering problems. To apply Baye's theorem and to find the moments and moment generating functions	R, U, A, E, An
CO-02	Gather knowledge of the standard distributions such as binomial, poison and normal distribution. To understand the functions of random variable and apply central limit theorem	R, U, A, E, An
CO-03	Be familiar with some of the commonly encountered two dimensional random variables and to obtain Marginal and conditional distributions. Also to find the regression curve and correlation between variables	R, U, A, E, An

CO-04	Use statistical tests in testing hypotheses on data. To know the type I and type II errors and to analyse small and large samples using tests based on normal, t, Chi square and F distributions for testing of mean , variance and proportions	R, U, A, E, An
CO-05	Understand the types of simulation such as discrete event simulation and stochastic simulation. Apply Monte Carlo simulation techniques and generation random numbers using congruent method.	R, U, A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	M	S	M	S	S	S	M	M	S	S	S	S
CO-02	S	L	S	M	S	M	S	M	S	S	S	S	S
CO-03	S	S	S	L	S	M	S	S	M	S	S	S	M
CO-04	S	S	S	M	S	S	S	L	M	S	S	M	M
CO-05	S	S	M	M	S	M	S	M	M	L	M	L	M

Unit I: Probability and Random Variables

9

Probability – Axioms of probability – Conditional probability – Baye’s theorem – Random variables – Probability function – Moments – Moment generating functions and their properties

Unit II: Standard Distributions

9

Binomial- Poisson - Geometric- Uniform- Exponential- Gamma and Normal distributions – Function of a random variable- Central Limit Theorem

Unit III: Two Dimensional Random Variables

9

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation

Unit IV: Testing Of Hypothesis

9

Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal- t- Chi square and F distributions for testing of mean - variance and proportions – Tests for independence of attributes and goodness of fit.

Unit V: Simulation

9

Discrete Event Simulation – Stochastic Simulation - Monte Carlo Simulation – Generation of Random Numbers using Congruent method – Applications to inventory and queueing models.

L: 45 + T: 15, TOTAL: 60 HOURS

REFERENCES:

1. Ross, “A first course in Probability”, Sixth Edition, Pearson Education, Delhi, 2011.
2. Richard A. Johnson and Dean W. Wichern, “Applied multivariate statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
3. Taha, H.A., “Operations Research – An Introduction”, Seventh Edition, Pearson Education, Delhi, 2002.

4. Oliver C. Ibe, “Fundamentals of Applied probability and Random Processes”, Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson India Education, Asia, 9th Edition, New Delhi, 2017.

CA4571	RELATIONAL DATABASE MANAGEMENT SYSTEM LABORATORY	L	T	P	C
		0	0	2	2

OBJECTIVES

- To know how to insert and retrieve data from the database.
- To know how to use PL/SQL programs.
- To know the advance concepts of DBMS.

Course Outcome		Cognitive Skill
CO-01	Ability to use data definition language commands in SQL.	U,A
CO-02	Ability to apply data manipulation language commands in SQL.	U,A
CO-03	Ability to use various string and mathematical functions in SQL.	U,A
CO-04	Ability to apply sub queries and joins in SQL	U,A
CO-5	Ability to develop PL/ SQL programs for various problems.	U,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	L	S	S	M	M	S	L	M	M	S	S	S	L
CO-02	M	L	S	M	M	S	L	M	S	S	S	S	M
CO-03	S	M	S	L	M	M	L	S	M	S	S	M	M
CO-04	M	M	S	M	M	M	L	L	M	S	L	M	S
CO-05	M	M	S	M	M	S	L	L	S	S	L	M	S

S – Strong, M- Medium, L – Low, N – Not Relevant

List of Experiments

1. Study of DDL Commands (Create , Alter , drop) Table: The Create Table Command, Creating a table from a table (with data, without data, with all columns, with selected columns), Drop Table, Alter Table, Renaming Tables
2. Study DML Commands (Select, insert, update, delete)
3. Constraints: Defining integrity constraints using create table and the alter table command, Dropping integrity constraints in the alter table command
4. Transaction Control statements: Commit, Rollback
5. Advanced Concepts: View, Index, Sequences, Default Value Concept
6. Join (Inner Join, Equi Joins, Self Join, Outer Joins)

7. Study sub query concepts and Set Operators
8. Study single row functions: String functions, Numeric Functions, Date Functions,
9. Date Conversion Functions, Study aggregate / group functions, having
10. Sorting Data, Handling Null values (IS NULL), Like Clause
11. PL/SQL programs using control structures
12. Procedures, functions and triggers

TOTAL: 30 HOURS

REFERENCES:

1. Ramez Elmsari, Shamkant B Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition
2. Silberschatz, Korth, Sudarshan, “Database System Concepts”, McGraw Hill Publication. 5th Edition
3. S K Singh, “Database Systems : Concepts, Design and Applications”, Pearson Education
4. Peter Rob, Carlos Coronel, “Database Systems : Design, Implementation and Management”, Cengage Learning
5. C J Date, A Kannan, S Swaminathan, “An Introduction to Database Systems”, Pearson Education, 8th Edition

CA4572	DATA STRUCTURES AND ALGORITHMS USING C LABORATORY	L	T	P	C
		0	0	2	2

OBJECTIVES

- Analyse step by step and develop algorithms to solve real world problems.
- Implementing various data structures, Stacks, Queues, Linked Lists, Trees and Graphs.
- Understanding various searching and sorting techniques.
- Define the basic concepts of algorithms and analyse the performance of algorithms.
- Discuss various algorithm design techniques for developing algorithms.

Course Outcome		Cognitive Skill
CO-01	Apply basic data structures such as arrays and stacks.	R, U, A
CO-02	Apply basic linear data structures such as queues and linked list.	R, U, A
CO-03	Ability to have knowledge of tree and graphs concepts.	R, U, A, An
CO-04	Be able to apply functions using asymptotic analysis and describe the relative Merits of worst-, average-, and best-case analysis.	R, U, A, E, An
CO-05	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data	R, U, A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	S	M	S	S	S	M	M	S	S	S	S
CO-02	S	S	S	M	S	S	S	M	S	S	S	S	S
CO-03	S	S	S	L	S	S	S	S	M	S	S	M	S
CO-04	S	S	S	M	S	S	S	L	M	S	S	M	S
CO-05	S	S	S	L	S	S	S	L	S	S	S	L	S

S – Strong, M- Medium, L – Low, N – Not Relevant

List of Experiments:

1. Simple programs using Control Structures,
2. Programs using structures and Arrays of Structures.
3. Stack Implementation
4. Queue Implementation
5. Implementation of Linked List
6. Binary tree traversal
7. Breadth First Search and Depth First Search
8. Binary Search using divide and conquer
9. Merge Sort and Quick Sort divide and conquer.
10. Knapsack Problem using greedy method.
11. All Pairs shortest path using dynamic programming.
12. Single source shortest paths using dynamic programming.

TOTAL: 30 HOURS

REFERENCES:

1. E Balagurusamy, “Programming in ANSI C”, Tata McGraw-Hill publications.
2. Brain W Kernighan and Dennis M Ritchie, “The ‘C’ Programming language”, Pearson publications.
3. Ashok N Kamthane, “Programming with ANSI and Turbo C”, Pearson Edition Publications.
4. Jean-Paul Tremblay & Paul G ,“An Introduction to Data Structures with Applications”, Sorenson Publisher-Tata McGraw Hill.
5. Yedidyah Langsam, “Data Structures using C & C++”, Prentice-Hall International.
6. Horowitz, Sahni, “Fundamentals of Computer Algorithms”, Galgotia Publications.

EG4571	COMMUNICATION SKILLS LAB – I	L	T	P	C
		0	1	1	2

OBJECTIVES

- To provide opportunities to learners to practice English and thereby make them proficient users of the language.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology.
- To improve the performance of students' listening, speaking, reading and writing skills and thereby enhance their career opportunities.

Course Outcome – Cos		Cognitive Skill
CO-01	Listen and comprehend lectures in English	R, U, A
CO-02	Articulate well and give presentations clearly	R, U, A
CO-03	Participate in Group Discussions successfully	R, U, A, An
CO-04	Communicate effectively in formal and informal writing Write proficient essays and emails	R, U, A, E, An
CO-05	Demonstrate overall competence in communication, encompassing listening, speaking, reading, and writing skills, enabling them to effectively engage in diverse communicative contexts with clarity, precision, and confidence.	R, U, A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	S	M	S	S	S	M	M	S	S	S	S
CO-02	S	S	S	M	S	S	S	M	S	S	S	S	S
CO-03	S	S	S	L	S	S	S	S	M	S	S	M	S
CO-04	S	S	S	M	S	S	S	L	M	S	S	M	S
CO-05	S	S	S	L	S	S	S	S	M	S	S	M	S

S – Strong, M- Medium, L – Low, N – Not Relevant

LIST OF ACTIVITIES

- Listening
 - Listening and practicing neutral accents
 - Listening to short talks and lectures and completing listening comprehension exercises
 - Listening to TED Talks
- Speaking
 - Giving one minute talks

- Participating in small Group Discussions
- Making Presentations
- 3. Reading
 - Reading Comprehension
 - Reading subject specific material
 - Technical Vocabulary
- 4. Writing
 - Formal vs. Informal Writing
 - Paragraph Writing
 - Essay Writing
 - Email Writing

REFERENCES: websites

TOTAL: 30 HOURS

SEMESTER - II

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CA4504	Advanced Python Programming	3	1	0	4
2.	CA4505	Full Stack Web Development	3	1	0	4
3.	CA4506	Data Science and Cloud Computing	3	0	0	3
4.	CA45**	Elective – I	3	0	0	3
5.	CA45**	Elective – II	3	0	0	3
PRACTICAL						
6.	CA4573	Python Programming Laboratory	0	0	2	2
7.	CA4574	Full Stack Web Development Laboratory	0	0	2	2
8.	EG4572	Communication Skill lab - II	0	0	1	1
TOTAL						22

CA4504	ADVANCED PYTHON PROGRAMMING	L	T	P	C
		3	1	0	4

OBJECTIVES

- Develop a basic understanding of programming and the Python Programming language.
- Understand the basics of Strings, Lists and Tuples.
- To develop the skills of designing Graphical user interface in Python.

Course Outcome		Cognitive Skill
CO-01	Understand the programming basics and explain basic principles of python programming language.	R, U
CO-02	Develop GUI applications using PyGTK.	R, U, A
CO-03	Implement basic object oriented concepts like inheritance and polymorphism.	R, U, A, An
CO-04	Implement database and GUI applications.	R, U, A, E, An
CO-05	Understand data science in python and begin to implement code using Numpy.	R, U, A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	M	M	S	S	S	S
CO-02	S	S	S	S	S	S	S	M	S	S	S	S	S
CO-03	S	S	S	M	S	S	S	S	M	S	S	M	M
CO-04	S	M	S	M	S	S	S	L	M	S	L	M	S
CO-05	M	S	S	S	S	S	S	S	S	S	S	L	M

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Python

9

Introduction to Python: Variables and Data Types – Operators – Conditional Statements: if – if else – Nested if – if elif else – Looping: For – While – Nested Loops – Control Statements: Break – Continue – Pass – Input/ Output Statements.

Unit II: Sequences and Functions

9

Sequences: String Manipulations – Lists – Tuples – Mapping and set types – Dictionaries – Sets – Functions: Defining a function – Calling a function – Types of function – Function Arguments – Lambda Function – Exception Handling – Modules.

Unit III: File Handling

9

File Handling: Object Oriented Programming – Classes – Objects – Attributes – Inheritance – Overloading – Polymorphism – Interacting with databases – Introduction to MySQL – Database Connection – Creating database table – insert operation – read operation – update operation – delete operation – Regular Expressions – Text handling.

Unit IV: Introduction to Graphics Programming

9

Introduction to Graphics Programming: Introduction to GTK – PyGTK – Developing GUI applications using PyGTK – Tooltip, Check button, Combo box, Menus, Calendar, Image, Image Processing – Network Programming – Socket Module – Server Socket Methods – Client Socket Methods – General Socket Methods – Web Services using SOAP.

Unit V: Data Science in Python

9

Data Science in Python: Numpy – Numpy Introduction – Data types object – dtype – Numerical operations on Numpy Arrays – Changing the dimensions of arrays – Matrix Arithmetic Scipy – Introduction – Basic functions – Special function – Optimization – Linear Algebra – Pandas – Introduction to Series and data frames – reading and writing data – Data Exploration.

L: 45 + T: 15, TOTAL: 60 HOURS

REFERENCES:

1. Allen B Downey, “Think Python: How to Think Like a Computer Scientist”, 1st Edition 2012, O’ Reilly Publications.
2. Jeff McNeil, “Python 2.6 Text Processing: Beginners Guide”, 2010, Packet Publications.
3. Mark Pilgrim, “Dive into Python”, 2nd Edition 2009, Apress Media LLC
4. VKent D Lee, “Python Programming Fundamentals”, 2010, Springer, 2nd Edition.
5. John. V. Guttag, “Introduction to Computation and Programming using Python”, Prentice Hall of India.

CA4505	FULL STACK WEB DEVELOPMENT	L	T	P	C
		3	1	0	4

OBJECTIVES

- To understand the fundamentals of web programming and client side scripting.
- To learn server side development using NodeJS
- To understand API development with Express Framework.
- To understand and architect databases using NoSQL and SQL databases.
- To learn the advanced client side scripting and ReactJS framework

Course Outcome		Cognitive Skill
CO-01	Write client side scripting HTML, CSS and JS.	R, U, A
CO-02	Implement and architect the server side of the web application.	R, U, A, E
CO-03	Implement Web Application using NodeJS.	R, U, A, An

CO-04	Architect NoSQL databases with MongoDB	A, E, An
CO-05	Implement a full-stack Single Page Application using React, NodeJS and MongoDB and deploy on Cloud.	A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	M	S	S	S	S	M	M	S	S	S	M
CO-02	S	S	L	S	M	M	S	M	S	S	S	S	S
CO-03	S	L	S	M	L	S	S	S	M	S	S	S	M
CO-04	S	M	S	L	M	S	S	S	M	S	L	M	S
CO-05	S	S	S	S	S	S	S	S	S	S	S	S	S

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction To CSS And Javascript

9

Introduction to Web: Server - Client - Communication Protocol (HTTP) – Structure of HTML Documents – Basic Markup tags – Working with Text and Images with CSS– CSS Selectors – CSS Flexbox - JavaScript: Data Types and Variables - Functions - Events – AJAX: GET and POST

Unit II: Server Side Programming With Node JS

9

Introduction to Web Servers – Javascript in the Desktop with NodeJS – NPM – Serving files with the http module – Introduction to the Express framework – Server-side rendering with Templating Engines – Static Files - async/await - Fetching JSON from Express.

Unit III: Advanced Node Js and Database

9

Introduction to NoSQL databases – MongoDB system overview - Basic querying with MongoDB shell – Request body parsing in Express – NodeJS MongoDB connection – Adding and retrieving data to MongoDB from NodeJS – Handling SQL databases from NodeJS – Handling Cookies in NodeJS – Handling User Authentication with NodeJS

Unit IV: Advanced Client Side Programming

9

React JS: ReactDOM - JSX - Components - Properties – Fetch API - State and Lifecycle - JSLocalStorage - Events - Lifting State up - Composition and Inheritance

Unit V: App Implementation In Cloud

9

Cloud providers Overview – Virtual Private Cloud – Scaling (Horizontal and vertical) – Virtual Machines, Ethernet and Switches – Docker Container – Kubernetes

TOTAL: 60 HOURS

REFERENCES:

1. David Flanagan, “Java Script: The Definitive Guide”, O’Reilly Media, Inc, 7th Edition, 2020
2. Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN: 978-1-119-36656-0, 2019

3. Alex Banks, Eve Porcello, "Learning React", O'Reilly Media, Inc, 2nd Edition, 2020
4. Marc Wandschneider, "Learning Node", Addison-Wesley Professional, 2nd Edition, 2016
5. Joe Beda, Kelsey Hightower, Brendan Burns, "Kubernetes: Up and Running", O'Reilly Media, 1st edition, 2017
6. Paul Zikopoulos, Christopher Bienko, Chris Backer, Chris Konarski, Sai Vennam, "Cloud Without Compromise", O'Reilly Media, 1st edition, 2021

CA4506	DATA SCIENCE AND CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the fundamental concepts of data science and applications
- To study the concepts of data science analytics
- To know the basics of cloud computing
- To study about virtualization and its techniques
- To know about cloud resource management and its issues

Course Outcome		Cognitive Skill
CO-01	The students should be able to work with big data platform.	R, U
CO-02	To become familiar with data analytic techniques.	R, U
CO-03	To become familiar with the basics of cloud computing.	R, U, A, An
CO-04	To implement virtualization techniques.	R, U, A, An, E
CO-05	To implement cloud resources and cloud databases.	R, U, A, An, E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	S	S	S	M	S	S	S	S
CO-02	S	L	S	S	S	S	S	M	S	S	S	S	S
CO-03	S	S	S	L	S	S	S	S	M	S	S	S	M
CO-04	S	S	S	M	S	S	S	L	M	S	M	S	S
CO-05	S	M	S	M	S	S	S	M	S	S	S	S	M

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Data Science

9

Introduction to Data Science – History of Data Science – Data Science Role and Skill Tracks-What Kind of Questions Can Data Science Solve?- Structure of Data Science Team-Data Science Roles- Data Science Process: Setting the research goal - Retrieving data – Data preparation - Data exploration - Data modelling - Presentation and automation.

Unit II: Soft Skills for Data Scientists**9**

Comparison between Statistician and Data Scientist– Beyond Data and Analytics– Three Pillars of Knowledge – Data Science Project Cycle– Common Mistakes in Data Science– Data Pre-processing - Data Cleaning– Missing Values- Centering and Scaling.

Unit III: Introduction to Cloud**9**

Cloud Computing Overview – Origins of Cloud computing – Cloud components -Essential characteristics - Roots of Cloud Computing – Service models and Deployment Model:Public Clouds – Private Clouds – Community Clouds - Hybrid Clouds - Advantages of Cloud Computing.–Features - Infrastructure Management - IaaS – PaaS – SaaS - Challenges and Risk.

Unit IV: Virtualization Techniques**9**

Introduction to Virtual Machines – Benefits - Levels of Virtualization - Emulation: Virtualization at OS level - Virtualization structure - mechanisms - open source virtualization technology -Xen virtualization architecture - Full virtualization - Para virtualization – virtualization of CPU,Memory and I/O devices - Hardware Support - processor virtualization.

Unit V: Cloud Resources Management and Issues**9**

Cloud architecture: Cloud delivery model- Cloud Storage Architectures- Software as a Service (SaaS): SaaS service providers – Google App Engine-Salesforce.com and google platform – Benefits – Operational benefits - Economic benefits – Evaluating SaaS – Platform as a Service(PaaS): PaaS service providers – Right Scale – Salesforce.com – Rackspace – Force.com –Services and Benefits – Infrastructure-as-a -Service (IaaS): IaaS Service Providers – Amazon EC2.

TOTAL: 45 HOURS**REFERENCES:**

1. Hui Lin and Ming Li “Practitioner’s Guide to Data Science”
2. Rachel Schutt, Cathy O’Neil, “Doing Data Science”, O’Reilly Publishers, 2013.
3. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science, Big data, machine learning, and more, using Python tools” Publisher: Dream tech Press January 2016.
4. Booz, Allen, Hamilton “The field guide to data science” eBook Social Science Electronic Publishing, April 2011
5. Cloud computing principles and paradigms by RajKumar Buyya, James Broberg, Andrzej Goscinski, Wiley India Pvt Ltd, Delhi 2011
6. Kailash Jayaswal, Jegannath Kallakurchi, Donald J Houde, Dr.Devan Shah , “Cloud computing Black book”, Kogent Learnig solutions Inc, 2014
7. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, 2012.

CA4573	PYTHON PROGRAMMING LABORATOY	L	T	P	C
		0	0	2	2

OBJECTIVES

- Develop a basic understanding of programming and the Python Programming language.
- Understand the basics of Strings, Lists and Tuples.
- To develop the skills of designing Graphical user interface in Python.

Course Outcome		Cognitive Skill
CO-01	Understand the programming basics and explain basic principles of python programming language.	U, A
CO-02	Develop GUI applications using PyGTK.	U, A, E
CO-03	Implement basic object oriented concepts like inheritance and polymorphism.	U, A, An, E
CO-04	Implement database and GUI applications.	U, A, E, An
CO-05	Understand data science in python and begin to implement code using Numpy.	A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	M	M	S	S	S	S
CO-02	S	S	S	S	S	S	S	M	S	S	S	S	S
CO-03	S	S	S	M	S	S	S	S	M	S	S	M	M
CO-04	S	M	S	M	S	S	S	L	M	S	L	M	S
CO-05	M	S	S	S	S	S	S	S	S	S	S	L	M

S – Strong, M- Medium, L – Low, N – Not Relevant

List of Experiments:

1. Programs to use control flow tools and loops.
2. Programs to create and delete list and tuples.
3. Programs to read and write files create and delete directories.
4. Programs with exception handling.
5. Programs using classes and objects
6. Connect with MYSQL and create an address book and do the operations Insert, read, update and delete.
7. Programs for String handling.
8. GUI program using PYGTK.
9. Programs using Numpy.
10. Programs using scipy.

11. Programs using series and data frames.
12. Programs using charts/graphs.

TOTAL: 30 HOURS

REFERENCES:

1. Allen B Downey, “Think Python: How to Think Like a Computer Scientist”, 1st Edition 2012, O’ Reilly Publications.
2. Jeff McNeil, “Python 2.6 Text Processing: Beginners Guide”, 2010, Packet Publications.
3. Mark Pilgrim, “Dive into Python”, 2nd Edition 2009, Apress Media LLC
4. VKent D Lee, “Python Programming Fundamentals”, 2010, Springer, 2nd Edition.
5. John. V. Guttag, “Introduction to Computation and Programming using Python”, Prentice Hall of India.

CA4574	FULL STACK WEB DEVELOPMENT LABORATORY	L	T	P	C
		0	0	2	2

OBJECTIVES

- To understand the fundamentals of web programming and client side scripting.
- To learn server side development using NodeJS.
- To understand API development with Express Framework.
- To understand and architect databases using NoSQL and SQL databases.
- To learn the advanced client side scripting and ReactJS framework

Course Outcome		Cognitive Skill
CO-01	To implement and deploy the client side of the web application.	A, U
CO-02	To develop and deploy server side applications using NodeJS.	U, A, E
CO-03	To use Express framework in web development.	A, An
CO-04	To implement and architect database systems in both NoSQL and SQL environments.	A, E, An
CO-05	To develop a full stack single page application using React, NodeJS, and a Database and deploy using containers.	A, E, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	M	S	S	S	S	M	M	S	S	S	M
CO-02	S	S	L	S	S	M	S	M	S	S	S	S	S
CO-03	S	L	S	M	S	S	S	S	M	S	S	S	M
CO-04	S	M	S	L	S	S	S	S	M	S	L	M	S
CO-05	S	S	S	S	S	S	S	S	S	S	S	L	M

S – Strong, M- Medium, L – Low, N – Not Relevant

List of Experiments:

1. Create a form and validate the contents of the form using JavaScript.
2. Get data using Fetch API from an open-source endpoint and display the contents in the form of a card.
3. Create a NodeJS server that serves static HTML and CSS files to the user without using express.
4. Create a NodeJS server using Express that stores data from a form as a JSON file and displays it in another page. The redirect page should be prepared using Handlebars.
5. Create a NodeJS server using Express that creates, reads, updates and deletes students' details and stores them in MongoDB database. The information about the user should be obtained from a HTML form.
6. Create a NodeJS server that creates, reads, updates and deletes event details and stores them in a MySQL database. The information about the user should be obtained from a HTML form.
7. Create a counter using ReactJS
8. Create a Todo application using ReactJS. Store the data to a JSON file using a simple NodeJS server and retrieve the information from the same during page reloads.
9. Create a simple Sign up and Login mechanism and authenticate the user using cookies. The user information can be stored in either MongoDB or MySQL and the server should be built using NodeJS and Express Framework.
10. Create and deploy a virtual machine using a virtual box that can be accessed from the host computer using SSH.
11. Create a docker container that will deploy a NodeJS ping server using the NodeJS image.

TOTAL: 30 HOURS

REFERENCES:

1. David Flanagan, "Java Script: The Definitive Guide", O'Reilly Media, Inc, 7th Edition, 2020
2. Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN: 978-1-119-36656-0, 2019
3. Alex Banks, Eve Porcello, "Learning React", O'Reilly Media, Inc, 2nd Edition, 2020
4. Marc Wandschneider, "Learning Node", Addison-Wesley Professional, 2nd Edition, 2016

5. Joe Beda, Kelsey Hightower, Brendan Burns, “Kubernetes: Up and Running”, O’Reilly Media, 1st edition, 2017
6. Paul Zikopoulos, Christopher Bienko, Chris Backer, Chris Konarski, Sai Vennam, “Cloud Without Compromise”, O’Reilly Media, 1st edition, 2021

EG4572	COMMUNICATION SKILLS LAB - II	L	T	P	C
		0	1	1	1

OBJECTIVES

- To provide opportunities to learners to practice their communication skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of Technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures

Course Outcome		Cognitive Skill
CO-01	Students will be able to make presentations and participate in Group discussions with confidence.	A, U
CO-02	Students will be able to perform well in the interviews.	U, A, E
CO-03	Students will make effective presentations.	A, An
CO-04	Students will demonstrate effective verbal and non-verbal communication skills	A, E
CO-05	Students will develop strategies for managing and coping with stress during interviews and other high-pressure situations	A, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO \ CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	S	S	S	M	M	S	S	S	M
CO-02	S	S	L	S	S	M	S	M	S	S	S	S	S
CO-03	S	L	S	M	S	S	S	S	M	S	S	S	M
CO-04	S	S	L	S	S	M	S	M	S	S	S	S	S
CO-05	S	L	S	M	S	S	S	S	M	S	S	S	M

S – Strong, M- Medium, L – Low, N – Not Relevant

1. SOFT SKILLS

- People skills
- Interpersonal skills
- Team building skills
- Leadership skills

- Problem solving skills

2. **PRESENTATION SKILLS**

- Preparing slides with animation related to the topic
- Introducing oneself to the audience
- Introducing the topic
- Presenting the visuals effectively – 5 minute presentation

3. **GROUP DISCUSSION SKILLS**

- Participating in group discussions
- Brainstorming the topic
- Activities to improve GD skills.

4. **INTERVIEW SKILLS**

- Interview etiquette – dress code – body language
- Attending job interviews
- Answering questions confidently
- Technical interview – telephone/Skype interview
- Emotional and cultural intelligence
- Stress Interview

REFERENCES: websites

TOTAL: 30 HOURS

SEMESTER – III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CA4507	Advanced Java Programming	3	1	0	4
2.	CA4508	Machine Learning Techniques	3	0	0	3
3.	CA45**	Elective - III	3	0	0	3
4.	CA45**	Elective - IV	3	0	0	3
5.	CA45**	Elective - V	3	0	0	3
PRACTICAL						
6.	CA4575	Advanced Java Programming Laboratory	0	0	2	2
7.	CA45P1	Project Work - I	0	0	12	6
TOTAL						24

CA4507	ADVANCED JAVA PROGRAMMING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- Enable the students to learn the basic functions, principles and concepts of advanced java programming.
- Provide knowledge on concepts needed for distributed Application Architecture.
- Learn JDBC, Servlet packages, Java Server Page.

Course Outcome		Cognitive Skill
CO-01	Understand the concepts of Java Fundamentals	R, U
CO-02	To analyze, review and synthesize the packages, interfaces and inheritances.	R, U, An
CO-03	Manage different event in java using the delegation event model, event listener and class	R, U, A, An
CO-04	Understand JDBC and RMI concepts	R, U, A, An
CO-05	Design interactive applications using Java Servlet, and JSP.	A, An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	M	S	L	S	S	M
CO-02	S	S	M	S	L	S	S	M	S	S	S	S	L
CO-03	S	S	M	S	L	S	S	M	S	S	S	L	M
CO-04	S	S	M	S	M	S	S	M	S	S	S	L	L
CO-05	S	S	M	S	S	S	S	M	M	S	S	L	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: JAVA Fundamentals

9

Object Oriented Concepts in Java: Java Features – Java Platform – Java Fundamentals – Data Types – Variables - Arrays – Expressions – Operators - Control Structures – Classes - Objects - Methods – Modifiers - Access Controls - Constructors.

Unit II: Windows Fundamentals

9

Packages - Interfaces - Inheritance – Exception Handling – Multithreading. Applets and Graphics – Applet Basics – Life Cycle – 2D Painting Controls – AWT Controls and Components - Command Line Arguments

Unit III:Files and Swing**9**

Input Output Packages – File Stream Classes - Byte Streams - Character Streams - Reading and Writing Files – Layout Managers – Java Swing – Controls working with JFrame - Event PackageS – Event Model – Event Classes – Event Listeners – Adapter Classes.

Unit IV: RMI and JDBC**9**

Remote Method Invocation - Distributed Application Architecture - Creating stubs and skeletons - Defining Remote objects - Remote Object Activation - Object Serialization - Java Spaces. Java in Databases - JDBC principles – database access – JDBC Drivers – JDBC Implementation

Unit V:Java Servlets and JSP**9**

Java Servlets: Java Servlet and CGI programming - A simple java Servlet - Anatomy of a java Servlet - Reading data from a client- Reading http request header - Sending data to a client and writing the http response header - working with cookies. Java Server Pages: JSP Overview - JSP tags - Components of a JSP page – Expressions – Java Beans.

TOTAL: 45 HOURS**REFERENCES:**

1. Jim Keogh,” The Complete Reference J2EE”, Tata McGraw Hill Publishing Company Ltd, 2010.
2. DeitelandDeitel, “Java How to Program”, Third Edition, PHI / Pearson Education Asia.
3. Campione, Walrath and Huml,“TheJavaTutorial”,AddisonWesley,1999.
4. Jamie Jaworski, “Java Unleashed”, SAMSTechmediaPublications,1999.

CA4508	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Machine Learning (ML).
- To understand the modelling and evaluation methods of Machine Learning.
- To know about the Bayesian concept learning and probability distributions.
- To understand the supervised and unsupervised algorithms and applications.

Course Outcome		Cognitive Skill
CO-01	To understand the characteristics of machine learning strategies.	U
CO-02	To apply various supervised learning methods to appropriate problems	U
CO-03	To know about the implementation aspects of Machine Learning	U
CO-04	To create probabilistic and unsupervised learning modesl for handling unknown pattern	U
CO-05	To understand and implement use cases of ML	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	S	S	S	M	S	M	S	M	S
CO-02	S	M	S	M	S	M	S	M	S	M	S	M	S
CO-03	M	S	S	S	S	S	S	M	M	M	S	S	M
CO-04	M	S	S	S	S	S	S	S	M	M	M	S	M
CO-05	S	M	M	S	M	M	S	M	S	M	S	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: MACHINE LEARNING BASICS

9

Human Learning and types - Machine Learning (ML) – Definition – Application Areas – Machine Learning Types - Types of learning – Tools in Machine learning - Issues in Machine learning – Machine Learning process - Data types – Data quality and remediation.

Unit II: MODELLING AND EVALUATION

9

Selecting a model - Training model – holdout - k-fold cross-validation - bootstrap sampling; model representation and interpretability – under-fitting – over-fitting -bias-variance trade off - model performance evaluation – classification – regression - clustering; - performance improvement of a model.

Unit III: FEATURE ENGINEERING

9

Feature Engineering – Feature Transformation – Feature Construction – Feature Extraction – Feature subset selection – Feature relevance – Feature redundancy – Measures of feature relevance and redundancy - Feature selection process – Feature selection approaches.

Unit IV: PROBABILITY AND BAYESIAN CONCEPT LEARNING

9

Basic concept of probability -Random variables - discrete distributions - binomial, Poisson - Bernoulli, etc.; continuous distribution – uniform - normal – Laplace –Central Limit Theorem - Monte Carlo approximation - Bayesian concept learning: Bayes theorem – Naïve Bayes Classifier – Applications - Bayesian Belief Network.

Unit V: SUPERVISED AND UNSUPERVISED LEARNING

9

Supervised learning – Classification model - Classification algorithms: k-Nearest neighbour - decision tree - random forest - support vector machine - Regression: Simple linear regression -other regression techniques - Unsupervised learning: Applications - Clustering techniques – association rules.

TOTAL: 45 HOURS

REFERENCES:

1. Machine Learning by Subramanian Chandramouli, SaikatDutt, Amit Kumar Das Pearson Education, India
2. Taeho Jo “Machine Learning Foundations: Supervised, Unsupervised, and Advanced Learning,” First Edition. 2021. Publisher: Springer

3. EthemAlpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
4. MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar "Foundations of Machine Learning", MIT Press, 2012.
5. Tom Mitchell, "Machine Learning", McGraw Hill, 3 rd Edition,1997.
6. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press,2014.

CA4575	ADVANCED JAVA PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	2

OBJECTIVES:

- Enable the students to learn the basic functions, principles and concepts of advanced java programming.
- Provide knowledge on concepts needed for distributed Application Architecture.
- Learn JDBC, Servlet packages, Java Server Page.

Course Outcome		Cognitive Skill
CO-01	Understand the concepts of Java Fundamentals	R, U
CO-02	To analyze, review and synthesize the packages, interfaces and inheritances.	R, U, An
CO-03	Manage different event in java using the delegation event model, event listener and class	R, U, A, An
CO-04	Understand JDBC and RMI concepts	R, U, A, An
CO-05	Design interactive applications using Java Servlet, and JSP.	A, An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	M	S	L	S	S	M
CO-02	S	S	M	S	L	S	S	M	S	S	S	S	L
CO-03	S	S	M	S	L	S	S	M	S	S	S	L	M
CO-04	S	S	M	S	M	S	S	M	S	S	S	L	L
CO-05	S	S	M	S	S	S	S	M	M	S	S	L	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS

1. Simple Programs using overloading and Constructor.
2. Program using interfaces and inheritance.
3. Creation of user defined packages.

4. Creation of program using threads and Exception handling.
5. Reading and writing text files.
6. Create an applet for calculator application.
7. Program using JDBC.
8. Program to build simple Client Server application using RMI.
9. Program to Implementing Events.
10. Program using Servlet.
11. Prepare an Employee pay slip using JSP.
12. Develop a program for calculating the percentage of the marks of student using Swing.
13. Creation and Usage of Java Beans.

TOTAL: 45 HOURS

REFERENCES:

1. Jim Keogh,” The Complete Reference J2EE”, Tata McGraw Hill Publishing Company Ltd, 2010.
2. Deitel and Deitel, “Java How to Program”, Third Edition, PHI / Pearson Education Asia.

CA45P1	PROJECT WORK- I	L	T	P	C
		0	0	12	6

OBJECTIVES:

- Opportunity to specialize in specific areas of computer science;
- Future employers will most likely ask about the project at interview;
- Opportunity to demonstrate a wide range of skills and knowledge learned
- Encourages integration of knowledge gained in the previous course units.

The Project Work-I is not only a part of the coursework, but also a mechanism to demonstrate the abilities and specialization. It provides the opportunity for the student to demonstrate originality, teamwork, inspiration, planning and organization in a software project, and to put into practice some of the techniques that have been taught throughout the previous courses. Mini Project work shall be carried out by a student under the guidance of a faculty. It is mandatory that a Student should submit the document of the completed work in the mid-semester and presentation before the project course committee during the semester in which the mini project work is undertaken. The students could demonstrate that he/she has acquired both analytical and practical skills in the field specialization. The student should submit the mini project report at the end of the semester. The project report should be documented with an engineering approach to the solution of the problem .The project report should be prepared in order to solve the problem in a methodical and professional manner, making due references to appropriate techniques, technologies and professional standards.

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45P2	Project Work – II	0	0	36	18
TOTAL			0	0	36	18

CA45P2	Project Work-II	L	T	P	C
		0	0	36	18

OBJECTIVE:

Student is expected to do an in depth study in his/her specialized area by doing a detailed literature survey, understanding different aspects of the problem, arriving at the status report in the area, carry out developmental and/or experimental Work, analyze and interpret the results to arrive the conclusions.

Project work is an inclusive component of a Program. Project work shall be carried out by a student under the guidance of a faculty either within the University department(s) or in external organizations like Industries, Research Institutes/Centers or other Academic Institutions recognized by the appropriate statutory bodies and approved by the Board of Management. In case of external organizations, a co-guide from such institutions is essential. The guide/co-guide may be from other related departments of the University also. Guide/co-guide is normally fixed by mutual consent but recommended by the HOD and approved by the Dean. In the Project Work, Student is expected to do an in depth study in his/her specialized area by doing a detailed literature survey, understanding different aspects of the problem, arriving at the status report in the area, carry out developmental and/or experimental Work, analyze and interpret the results to arrive the conclusions. Project presentations are inclusive components of a program. These presentations are based on learnt investigation methodologies, concepts and techniques from the available relevant research literature, etc., critical correlation of work of various authors/researchers and results pertaining to the project work and their analysis. The student should demonstrate that he/she has acquired both analytical and practical skills in the field specialization. Interdisciplinary projects are also encouraged. Project may be applied research or industry oriented or a combination of both.

ELECTIVES

ELECTIVE - I

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
6.	CA45A1	Software Project Management	3	0	0	3
7.	CA45A2	Professional Ethics in IT	3	0	0	3
8.	CA45A3	Software Quality and Testing	3	0	0	3
9.	CA45A4	Software Reuse	3	0	0	3
10.	CA45A5	Agile Methodologies	3	0	0	3

ELECTIVE - II

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
6.	CA45A6	Advances in Networking	3	0	0	3
7.	CA45A7	Wireless Networking	3	0	0	3
8.	CA45A8	Network Programming	3	0	0	3
9.	CA45A9	Cryptography and Network Security	3	0	0	3
10.	CA45B1	Mobile Communication Techniques	3	0	0	3

ELECTIVE - III

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45B2	Digital Image Processing	3	0	0	3
2.	CA45B3	Digital Forensics	3	0	0	3
3.	CA45B4	Soft Computing	3	0	0	3
4.	CA45B5	Artificial Intelligence	3	0	0	3
5.	CA45B6	Block Chain Technology	3	0	0	3

ELECTIVE - IV

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45B7	Information Retrieval Techniques	3	0	0	3
2.	CA45B8	Data Mining and Data Warehousing	3	0	0	3
3.	CA45B9	Data Visualization	3	0	0	3
4.	CA45C1	Big Data Analytics	3	0	0	3
5.	CA45C2	Knowledge Engineering	3	0	0	3

ELECTIVE - V

SL.NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CA45C3	Management Information System	3	0	0	3
2.	CA45C4	Digital Marketing	3	0	0	3
3.	CA45C5	Organizational Behaviour	3	0	0	3
4.	CA45C6	Information System Security	3	0	0	3
5.	CA45C7	Ethical Management	3	0	0	3

ELECTIVE - I

CA45A1	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know how to do project planning for the software process.
- To learn the cost estimation techniques during the analysis of the project.
- To understand the quality concepts for ensuring the functionality of the software

Course Outcome		Cognitive Skill
CO-01	Understand the activities during the project scheduling of any software application.	R, U, A, An
CO-02	Learn the risk management activities and the resource allocation for the projects.	R, U, A
CO-03	Apply the software estimation and recent quality standards for evaluation of the software projects	R, U, A, An
CO-04	Acquire knowledge and skills needed for the construction of highly reliable software project	R, U, A,
CO-05	Create reliable, replicable cost estimation that links to the requirements of project planning and managing	R, U, A,

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	S	S	S	M	L	S	S	S	M
CO-02	S	S	S	M	S	S	M	L	L	S	S	S	M
CO-03	S	M	S	S	S	S	M	S	M	S	S	S	M
CO-04	S	M	S	M	S	S	M	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	S	S	S	S	S	S	M

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Software Project Management Concepts

9

Introduction to Software Project Management: An Overview of Project Planning: Select Project- Identifying Project scope and objectives- infrastructure- project products and Characteristics- Estimate efforts- Identify activity risks- and allocate resources- Six Sigma- Software Quality: defining software quality- ISO9126- External Standards

Unit II: Software Evaluation and Costing

9

Project Evaluation: Strategic Assessment- Technical Assessment- cost-benefit analysis- Cash flow forecasting- cost-benefit evaluation techniques- Risk Evaluation- Selection of

Appropriate Project approach: Choosing technologies- choice of process models- structured methods

Unit III: Software Estimation Techniques

9

Software Effort Estimation: Problems with over and under estimations- Basis of software Estimation- Software estimation techniques- expert Judgment- Estimating by analogy- Activity Planning: Project schedules- projects and activities- sequencing and scheduling Activities- networks planning models- formulating a network model

Unit IV: Risk Management

9

Risk Management: Nature of Risk- Managing Risk- Risk Identification and Analysis- Reducing the Risk- Resource Allocation: Scheduling resources- Critical Paths- Cost scheduling- Monitoring and Control: Creating Framework- cost monitoring- prioritizing monitoring

Unit V: Globalization Issues In Project Management

9

Globalization issues in project management: Evolution of globalization- challenges in building global teams-models for the execution of some effective management techniques for managing global teams- Impact of the internet on project management: Introduction – the effect of the internet on project management – managing projects for the internet – effect on project management activities- Comparison of project management software: dot Project-Launch pad- openProj- Case study: PRINCE2

TOTAL:45 HOURS

REFERENCES:

1. Robert K Wysocki, “ Effective Software Project Management”, - Willy Publications
2. Walkwr Royce, “ Software Project Management”, Addition Wesley Publications.
3. Gopalasamy Ramesh, “ Managing Global Software Projects”, Mcgraw Hill Publications, 14th Reprint.
4. Bob Hughes, Mike Cotterell and Rejib Mall, “Software Project Management” 5th Edition Tata Mcgraw Hill

CA45A2	PROFESSIONAL ETHICS IN IT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of computer ethics in the work environment.
- To understand the threats in computing environment
- To Understand the intricacies of accessibility issues
- To ensure safe exits when designing the software projects

Course Outcome		Cognitive Skill
CO-01	Examine situations and to internalize the need for applying ethical principles, values totackle various situations.	R, U, A, An
CO-02	Develop a responsible attitude towards the use of computers as well	R, U, A,E

	as the technology.	
CO-03	Envision the societal impact on the products/ projects they develop in their career	R, U, A, An
CO-04	Understand the code of ethics and standards of computer professionals.	R, U
CO-05	Analyze professional responsibility and empower access to information in the workplace.	R, U, A, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	S	S	M	S	S	S	M	L	S	S	S	S
CO-02	S	S	S	M	S	S	M	L	L	S	S	S	S
CO-03	S	S	S	S	L	S	S	S	M	S	S	S	S
CO-04	S	S	S	M	S	S	S	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	S	S	S	S	S	S	L

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction to Ethics

9

Definition of Ethics- Right- Good- Just- The Rational Basis of Ethics -Theories of Right: Intuitionist vs. End-Based vs. Duty-Based -Rights- Duties- Obligations -Theory of Value - Conflicting Principles and Priorities -The Importance of Integrity -The Difference Between Morals- Ethics- and Laws -Ethics in the Business World - Corporate Social Responsibility - Creating an Ethical Work Environment -Including Ethical Considerations in Decision Making

Unit II: Ethics in Information Technology- InternetCrime

9

IT Professionals - Are IT Workers Professionals- Professional Relationships That Must Be Managed -Professional Codes of Ethics - Professional Organizations - Certification - IT Professional Ethics- Three Codes of Ethics- Management Conflicts- The Reveton Ransom were Attacks -IT Security Incidents: A Major Concern - Why Computer Incidents Are So Prevalent - Types of Exploits -Types of Perpetrators-Federal Laws for Prosecuting Computer Attacks- Implementing Trustworthy Computing -Risk Assessment -Establishing a Security Policy - Educating Employees and Contract Workers

Unit III: Freedom of Expression- Privacy

9

First Amendment Rights -Obscene Speech-Defamation -Freedom of Expression: Key Issues - Controlling Access to Information on the Internet -Strategic Lawsuit Against Public Participation (SLAPP)-Anonymity on the Internet-Hate Speech- Privacy Protection and the Law- Information Privacy- Privacy Laws- Applications- and Court Rulings-Key Privacy and Anonymity Issues- Data Breaches -Electronic Discovery-Consumer Profiling- Workplace Monitoring –Advanced Surveillance Technology

Unit IV: Freedom of Expression- Intellectual Property Rights

9

Intellectual Property Rights-Copyrights-Copyright Term - Eligible Works -Fair Use Doctrine

- Software Copyright Protection –Copyright Laws and the internet-Copyright and Piracy– Patents- -Software Patents -Cross-Licensing Agreements -Trade Secrets-Trade Secret Laws - Employees and Trade Secrets-Key Intellectual Property Issues-Plagiarism -Reverse Engineering-Open Source Code- Competitive Intelligence -Trademark Infringement -Cyber squatting

Unit V: Social Networking Ethics and Etiquettes

9

Social Networking Web Site- Business Applications of Online Social Networking-Social NetworkAdvertising-The Use of Social Networks in the Hiring Process-Social Networking Ethical Issues – Cyber bullying- Online Virtual Worlds-Crime in Virtual Worlds-Educational and Business Usesof Virtual Worlds

TOTAL:45 HOURS

REFERENCES:

1. Caroline Whitback, "Ethics in Engineering Practice and Research", Cambridge University Press, 2nd Edition 2011.
2. George Reynolds, "Ethics in Information Technology", Cengage Learning, 6th Edition 2018.
3. Barger, Robert. (2008). Computer ethics: A case-based approach. Cambridge University Press 1st Edition.
4. John Weckert and Douglas Adeney, Computer and Information Ethics, Greenwood Press, First Edition 1997.
5. Penny Duquenoy, Simon Jones and Barry G Blundell, "Ethical, legal and professional issues in computing", Middlesex University Press, First Edition 2008.
6. Sara Baase, "A Gift of Fire: Social, Legal, and Ethical Issues for Computing Technology", 4th Edition, Pearson India, 2018.
7. http://www.infosectoday.com/Articles/Intro_Computer_Ethics.html

CA45A3	SOFTWARE QUALITY AND TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the behavior of the testing techniques and to design test cases to detect the errors in the software
- To get insight into software testing methodologies
- To understand standard emerging areas in testing
- To learn about the software quality models.
- To understand the models and metrics of software quality and reliability

Course Outcome		Cognitive Skill
CO-01	Choose the software testing techniques to cater to the need of the project	R, U, A, An
CO-02	Identify the components of software quality assurance systems	R, U, A,E
CO-03	Apply various software testing strategies	R, U, A, An
CO-04	Design and develop software quality models	R, U,A
CO-05	Make use of statistical methods in software quality.	R, U, A, An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	M	S	S	S	S	S	S	M	S	S	S	M	S
CO-02	M	S	S	S	S	S	M	L	S	S	S	M	S
CO-03	L	S	S	S	L	S	S	S	M	S	S	S	S
CO-04	S	S	S	M	S	S	S	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	M	M	L	S	S	S	L

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction

9

Basic concepts and Preliminaries – Theory of Program Testing– Unit Testing – Control Flow Testing –Data Flow Testing– System Integration Testing

Unit II: Software Testing Methodology

9

Software Test Plan–Components of Plan - Types of Technical Reviews - Static and Dynamic Testing- – Software Testing in Spiral Manner - Information Gathering - Test Planning - Test Coverage - Test Evaluation - Acceptance Test – Summarize Testing Results.

Unit III: Emerging Specialized Areas In Testing

9

Test Process Assessment – Test Automation Assessment - Test Automation Framework –Agile Testing – Testing Center of Excellence – Onsite/Offshore Model - Modern Software Testing Tools – Software Testing Trends – Methodology to Develop Software Testing Tools. **Unit IV:**

Software Quality Models

9

Software quality –Verification versus Validation– Components of Quality Assurance – SQA Plan – Quality Standards – CMM – PCMM – CMMI – Malcolm Baldrige National Quality Award.

Unit V: Quality Through Continuous Improvement Process

9

Role of Statistical Methods in Software Quality – Transforming Requirements into Test Cases –Deming's Quality Principles – Continuous Improvement through Plan Do Check Ac (PDCA)

TOTAL: 45 HOURS

REFERENCES:

1. William E.Lewis, “Software Testing and Continuous Quality Improvement”, 3rd Edition, Auerbach Publications, 2011
2. KshirasagarNaik and PriyadarshiTripathy, “Software Testing and Quality Assurance Theory and Practice”, 2nd Edition, John Wiley & Sons Publication, 2011
3. Ron Patton, “Software Testing”, 2nd Edition, Pearson Education, 2007
4. Glenford J. Myers, Tom Badgett, Corey Sandler, “The Art of Software Testing”, 3rd Edition, John Wiley & Sons Publication, 2012.
5. Paul C. Jorgensen, “Software Testing, A Craftman’s Approach”, CRC Press Taylor & Francis Group, Fourth Edition, 2018

CA45A4	SOFTWARE REUSE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explain the benefits of software reuse and some reuse problems.
- To discuss several different ways to implement software reuse.
- To describe the development of Software product lines.
- To develop reusable components.
- To understand the metrics used in software reusable components.

Course Outcome		Cognitive Skill
CO-01	Implementing software systems using existing software components.	R, U, A, An
CO-02	Achieve better software quality more quickly at lower cost.	R, U, A, E
CO-03	Reuse abstract knowledge about a problem and its solution.	R, U, A, An, E, S
CO-04	Understand the concepts of object-oriented software engineering.	R, U, A
CO-05	Reusability of components shall be applied using the available methods of reusable processes.	R, U, A, An, E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	S	S	S	M	S	S	S	M	S
CO-02	M	S	S	S	S	S	M	L	S	S	S	M	S
CO-03	L	S	S	S	L	S	S	S	M	S	S	S	S
CO-04	S	S	S	M	S	S	S	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	M	M	L	S	S	S	L

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Introduction**9**

Software Reuse success Factors- Change in process - Change in Organization-set of Principles
Reuse Cost effective-software Engineering Processes- Establishing and Managing a Reuse business.

Unit II: Object-Oriented Software Engineering**9**

Transform requirement into code- Use Case model-Analysis model-Design model
Implementation Model-Test Model-Application and Component Systems- Layered Architecture.

Unit III: Components**9**

Use case Components-Structure the use case model to ensure component reuse- Reusing
Component to build the use case model-Design the use case components for effective reuse
Expressing use case Variability- Packaging and Documenting use case components- objects
Components.

Unit IV: Reuse Processes**9**

Object-oriented Business Engineering-Appling Business Engineering-Appling Business
engineering to Define process and organization- Application family Engineering.

Unit V: Reuse In Business**9**

Organizing a Reuse Business- Transition to a Reuse Business- Managing the reuse business
Making the reuse Business work-Applications of reuse in business- A case study of reuse in
business

TOTAL: 45 HOURS**REFERENCES:**

1. Ivar Jacobson, Martin Gres, Patrick Johnson, "Software Reuse", Pearson Education, 2004. Elsevier, 5th edition, 2012.
2. Even-Andre Karisson, "Software Reuse, A Holistic Approach", John Wiley and Sons, 1996.
3. Karma McClure, "Software Reuse Techniques, Additional reuse to the systems development process", Prentice Hall, 1997.
4. Themistoklis Diamantopoulos and Andreas L. Symeonidis "Mining software Engineering Data For Software Reuse", 1st edition, 30 March 2020.

CA45A5	AGILE METHODOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing

Course Outcome		Cognitive Skill
CO-01	Realize the importance of interacting with business stakeholders in determining the requirements for a software system	R, U, A, An
CO-02	Perform iterative software development processes: how to plan them, how to execute them.	R, U, A,E, An
CO-03	Point out the impact of social aspects on software development success.	R, U, A, An
CO-04	Develop techniques and tools for improving team collaboration and software quality.	R, U,A, E
CO-05	Show how agile approaches can be scaled up to the enterprise level	R, U, A, An, E, S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	M	S	M	S	S	S	S	M	S	S	S	M	S
CO-02	M	S	M	S	S	S	M	L	S	S	S	L	S
CO-03	L	S	L	S	L	S	S	S	M	S	M	S	S
CO-04	S	S	S	M	S	S	S	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	M	S	L	S	S	S	S

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Agile Fundamental

9

Theories for Agile Management – Agile Software Development – Traditional Model - Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design-Testing – Agile Documentations – Agile Drivers- Capabilities and Values

Unit II: Agile Processes

9

Lean Production - SCRUM- Crystal- Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products- Roles and Practices

Unit III: Agility and Knowledge Management

9

Agile Information Systems – Agile Decision Making –Development- Acquisition-Refinement- Distribution- Deployment- Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM)

Unit IV: Agility and Requirements Engineering

9

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment– Agile Requirements Modeling and Generation

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Agile Approach in Global Software Development - Agile Scrum - Scrum Master – Scaling Projects using Scrum

TOTAL: 45 HOURS

REFERENCES:

1. David J. Anderson and Eli Schragenheim,, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results”, Illustrated Edition, Prentice Hall PTR, 2004
2. Orit Hazza and Yaepl Dubinsky, “Agile Software Engineering,: Undergraduate Topics inComputer Science, Springer Verlag, First Edition,2009
3. Craig Larman, “Agile and Iterative Development: A Manager’s Guide”, Pearson Education,Second Impression, 2007
4. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management”, Elsevier, Butterworth-Heinemann, FirstEdition,2007
5. Ken Schwaber, “Agile Project Management with Scrum”, Illustrated, Revised Edition Microsoft Press, 2004
6. Konnor Cluster, “Agile Project Management: Learn How To Manage a Project With Agile Methods, Scrum, Kanban and Extreme Programming”, Independently Published,FirstEdition,2019

ELECTIVE - II

CA45A6	ADVANCES IN NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the theme underlying IPv6 Structure and addressing methods
- To understand and analyze the protocols for IPv6 Implementation
- To identify and provide solutions for QoS and Security Issues with IPv6
- To learn about Software Defined concepts, architectures, protocols and applications
- To explore the significance of Network Function Virtualization

Course Outcome		Cognitive Skill
CO-01	Describe how IPv6 interacts with data link layer with IPv6 Structure and addressing methods	R, U, A, An
CO-02	To develop the strategies for deploying IPv6 in the place of IPv4	R, U, A,E, An
CO-03	Analyze the security issues for IPv6 in emerging applications	R, U, A, An
CO-04	Analyze the need for separation of data and control plane in Networking	R, U,A, E
CO-05	To use SDN to enable and enhance NFV	R, U, A, An, E, S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	M	S	S	S	S	M	S	S	S	M	S
CO-02	M	S	M	S	S	S	M	L	S	S	S	M	S
CO-03	L	S	L	S	L	S	S	S	M	S	M	S	S
CO-04	S	S	S	M	S	S	S	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	M	M	L	S	M	S	S

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: IPv6 Structure and Addressing

9

IPv4 Address Depletion- IPv6 Transition Issues-IPv6 Structure: IPv6 Header- Extension Headers: Hop-by-Hop Options Header- Destination Options Header- Routing Header- Fragment Header- AH- ESP- IPv6 Addresses: Unicast- Anycast- Multicast – Address Auto configuration

Unit II: IPv6 Networking

9

IPv6 Internet Control Message Protocol (ICMPv6): ICMPv6 Messages- Fragmentation and Path MTU- IPv6 Neighbor Discovery- IPv6 Routing : RIPng - EIGRP for IPv6- OSPFv3 -

Unit III: QoS- Provisioning and Security With IPv6**9**

QoS in IPv6 Protocols: Differentiated Services and IPv6- IPv6 Flows- Explicit Congestion Notification in IPv6 – Provisioning: Stateless DHCPv6- Stateful DHCPv6- DNS Extensions for IPv6- Security with IPv6: IP Security Protocol (IPsec) Basics- IPv6 Security Elements- Interaction of IPsec with IPv6 Elements

Unit IV: Software Defined Networking**9**

Genesis of SDN – Separation of Control Plane and Data Plane – Distributed Control Plane – IP and MPLS – Characteristics of SDN – Operation – Devices – Controller – Open Flow

Specification

Unit V: Network Function Virtualization**9**

Building SDN Framework – Network Functions Virtualization – Introduction – Virtualization and Data Plane I/O – Service Locations and Chaining – Applications – Use Cases of SDNs: Data Centers- Overlays- Big Data and Network Function Virtualization

TOTAL: 45 HOURS**REFERENCES:**

1. Rick Graziani, “IPv6 Fundamentals: A Straightforward Approach to Understanding IPv6” Second Edition, Cisco Press, 2017
2. Peter Loshin, “IPv6: Theory, Protocol, and Practice” Second Edition, Morgan Kaufmann Publishers, 2004
3. William Stallings, “Foundations of Modern Networking – SDN, NFC, QoE, IoT and Cloud” Third Edition, Pearson Publications, 2019.
4. Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, Second Edition, Packt Publishing, 2017.

CA45A7	WIRELESS NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

Course Outcome		Cognitive Skill
CO-01	Conversant with the latest 3G/4G networks and its architecture	R, U, A, An
CO-02	Design and implement wireless network environment for any application using latest wireless protocols and standards	R, U, A, E, An
CO-03	Ability to select the suitable network depending on the availability and requirement	R, U, A, An

CO-04	Get a detailed knowledge on internetworking of WLAN and WWAN	R, U,A, E
CO-05	Implement different type of applications for smart phones and mobile devices with latest network strategies	R, U, A, An, E, S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	M	S	M	S	S	S	S	M	S	S	S	M	S
CO-02	M	S	M	S	S	S	M	L	S	S	S	M	S
CO-03	L	S	L	S	L	S	S	S	M	S	M	S	S
CO-04	S	S	S	M	S	S	S	S	M	S	S	S	M
CO-05	S	S	S	L	S	S	M	M	L	S	M	S	S

S – Strong, M- Medium, L – Low, N – Not Relevant

Unit I: Wireless Local Area Networks

9

Introduction to wireless LANs-IEEE 802.11 WLANs-Architecture-Protocol Stack-Physical Layer - MAC sublayer - MAC Management - HIPERLAN - System Architecture - Protocol Stack-HIPERLAN-2- Wi-Max

Unit II: 3G Overview And 2.5G Evolution

9

Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture,CDMA2000 overview-Radio and Network components, Network structure, Radio network, TD-CDMA, TD-SCDMA

Unit III: ADHOC AND Sensor Networks

9

Characteristics of MANETs-Introduction- Routing protocols-Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks-Sensor deployment-Network characteristics-Design issues-Multipath routing-Data aggregation

Unit IV: WLAN

9

Interworking objectives and requirements, Schemes to connect WLANs and 3G Networks, Session Mobility, Interworking Architectures for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution system

Unit V: 4G And Beyond

9

4G Features and Challenges, Technology path, IMS Architecture, Convergent Devices, 4G Technologies and Handovers-Advanced Broadband Wireless Access- Advanced wireless Services, Multimedia (mobile TV), MVNO

TOTAL: 45 HOURS

REFERENCES:

1. Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata Mc Graw Hill, 2007.
2. ItiSahaMisra, "Wireless Communications and Networks", 2nd Edition, Tata Mc Graw Hill, 2013.

3. Vijay.K.Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2007.
4. Dharma Prakash Agrawal Qing-An Zeng, "Introduction to Wireless and Mobile Systems", Thomson India Edition, 2nd Ed., 2007.
5. SumitKasera and Nishit Narang "3G Networks-Architecture, Protocols and Procedures", Tata McGraw Hill, 2007

CA45A8	NETWORK PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand inter-process and inter-system communication
- To understand socket programming in its entirety
- To understand usage of TCP/UDP / Raw sockets
- To understand how to build network applications

Course Outcome		Cognitive Skill
CO-01	Basic concepts of UNIX in network programming	R,U,A
CO-02	Understand the concept of socket programming	R,U,A
CO-03	Understand the concept of echo client and I/O models	R,U,A
CO-04	Understand the concept of socket options	R,U,A
CO-05	Understand the concept of raw sockets and threads	R,U,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	M	L	L	M	M	M	S	M	L	M	M	N	M
CO-02	S	S	M	S	S	S	S	S	S	S	S	N	M
CO-03	M	S	M	M	S	M	M	M	S	M	M	N	M
CO-04	S	S	M	S	L	S	S	S	S	S	S	N	M
CO-05	S	S	M	S	L	M	M	S	S	S	S	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Overview of UNIX OS - Environment of a UNIX process - Process control – Process relationships Signals – Inter process Communication- overview of TCP/IP protocols

Unit II: Elementary Tcp Sockets

9

Introduction to Socket Programming –Introduction to Sockets – Socket address Structures – Byte ordering functions – address conversion functions – Elementary TCP Sockets – socket-connect- bind- listen- accept- read- write - close functions – Iterative Server – Concurrent Server

Unit III: Application Development

9

TCP Echo Server – TCP Echo Client – Posix Signal handling – Server with multiple clients – boundary conditions: Server process Crashes- Server host Crashes- Server Crashes and reboots- Server Shutdown – I/O multiplexing – I/O Models – select function – shutdown function – TCP echo Server (with multiplexing) – poll function – TCP echo Client (with Multiplexing)

Unit IV: Socket Options- Elementary Udp Sockets

9

Socket options – getsocket and setsocket functions – generic socket options – IP socketoptions – ICMP socket options – TCP socket options – Elementary UDP sockets – UDP echo Server – UDP echo Client – Multiplexing TCP and UDP sockets – Domain name system – gethostbyname function – Ipv6 support in DNS – gethostbyadr function –getservbyname and getservbyport functions

Unit V: Advanced Sockets

9

Ipv4 and Ipv6 interoperability – threaded servers – thread creation and termination – TCP echoserver using threads – Mutexes – condition variables – raw sockets – raw socket creation – rawsocket output – raw socket input – ping program – trace route program

TOTAL: 45 HOURS

REFERENCES:

1. W. Richard Stevens, B. Fenner, A.M. Rudoff, “Advanced UNIX Network Programming –The Sockets Networking API”, 3rd edition, Pearson, 2004.
2. W. Richard Stevens, “UNIX Network Programming”, Pearson, 2003.
3. W. Richard Stevens, S.A Rago, “Programming in the Unix environment”, 2nd edition, Pearson, 2005.

CA45A9	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the techniques and standard algorithms behind Cryptography.
- To learn Encryption Techniques
- To Learn the Digital signatures
- To learn Network Security
- To Learn System Security.

Course Outcome		Cognitive Skill
CO-01	Understand revolving techniques of cryptography, related mathematical theorems of cryptosystem	U
CO-02	Compare and construct encryption system techniques and analyze the characteristic of the services.	An, S
CO-03	Analyze and understand various protocols and evaluate the authentication and hash algorithms.	An, U
CO-04	Compare and construct different IEEE standards and E- mail security and evaluate the IP security modes and security protocols	An, A
CO-05	Summarize the instruction detection systems and analyse various security applications	S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	M	M	S	M	S	S	M	S	S	M	L	M	S
CO-02	S	M	S	M	M	S	M	S	S	L	M	M	S
CO-03	M	L	M	L	S	S	M	S	M	M	L	M	M
CO-04	S	M	S	M	S	S	M	S	S	M	M	L	S
CO-05	M	S	S	L	M	S	L	S	S	M	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Fundamentals And Mathematics Of Cryptography

9

Overview – Cryptographic attacks - Services and mechanisms – Techniques - Classical Crypto Systems – Substitution Ciphers –Transposition Ciphers - Stream and Block Ciphers – Introduction to number theory: Linear congruences – Chinese Remainder theorem – Modular arithmetic - Modular exponentiation – Fermats and Eulers theorem.

Unit II: Encryption Techniques

9

Data Encryption Standard – Advanced Encryption Standard – Confidentiality using symmetric Encryption - Public-Key Cryptography and RSA – Key Management - Diffie- Hellman Key Exchange – Elliptic Curve Cryptography – Kerberos - X.509 Authentication Service.

Unit III: Hash Functions And Signatures

9

Message Authentication and Hash Functions –Secure Hash Algorithms – SHA-512 - Digital Signatures and Authentication Protocols – Digital Signature Standard – Comparison - Process - Services - Attacks on Digital Signature - Digital Signature Schemes.

Unit IV: Network Security

9

Security at the application layer: E-Mail - Pretty Good Privacy – S/MIME – Security at the transport layer: SSL Architecture – Protocols – Message Formats - TLS – Security at the

Network Layer: IPSec –modes - Authentication Header (AH) – Encapsulating Security Payload (ESP) –Security Association – Security Policy – Internet Key Exchange.

Unit V: System Security

9

Intruders – Intrusion Detection – Password Management – Malwares and Related Threats – DOS Attacks - Distributed Denial of Service Attacks - Firewalls – Firewall Types- Configuration and Implementation - Demilitarized Zone - Firewall limitations - Intrusion Deduction System.

TOTAL: 45 HOURS

REFERENCES:

1. William Stallings, “Cryptography and Network Security – Principles and Practices”, Fourth Edition, Pearson Education, 2006.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security”, Second Edition, Tata Mc Graw Hill, 2010.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2003.
4. Joseph Migga Kizza, “A Guide to Computer Network Security”, Springer International Edition, 2010.
5. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007

CA45B1	MOBILE COMMUNICATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study about Fundamental Concept of Wireless.
- To study about Mobile device Technologies
- To study about Wireless networks.

Course Outcome		Cognitive Skill
CO-01	Understand the technologies used in wireless communication.	U
CO-02	To be familiar with protocols and its architecture in telecommunication system.	An
CO-03	To get a detailed idea on various wireless networking process and its deployments.	U
CO-04	To master the terminology and concepts of network layer.	A
CO-05	To be familiar with transport protocols and network security.	S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	N	L	M	m	N	S	L	L	L	S	L	M
CO-02	M	S	S	M	M	M	M	s	M	L	S	S	M
CO-03	M	M	L	S	N	N	S	S	L	L	M	M	L
CO-04	L	L	M	M	S	L	S	L	S	L	M	S	L
CO-05	M	M	L	M	M	L	S	M	L	L	S	L	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Wireless Communication Fundamentals

9

Introduction – Wireless transmission – Frequencies for radio transmission – Signals –Antennas – Signal Propagation – Multiplexing – Modulations – Spread spectrum – MAC - SDMA – FDMA-TDMA – CDMA – Cellular Wireless Networks.

Unit II: Telecommunication Systems

9

GSM – System Architecture – Radio Interface – Protocols – Connection Establishment – Frequency Allocation – Routing – Handover – Security – GPRS – DECT architecture – ProtocolArchitecture

Unit III: Wireless LAN

9

Wireless LAN – IEEE 802.11 Standards – System Architecture – Protocol Architecture – Physical Layer – MAC Layer – services – HIPERLAN – AdHoc Network – Blue Tooth.

Unit IV: Network Layer

9

Mobile IP – Goals, assumptions and requirements – Entities _ IP packet delivery – Agent discovery – registration – Tunneling and Encapsulation – Optimizations _ IPV6.0 – Dynamic Host Configuration Protocol - Routing – DSDV – DSR – Alternative Metrics.

Unit V: Transport and Application Layers

9

TCP over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing – Selective Retransmission – Transaction Oriented TCP – WAP – WAP Architecture – WDP – WTLS – WTP – WSP – WML – WML Script – WAE – WTA.

TOTAL: 45 HOURS

REFERENCES:

1. Jochen Schiller, “Mobile Communications”, Second Edition, Prentice Hall of India Pearson Education, 2003.
2. William Stallings, “Wireless Communications and Networks”, Second Edition, Prentice Hall of India / Pearson Education, 2004.
3. Kaveh Pahlavan, Prasanth Krishnamoorthy, “Principles of Wireless Networks”, Pearson Education, 2003.
4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, New York, 2003.

ELECTIVE-III

CA45B2	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- Learn basic image processing techniques for solving real problems.
- Gain knowledge in image transformation and image enhancement techniques.
- Learn image compression and segmentation procedures.

Course Outcome		Cognitive Skill
CO-01	Understanding the fundamentals of Digital Image Processing.	R, U
CO-02	Understand the mathematical foundations for digital image representation, image acquisition, image transformation and image enhancement.	R, U
CO-03	Apply, Design and implement and get solutions for digital image processing problems.	R, U, A
CO-04	Apply the concepts of filtering and segmentation for digital image retrieval.	R, U, A, An
CO-05	Explore the concepts of Multi-resolution process and recognize the objects in an efficient manner.	R, U, A, An, E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	L	S	M	S	S	S	S	S	S	L
CO-02	S	S	S	M	S	S	S	S	S	S	S	S	S
CO-03	S	S	S	M	S	S	S	S	S	S	S	M	S
CO-04	S	S	S	M	S	M	S	S	S	S	S	M	M
CO-05	S	S	S	M	S	S	L	S	S	S	S	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction

9

Introduction: What is Digital Image Processing – The origin of DIP – Examples of fields that use DIP – Fundamental Steps in DIP – Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception – Light and the electromagnetic spectrum – Image Sensing and Acquisition – Image Sampling and Quantization – Some basic relationship between pixels – Linear and Nonlinear operations.

Unit II: Image Enhancement**9**

Image Enhancement in the spatial domain: Background – Some basic gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic Operations – Basics of spatial Filtering – Smoothing spatial filters – Sharpening spatial filters – Combining Spatial Enhancement methods.

Unit III: Image Restoration**9**

Image Restoration: A model of the Image Degradation / Restoration Process – Noise Models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse Filtering – Minimum Mean Square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.

Unit IV: Image Compression**9**

Image Compression: Fundamentals – Image Compression Models – Elements of Information Theory – Error Free Compression – Lossy Compression – Image Compression Standards.

Unit V: Image Segmentation**9**

Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region Based Segmentation – Segmentation by Morphological watersheds – The use of motion in Segmentation.

TOTAL: 45 HOURS**REFERENCES:**

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Second Edition, PHI, Pearson Education
2. B. Chanda, D. DuttaMajumder, “Digital Image Processing and Analysis”, PHI 2003.
3. Nick Efford, “Digital Image Processing a Practical Introduction using Java”, Pearson Education 2004.

CA45B3	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
- To understand how to examine digital evidences such as the data acquisition, identification analysis.

Course Outcome		Cognitive Skill
CO-01	Understand the basic concepts of digital forensics.	R,U
CO-02	Apply Computer forensics and digital detective and various processes, policies and procedures.	R,U,A
CO-03	To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.	R,U

CO-04	Evaluate the techniques of Email and web forensics and network forensics tools.	R,U,A
CO-05	Examine digital evidences such as the data acquisition, identification analysis	R,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate,S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	M	L	M	M	S	S	M	S	M	S
CO-02	S	M	S	S	S	L	M	S	M	S	S	M	S
CO-03	M	L	S	S	S	M	M	S	M	S	M	S	S
CO-04	S	M	S	S	M	S	L	S	M	S	S	M	S
CO-05	S	M	L	S	S	M	L	S	M	M	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction

9

Digital Forensics – Uses- Digital Forensics Process – Locard’s Exchange Principle – Scientific Method – Role of Forensic examiner in Judicial System – Key technical concepts – Bits, bytes and numbering schemes- File extension and file signatures – Storage and memory- computing environment.

Unit II: Anti-forensics & legal

9

Introduction – Hiding data – Password attacks – Additional resources – Steganography – Data destruction. Legal: Fourth Amendment – Criminal law-searches without a warrant – searching with a warrant- Electronic discovery-Expert testimony.

Unit III: Evidence collection

9

Evidence Collection – Collection option – Obstacles – Types of Evidence – The rules of Evidence – General Procedure – Collection and archiving – Methods of collection – Artifacts – Collection steps – Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the digital Crime Scene – Computer Evidence processing steps - Legal Aspects of Collecting and Preserving Computer Forensic Evidence- Computer Image Verification and Authentication

Unit IV: Computer forensics

9

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud.Types of CF techniques – Incident and incident response methodology – Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. – Forensics Technology and Systems – Understanding Computer Investigation – Data Acquisition.

Unit V: Network forensics & mobile device forensics

9

Introduction – Network fundamentals – Network Security tools – Network evidence and investigations. Mobile device forensics: Cellular Network – Cell phone evidence – Cell phone forensic tools- Global Positioning systems..

TOTAL: 45 HOURS

REFERENCES:

1. Warren G. Kruse II and Jay G. Heiser, “Computer Forensics: Incident Response Essentials”, Addison Wesley, 2002.
2. Nelson,B,Phillips,A,Enfinger,F,Stuart,C.,“GuidetoComputerForensicsand Investigations, 2nd ed., Thomson Course Technology, 2006
3. John Sammons, The Basics of Digital Forensics The Primer for Getting Started in Digital Forensics, Second Edition, Syngress, 2015.
4. Cory Altheide and Harlan Carvey, —Digital Forensics with Open Source Tools, 1st Edition, Elsevier publication, April 2011.
5. Nihad A. Hassan, Digital Forensics Basics: A Practical Guide Using Windows OS, 1st Edition, A Press, 2019.

CA45B4	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of soft computing and machine learning basics
- To make students familiar with neural networks that can learn from available examples
- To introduce the concepts of fuzzy sets and fuzzy logic process
- To understand genetic algorithm concepts and applications.

Course Outcome		Cognitive Skill
CO-01	Understand the basics of soft computing.	A
CO-02	Analyze various neural network architectures	A
CO-03	Understand perceptions’ and counter propagation networks	U
CO-04	Understand the fuzzy inference systems and process	U
CO-05	Analyze the genetic algorithms and their applications	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	S	S	S	M	S	M	S	M	S
CO-02	S	M	S	M	S	M	S	M	S	M	S	M	S
CO-03	M	S	S	S	S	S	S	M	M	M	S	S	M
CO-04	M	S	S	S	S	S	S	S	M	M	M	S	M
CO-05	S	M	M	S	M	M	S	M	S	M	S	M	M

S-Strong, M-Medium, L-Low,N-Not relevant

Unit I: Introduction	9
Concept of Computing - Characteristics of Hard Computing and Soft Computing - Characteristics of Soft Computing, - Hard Computing vs. Soft Computing - Limitations of Hard and Soft Computing - Types of Soft Computing Techniques - Applications of Soft Computing - Hybrid Computing	
Unit II: Neural Networks	9
Machine Learning Using Neural Networks - Adaptive Networks - Feed Forward Networks - Supervised Learning Neural Networks - Radial Basis Function Networks - Reinforcement Learning - Unsupervised Learning Neural Networks - Adaptive Resonance Architectures and Advances in Neural Networks.	
Unit III: Fuzzy Logic	9
Fuzzy Sets - Operations on Fuzzy Sets - Fuzzy Relations - Membership Functions - Fuzzy Rules and Fuzzy Reasoning - Fuzzy Inference Systems - Fuzzy Expert Systems and Fuzzy Decision Making-Defuzzification	
Unit IV:Neuro-Fuzzy Modelling	9
Adaptive Neuro - Fuzzy Interference Systems - Coactive Neuro-Fuzzy Modelling - Classification and Regression Trees - Data Clustering Algorithms – Rule base Structure Identification Neuro-Fuzzy Control	
Unit V:Genetic Algorithms	9
Introduction to Genetic Algorithms (GA) – Genetic algorithm and Search space - Classification of GA – Advantages – Limitations - Applications of GA in Machine Learning- GA vs. traditional methods.	

TOTAL: 45 HOURS

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Application”, Prentice Hall, 1995.
3. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
4. S.N.Sivanandam, and S.N.Deepa, Principles of Soft computing, Second Edition, Wiley India Pvt. Ltd, 2013.
5. D. K. Pratihar, Soft Computing, Narosa Publications, Revised Edition, 2018

CA45B5	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of artificial intelligence and real world problems
- To understand various problem solving methods and search techniques.
- To know about the basics of prolog and expert systems.
- To understand the various applications of artificial intelligence.

Course Outcome		Cognitive Skill
CO-01	Understand design of AI and Deep learning based systems and design AI based expert system.	U
CO-02	Solve different AI puzzles such as Sudoku, 8-puzzle etc. in Prolog.	A
CO-03	Build, train and apply fully connected deep neural networks.	A
CO-04	To implement efficient recurrent neural networks for sequence based data	U
CO-05	To understand the concept of Genetic algorithm and fuzzy logic	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	L	M	S	S	M	M	L	M	M	M
CO-02	M	L	M	S	S	M	L	M	S	M	M	S	M
CO-03	S	M	S	S	M	M	L	M	S	S	M	L	M
CO-04	S	S	M	L	M	S	S	M	M	L	M	M	L
CO-05	M	L	S	M	L	M	L	S	S	S	L	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: AI Techniques

9

History - AI techniques - Problem solving using Search - Uninformed v/s Informed Search - Heuristic Search Techniques: Hill Climbing, Simulated Annealing - Best First Search: OR Graphs - Heuristic Functions - A* Algorithm - AND-OR Graphs - AO* Algorithm - Adversarial Search: Zero-sum perfect information Games - Optimal Decisions and Strategies in Games - Mini-max Algorithm - Alpha-beta Pruning - Solving game puzzles - Chess and Chinese Checkers.

Unit II: Knowledge Representation & Reasoning

9

Propositional logic - Inference in First order logic - Forward v/s Backward chaining - Resolution - Resolution-refutation – PROLOG - Logic Programming and Horn Clauses - CUT and FAIL operators - Built-in Goals - Negation - recursive Lists processing - PROLOG programs for puzzles - KR methods - Weak Slot-and-Filler Structures - Semantic Nets - Frames; Semantic Web and ontologies - Strong Slot-and-Filler Structures

Unit III: Connectionist Models

9

Feed-forward - Feedback - Activation Functions - Loss functions - Different Models - McCulloch and Pitts Model - Feed-forward model - Perceptron Learning - Delta rule and error Back propagation learning - Deep learning - CNN architecture - layers - and learning; Feedback architectures and learning - Hopfield Model and Memories - Hebbian Learning .

Unit IV: Recurrent Neural Network**9**

RNN architecture and learning - different models and their applications in sequence classification and text analytics - long short-term memory (LSTM) - Gated recurrent Unit (GRU); Unsupervised learning with ANN - Competitive Learning - SOM - architecture - classifications - Implementation and training .

Unit V: Genetic Algorithm And Fuzzy Logic**9**

Encoding, fitness functions - genetic operators - reproduction evolutionary strategies - Applications of GA - Fuzzy Logic - fuzzy sets - properties and operations - Fuzzy logic and fuzzy rules - Mamdani fuzzy rule inferencing mechanism - Fuzzy Systems and Neuro Fuzzy Systems.

TOTAL: 45 HOURS**REFERENCES:**

1. Tom M. Mitchell: Machine Learning. McGraw Hill.
2. E. Rich & K. Knight: Artificial Intelligence. TMH
3. Michael Nielsen: Neural Networks and Deep Learning
4. Stuart Russel & Peter Norvig: Artificial Intelligence—A Modern Approach. Pearson.
5. Padhy: Artificial intelligence and intelligent systems. Oxford University Press.
6. S. Russel, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson.
7. N. J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann.

CA45B6	BLOCK CHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get acquainted with the concept of Distributed ledger system and Block chain.
- To learn the concepts of consensus and mining in Block chain through the Bitcoin network.
- To understand permissioned Block chain and explore Hyper ledger Fabric.

Course Outcome		Cognitive Skill
CO-01	Learn and explain the difference between centralized, decentralized network and blockchain.	R,U
CO-02	Understand the fundamental concept of blockchain technology.	R,U,A
CO-03	Understand the concept of mining in blockchains.	R,U
CO-04	Understand the working of Bitcoin and its security.	R,U
CO-05	Know about the different platforms for implementing blockchain and its varied application.	R,E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K	PO- L	PO- M
CO-01	S	M	S	M	L	S	M	S	S	M	L	M	S
CO-02	L	M	S	M	S	M	S	L	S	S	S	S	L
CO-03	S	M	L	S	S	S	M	S	M	S	M	S	L
CO-04	S	M	S	M	S	M	M	S	S	M	M	L	S
CO-05	S	M	S	L	S	M	S	S	S	M	L	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction to blockchain technology

9

Introduction to Blockchain - Trusted Third party for transactions - Difference between centralized - decentralized and distributed peer to peer networks - Types of Blockchain (Permission Blockchain vs. Permission less Blockchain)- History of Bitcoins.

.Unit II: Fundamental concepts of block chain

9

Concepts of Block – Transactions - Hashes- Consensus. Hashes: Hash cryptography- Encryption vs. hashing- Transactions: Recording transactions- Digital Signature- Verifying and confirming transactions- Blocks and blockchain: Hash pointers- Blocks- Consensus building. Distributed consensus- Byzantine generals problem- Consensus mechanism: POW- POS- POB- POA.

Unit III: Mining and simulating blockchain

9

Blockchain: Architecture- Versions- Variants- Use cases- Introduction to crypto currencies- Types- Applications. Mining and simulating blockchain: Game theory behind competitive mining. Incentives: mining and transaction fees- Energy expended in mining.

Unit IV: Bitcoin ad security

9

Bitcoin: Bitcoin creation- exchanges. Wallets- security. Protecting blockchain from attackers. Forks – soft and hard- Blockchain security- Key Management in Bitcoin- Case studies.

Unit V: Platforms and applications

9

Introduction to Blockchain platform: Ethereum- Hyperledger- IOTA- EOS- Multichain- Bigchain- CORDA- SOLIDITY- Designing a new blockchain- Distributed Application (DAPP). Applications: E-Governance- Elections- File sharing- Micropayments Challenges and Research Issues in blockchain.

TOTAL: 45 HOURS

REFERENCES:

1. Bitcoin and Cryptocurrency technologies: a comprehensive introduction. Arvind Narayanan- Joseph Bonneau- Edward Felten- Andrew Miller- and Steven Goldfeder. Princeton University Press- First edition-2016
2. Blockchain Applications: A Hands-On Approach. Arshdeep Bahga- Vijay Madiseti. VPT Publisher. First edition-2018.
3. Blockchain: Step – by – Step Guide to Understand by Paul Laurence- Createspace Independent Pub.

4. Introducing Ethereum and Solidity Foundations of Crypto currency and Block chain Programming for Beginners by Chris Dannen- Apress
5. Blockchain: The comprehensive beginner's guide by Frank Walrtin

ELECTIVE - IV

CA45B7	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Information Retrieval.
- To understand machine learning techniques for text classification and clustering.
- To understand various search engine system operations.
- To learn different techniques of recommender system.

Course Outcome		Cognitive Skill
CO-01	Understand the basics of information retrieval.	U
CO-02	Understand various retrieval models and metrics	U
CO-03	Apply appropriate method of classification or clustering.	U
CO-04	Design and implement innovative features in a search engine.	U
CO-05	Design and implement a recommender system.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	L	M	S	S	M	M	L	M	M	M
CO-02	M	L	M	S	S	M	L	M	S	M	M	S	M
CO-03	S	M	S	S	M	M	L	M	S	S	M	L	M
CO-04	S	S	M	L	M	S	S	M	M	L	M	M	L
CO-05	M	L	S	M	L	M	L	S	S	S	L	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Information Retrieval - Early Developments - The IR Problem - The User Task - Information versus Data Retrieval - The IR System - The Software Architecture of the IR System - The Retrieval and Ranking Processes - The Web - The e-Publishing Era - How the web changed Search - Practical Issues on the Web

Unit II: MODELING AND RETRIEVAL EVALUATION

9

Basic IR Models - Boolean Model - Vector Model - Probabilistic Model – Fuzzy set model - Latent Semantic Indexing Model - Neural Network Model - Retrieval Evaluation - Retrieval Metrics - Precision and Recall - Reference Collection - User-based Evaluation - Relevance Feedback and Query Expansion :Explicit Relevance Feedback.

Unit III: TEXT CLASSIFICATION AND CLUSTERING

9

Characterization of Text Classification - Unsupervised Algorithms: Clustering - Naïve Text Classification - Supervised Algorithms - Decision Tree - k-NN Classifier - SVM Classifier - Evaluation metrics - Accuracy and Error -Indexing and Searching - Inverted Indexes - Sequential Searching and Multi-dimensional Indexing

Unit IV:WEB RETRIEVAL AND WEB CRAWLING

9

The Web - Search Engine Architectures - Cluster based Architecture - Distributed Architectures - Search Engine Ranking – Link based Ranking - Simple Ranking Functions - Learning to Rank - Evaluations - Search Engine User Interaction - Browsing - Applications of a Web Crawler - Taxonomy - Architecture and Implementation - Scheduling Algorithms - Evaluation.

Unit V:RECOMMENDER SYSTEM

9

Recommender Systems Functions - Data and Knowledge Sources - Recommendation Techniques - Basics of Content-based Recommender Systems - High Level Architecture - Advantages and Drawbacks of Content-based Filtering - Collaborative Filtering - Matrix factorization models and Neighbourhood models.

TOTAL: 45 HOURS

REFERENCES:

1. Ricardo Baeza-Yates and BerthierRibeiro-Neto, —Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
2. Ricci, F, Rokach, L. Shapira, B.Kantor, —Recommender Systems Handbook, First Edition, 2011.
3. C. Manning, P. Raghavan, and H. Schütze, —Introduction to Information Retrieval, Cambridge University Press, 2008.
4. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

CA45B8	DATA MINING AND DATA WAREHOUSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Enable the students to learn the concepts of mining tasks, classification, clustering and data warehousing.
- Develop skills of using recent data mining software for solving practical problems.
- Develop and apply critical thinking, problem solving and decision-making skills.

Course Outcome		Cognitive Skill
CO-01	Understand the basic data mining techniques and algorithms	R, U
CO-02	Understand the Association rules, Clustering techniques and Data warehousing contents.	R, U
CO-03	Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.	R, U, A
CO-04	Design data warehouse with dimensional modeling and apply OLAP operations.	R, U, A, An
CO-05	Identify appropriate data mining and data warehousing algorithms to solve real world.	R, U, A, An, E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	S	S	S	S	S	M	S	S	S
CO-02	S	S	S	M	S	S	M	S	S	L	S	S	M
CO-03	S	M	S	M	S	S	M	S	S	M	S	S	L
CO-04	S	M	S	M	S	S	M	S	S	M	S	S	S
CO-05	S	M	S	M	S	S	S	S	S	L	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Basics and Techniques

9

Basic Data Mining tasks – Data mining versus knowledge discovery in Databases – Data Mining Issues – Data Mining metrics – Social Implications of data mining – Data Mining from a database perspective. Data mining Techniques: Introduction – Statistical perspective on data mining – Similarity measures – Decision trees – Neural networks – Generic algorithms.

Unit II: Algorithms

9

Classification: Introduction – Statistical – Based algorithms – Distance - Based algorithms – Decision tree – Based algorithms – Neural network – Based algorithms - Rule based algorithms – Combining techniques.

Unit III: Clustering and Association

9

Clustering: Introduction – Similarity and distance measures – Outliers – Hierarchical algorithms – Partitional algorithms. Association rules: Introduction – Large item sets – Basic algorithms – Parallel & distributed algorithms – Comparing approaches – Incremental rules – Advanced association rules techniques – Measuring the quality of rules.

Unit IV: Data Warehousing and Modeling

9

Data Warehousing: Introduction – Characteristics of a data warehouse – Data marts – other aspects of data mart. Online analytical processing: Introduction – OLTP & OLAP systems data modeling – Star schema for multidimensional view – Data modeling – Multifactor schema or snowflake schema – OLAP Tools.

Unit V: Applications of data warehouse

9

Developing a data warehouse: Data Warehouse architectural strategies and organization issues – Design consideration – Tools for data warehousing – Performance considerations – Crucial decisions in designing a data warehouse. Applications of data warehousing and data mining in government: Introduction – National data warehouses – Other areas for data warehousing and data mining.

TOTAL: 45 HOURS

REFERENCES

1. Margaret H. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson education, 2003.
2. C. S. R. Prabh, “Data Warehousing Concepts, Techniques, Products and Applications”, PHI, Second Edition.
3. Arun K. Pujari, “Data Mining Techniques”, Universities Press (India) Pvt. Ltd. 2003.
4. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, TMCH, 2001.

CA45B9	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand how accurately represent voluminous complex data set in web and from other data sources.
- To understand the methodologies used to visualize large data sets.
- To understand the process involved in data visualization and security aspects involved in data visualization.

Course Outcome		Cognitive Skill
CO-01	To study the basic data visualization	R, U
CO-02	To study and understand the different methods of data visualization	R, U, A, An
CO-03	To study and understand the different processing methods and its visualization	R, U, A
CO-04	To study and understand the different data interactive methods	R, U, A, An

CO-05	To study and understand the different security methods in data visualization	R,U, A, An
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R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	M	S	S	S	L	S	S	S
CO-02	S	M	S	M	S	S	S	M	S	M	S	S	S
CO-03	S	L	S	S	S	S	L	S	S	M	S	S	S
CO-04	S	M	S	M	S	S	M	S	S	M	S	S	S
CO-05	S	M	S	M	S	S	S	S	S	L	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction

9

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

Unit II: Visualizing Data Methods

9

Mapping - Time series - Connections and correlations - Scatterplot maps - Trees, Hierarchies and Recursion - Networks and Graphs, Info graphics.

Unit III: Visualizing Data Process

9

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, Using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation.

Unit IV: Interactive Data Visualization

9

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3js - tablo.

Unit V: Security Data Visualization

9

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems - Creating security visualization system.

TOTAL: 45 HOURS

REFERENCES

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

CA45C1	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs

Course Outcome		Cognitive Skill
CO-01	To study the basic concepts of data analytics	R,U
CO-02	To understand the data analysis technology	R, U, An
CO-03	To understand the concept of Mango DB and map reduce	R,U
CO-04	To study and understand the tools used in Hadoop	R, U, A
CO-05	To study and understand the Pig tool in Hadoop	R, U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	L	S	M	S	S	S	S	S	S	L
CO-02	S	M	S	M	S	S	S	S	S	S	S	S	S
CO-03	M	S	S	M	S	S	S	L	M	S	S	M	S
CO-04	S	S	S	M	S	M	S	S	S	S	S	M	M
CO-05	S	S	S	M	S	S	L	S	S	S	S	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction to big data and analytics

9

Classification of Digital Data, Structured and Unstructured Data - Introduction to Big Data:

Characteristics - Evolution - Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment - Big Data Analytics: Classification of Analytics - Challenges - Big Data Analytics importance - Data Science - Data Scientist - Terminologies used in Big Data Environments - Top Analytics Tools.

Unit II: Introduction to technology landscape**9**

NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges - Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem.

Unit III: Introduction to mongodb and mapreduce programming**9**

MongoDB: Why Mongo DB - Terms used in RDBMS and Mongo DB - Data Types - MongoDB Query Language MapReduce: Mapper - Reducer - Combiner - Partitioner - Searching - Sorting - Compression.

Unit IV: Introduction to Hive**9**

Hive: Introduction - Architecture - Data Types - File Formats - Hive Query Language Statements - Partitions - Bucketing - Views - Sub- Query - Joins - Aggregations - Group by and Having - RCFile Implementation - Hive User Defined Function - Serialization and Deserialization.

Unit V: Introduction to Pig**9**

Pig: Introduction - Anatomy - Features - Philosophy - Use Case for Pig - Pig Latin Overview - Pig Primitive Data Types - Running Pig - Execution Modes of Pig - HDFS Commands - Relational Operators - Eval Function - Complex Data Types - Piggy Bank - User-Defined Functions - Parameter Substitution - Diagnostic Operator - Word Count Example using Pig - Pig at Yahoo!.

TOTAL: 45 HOURS**REFERENCES:**

1. SeemaAcharya, SubhashiniChellappan, “Big Data and Analytics”, Wiley Publications, First Edition,2015.
2. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, John Wiley & Sons, Inc. (2013).
3. Tom White, “HadoopThe Definitive Guide”, O’Reilly Publications, Fourth Edition, 2015.
4. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnky, Bruce Brown, Rafael Coss, “Hadoop For Dummies”, Wiley Publications, 2014
5. Robert D.Schneider, “Hadoop For Dummies”, John Wiley & Sons, Inc. (2012)
6. Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill, 2012 Chuck Lam, “Hadoop In Action”, Dreamtech Publications, 2010

CA45C2	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the students with the basic concepts of knowledge engineering
- To teach the basics of knowledge acquisition methods, IR, NLP and machine learning techniques
- To teach students about knowledge representation, logic and reasoning

Course Outcome		Cognitive Skill
CO-01	Understand the fundamentals of problems and search methods.	U
CO-02	Learn and understand various knowledge representation methods and methodologies	U,R
CO-03	Understand the learning methods	U
CO-04	Apply and develop various knowledge models in various domains	U,A
CO-05	Apply the domain knowledge in various expert systems	U,A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate,S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	M	S	M	S	S	M	S	M	S	S
CO-02	S	M	S	S	S	S	M	S	S	S	M	S	S
CO-03	S	M	S	M	S	S	S	M	S	M	S	S	S
CO-04	S	M	S	M	L	S	S	L	S	S	M	S	S
CO-05	S	M	S	S	S	S	M	L	S	S	M	S	S

S-Strong,M-Medium,L-Low,N-Notrelevant

Unit I: Problems and search methods

9

Introduction to Artificial Intelligence, The AI Problems, Defining the Problem as a State Space Search, Problem Characteristics Searching strategies – Generate and Test, Heuristic Search Techniques- Hill climbing– issues in hill climbing. Python-Introduction to Python- Lists Dictionaries & Tuples in Python- Python implementation of Hill Climbing.

Unit II: Knowledge presentation

9

Using Predicate logic - representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification. Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning

Unit III: Learning**9**

Introduction to learning, Rote learning, Learning by Taking Advice, Learning in Problem-solving, Learning from example: induction, Explanation-based learning

Unit IV: Knowledge modeling and knowledge model construction**9**

The nature of knowledge, challenges in representation, inference knowledge, task knowledge, Knowledge model construction – stages in knowledge model construction, identification, specification and refinement, knowledge model maintenance.

Unit V: Expert systems**9**

Representing and using Domain Knowledge – Reasoning with knowledge– Expert System Shells – Support for explanation- examples –Knowledge acquisition-examples Data mining and intelligent business support, Internet based applications.

TOTAL: 45 HOURS**REFERENCES:**

1. Gusus Schreiber , Hans Akkermas ,Knowledge Engineering And Management Universities Press (India) Pvt. Limited 2001
2. Nikola K. Kasabov Foundations of neural networks, fuzzy systems, and knowledge engineering, 1996
3. Ela Kumar, Knowledge Engineering by I K International Publishing House; 2018

ELECTIVE - V

CA45C3	MANAGEMENT INFORMATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the process of management roles, activities and functions.
- To understand types of information, strategic roles and business process reengineering.
- To study the value of information and decision making process.
- To understand the requirement & analysis of MIS across the functional areas
- To study the new trends in management information systems

Course Outcome		Cognitive Skill
CO-01	To understand the framework / structure and role of Information of IS	R
CO-02	Understand the levels and process of IS.	U
CO-03	To understand the information needs for an individual & organization for decision making process.	U
CO-04	To understand the requirement & analysis of MIS across the functional areas	A
CO-05	Understand the new trends in management information systems	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	L	M	S	S	M	M	L	M	M	M
CO-02	M	L	M	S	S	M	L	M	S	M	M	S	M
CO-03	S	M	S	S	M	M	L	M	S	S	M	L	M
CO-04	S	S	M	L	M	S	S	M	M	L	M	M	L
CO-05	M	L	S	M	L	M	L	S	S	S	L	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction

9

Management Concepts – Functions of management – Levels of management – System concepts – Components – Data and information – Information system and components – Information system resources — Users of Information systems - Role of information system in business.

Unit II: Information and Managerial Effectiveness

9

Information and Managerial Effectiveness - Information as a corporate resource - Types of information based on characteristics and application Process of generation of information - Quality of information - Strategic roles of IS - Use of Information for Customer Bonding - Business Processes Reengineering -Steps – Benefits and challenges.

Unit III: Information needs for an organization

9

Overview of use of data and Information - - Value of information – Metrics - Decision making processes – Steps in decision making process - Types of decision making models - Types of information systems - Transaction processing systems - Decision support systems - Executive support system - Enterprise Resource Planning (ERP) system and Business expert system.

Unit IV: Information System for Functional Areas and Issues

9

MIS across the functions of the Management and Sectors - Marketing Information Systems - Manufacturing Information Systems - Human Resource Information Systems - Financial Information Systems -. Security Issues Relating to Information Systems - Threats to information systems – Vulnerability and risk and control measures.

Unit V: New Trends in MIS

9

Cloud computing – Characteristics – Benefits - Big data – characteristics –types-applications- Customer Relationship management (CRM) technology for Business – Types - Data ware housing – components - Artificial intelligence - Near field Communication and Super Beam.

TOTAL: 45 HOURS

REFERENCES:

1. Management Information System- Managing the Digital Firm , by Laudon and Laudon
2. Principal of Information System , by Ralph M. Stair and Georg Raynold
3. O'Brien, James A Management Information Systems, Tata McGraw Hill, New Delhi,

4. Marvin Gore, Elements of Systems Analysis & Design, Galgota Publications.

CA45C4	Digital Marketing	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the confluence of marketing, operations, and human resources in real-time delivery.
- Understand the cognitive knowledge of the skills required in conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities.
- To study the emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.

Course Outcome		Cognitive Skill
CO-01	Understand the role and importance of digital marketing in today's rapidly changing business environment.	U
CO-02	Understand the various types of digital & social marketing formats.	U
CO-03	Remember the significance of social promoting brands.	R
CO-04	Analyse the importance of store maintenance of digital marketing	An
CO-05	Understand the key elements of a digital marketing strategy.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	M	S	M	S	M	S	S	L	S
CO-02	S	M	M	S	M	S	M	S	M	S	S	L	S
CO-03	S	M	M	M	M	S	M	S	S	S	S	L	S
CO-04	L	M	M	S	S	S	M	L	M	S	M	L	S
CO-05	S	M	M	S	M	S	S	S	M	S	S	L	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction

9

Understanding Digital Marketing -Concept - Components of Digital Marketing -Need and Scope of Digital Marketing -Benefits of Digital Marketing -Digital Marketing Platforms and Strategies - Comparison of Marketing and Digital Marketing -Digital Marketing Trends - Digital Media -Analyzing Digital Media Performance -Analyzing Website Performance - Analyzing Advertising Performance.

Unit II: Understanding Digital Channels

9

Digital Marketing -Website Marketing - Search Engine Marketing – Online Advertising – Email Marketing –Blog Marketing -Audio, Video and Interactive Marketing –Online Public Relations –Mobile Marketing –Migrating from Traditional Channels to Digital Channels.

Unit III: Digital Marketing Plan

9

Need of a Digital Marketing Plan -Elements of a Digital Marketing Plan – Marketing Plan - Executive Summary -Mission -Situational Analysis -Opportunities and Issues –Marketing Strategy –Action Plan -Budget -Writing the Marketing Plan and Implementing the Plan.

Unit IV: Marketing in the Digital Era

9

Segmentation – Importance of Audience Segmentation - Different segments used in Digital Media – Organizational Characteristics -Purchasing Characteristics -Acquisition and Retention of new customers -Digital Media for Customer Loyalty -Social Media Marketing - Understanding Social Media - Social Networking with Facebook -Social Sharing with YouTube -Social Media for Customer Reach.

Unit V: Social Media for Marketing

9

Social Media for Marketing – Facebook – LinkedIn – Twitter – YouTube .Establishing Relationship with customers Social Media – Social Analytics-Automation and Social Media – Social Media and other types of Marketing –Managing Tools of Social Media.

TOTAL:45 HOURS

REFERENCES:

1. MichaelRSolomon,TracyTuten,SocialMediaMarketing,3rdedition(2017),Pearson.
2. Fundamentals of Digital Marketing by Puneet Singh Bhatia: Publisher: Pearson Education.
3. MichaelMiller,B2BDigitalMarketing,1stedition(2012),Pearson.
4. JudyStrauss&RaymondFrost,E-Marketing,7thedition(2013),Pearson.
5. Richard Gay, Alan Charles worth and Rita Esen, Online marketing – A customer led approach, 1st edition (2007), Oxford University Press.
6. Digital Marketing: Seema Gupta-Mc graw hill

CA45C5	ORGANIZATIONAL BEHAVIOR	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce students to the fundamental concepts and theories of organizational behavior, emphasizing the need and importance of studying human behavior in organizations
- To analyze individual behavior, including attitudes, personality, perception, learning, and motivation, and their implications for individual performance and job satisfaction.
- To examine group behavior, including theories of group dynamics, organizational structure, decision-making processes, employee participation, conflict management, and team building.
- To explore the concepts of leadership and communication, including sources of power, leadership theories, interpersonal and organizational communication, and the role of effective communication in organizational success.

Course Outcome		Cognitive Skill
CO-01	Understand and explain the fundamental concepts, models, and theories of organizational behaviour.	U
CO-02	Analyze individual behaviour factors to improve individual performance and job satisfaction	U, An
CO-03	Assess group behaviour dynamics to enhance group effectiveness and collaboration.	U
CO-04	Evaluate leadership styles, sources of power, and communication processes in organizations, and apply effective leadership and communication strategies	A, E
CO-05	Analyze and apply organizational dynamics concepts to enhance organizational efficiency and effectiveness.	U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	M	M	S	M	S	S	S	M
CO-02	S	L	S	S	S	M	S	M	S	L	M	S	M
CO-03	S	M	S	S	S	L	S	S	S	S	M	S	S
CO-04	M	M	M	M	S	M	M	M	M	S	S	S	S
CO-05	M	S	S	M	M	M	L	M	M	S	M	S	M

S-Strong, M-Medium, L-Low, N-Notrelevant

Unit I: Introduction

9

Definition, need and importance – Management Functions–Roles - Skills–Fundamental Concepts– Hawthorne Experiments and their Significance in Industry– Models of Organizational Behavior– Disciplines–Organizational Behavior Process

Unit II: Individual Behavior

9

Foundations of Individual Behaviour – Attitudes – Components - Personality – Personality Determinants – Personality Theories–Perception– Learning–Learning Theories - Motivation– Motivational Theories.

Unit III: Group Behavior

9

Organizational Structure and theories – Decision process – Groups in Organization–Formal Vs Informal Groups – Group Dynamics – Employee Participation–Transactional Analysis– Team Building– Conflict - Organizational Conflict –Management of Conflict– Negotiation– Importance- Negotiation Process-Common Negotiation Mistakes-Tools of Powerful Negotiations.

Unit IV: LeadershipAnd Communication

9

Power and authority Sources of Power - Leadership– Definition– Importance– Leadership Theories– Communication – Functions – Communication process - Interpersonal Communication - Organizational Communication– Barriers Effective Organizational Communication.

Unit V: Organizational Dynamics

9

Organizational Culture and Climate –Organizational Change–Resistance to Change– Change Management – Creativity and Innovation- Organizational Development- Organizational Efficiency and Effectiveness. Discussion of real-world case studies related to organizational behavior issues- Application of theoretical concept to practical situations.

TOTAL:45 HOURS

REFERENCES:

1. Robbins,S.P.,Judge,T.A.,&Campbell,T.T.(2020).OrganizationalBehavior(18thed.).Pearson.
2. Luthans, F. (2017). OrganizationalBehavior: An Evidence-Based Approach (13th ed.).McGraw-HillEducation.
3. Colquitt,J.A.,LePine,J.A.,&Wesson,M.J.(2020).OrganizationalBehavior:ImprovingPerformance and Commitmentin the Workplace (6thed.). McGraw-HillEducation.
4. Greenberg,J. (2017).Behavior in Organizations(11thed.). Pearson.
5. Kinicki,A.,&Fugate,M.(2018).OrganizationalBehavior:APractical,problem-Solving Approach (2nd ed.). McGraw-HillEducation.

CA45C6	INFORMATION SYSTEM SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn fundamentals of cryptography and its application to network security.
- Understand network security threats, security services, and countermeasures
- To acquire knowledge of security in software and operating systems
- To gain knowledge of data security and secure system development
- To acquire knowledge of privacy and data protection.

Course Outcome		Cognitive Skill
CO-01	To test and evaluate security in systems and networks	U
CO-02	Use methods for planning and designing secure systems	U
CO-03	Apply techniques and tools for secure system deployment and operation	A

CO-04	Perform continuous testing, assessment and updating of system security	U
CO-05	To understand authentication and firewall techniques	U

R-Remember, U-Understand, A-Apply, An-Analyze ,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	S	S	S	M	S	M	S	M	S
CO-02	S	M	S	M	S	M	S	M	S	M	S	M	S
CO-03	M	S	S	S	S	S	S	M	M	M	S	S	M
CO-04	M	S	S	S	S	S	S	S	M	M	M	S	M
CO-05	S	M	M	S	M	M	S	M	S	M	S	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction and Principles

9

IT Security Importance and Opportunities - Multidisciplinary Approach - Contextualizing Information Security - IS Expertise & Business Systems - Security Management Practices: Security Architecture and Models - Physical Security - Operations Security - ACM Systems and Methodology - Network and Internet Security - Application Development Security - Twelve Security Principle - CIA triad.

Unit II: Cryptographic Techniques

9

Conventional substitution cipher; Caesar cipher – play fair cipher – Hill cipher - One-time Pad - Transposition ciphers – rail fence cipher - Block cipher and Stream Cipher - Steganography - DES – AES - RSA algorithms.

Unit III: Authentication

9

Secure Hash function - Key management - Kerberos - Authentication Methods - Passwords, Biometric - Challenge Response based authentication - Two-Factor Authentication - Single Sign-On - Web Cookies

Unit IV: Program Security

9

Buffer overflow - Incomplete mediation - Time-of-check to Time-of- use Errors – Malicious softwares -Viruses – Trojan horse – Worms – Distributed Denial of service attacks – Counter measures - Trapdoors Man-in-the- middle attacks - Covert channels

Unit V:Security in Networks

9

Threats in networks - Network Security Controls – Architecture, Encryption - Content Integrity, Strong Authentication - Access Controls - Wireless Security - Honey pots - Traffic flow security - Firewalls - Design and Types of Firewalls - Personal Firewalls - IDS - Email Security - PGP - S/MIME

TOTAL: 45 HOURS

REFERENCES:

1. “Information Systems Today, Managing in the Digital World”, Third Edition by Leonard
2. M. E. Whitman & H. J. Mattord: Principles of Information Security. CENGAGE
3. “Information Systems Management in Practice” Barbara C. McNurlin, Ralph H. Sprague, and Publisher: Pearson Education.
4. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
5. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
6. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
7. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

CA45C7	ETHICAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Familiarize with the nature of business environment and its components.
- The students will be able to demonstrate and develop conceptual framework of business environment and generate interest in international business.
- Understand the definition of ethics and the importance and role of ethical behavior in the business world today.

CourseOutcome		Cognitive Skill
CO-01	Role modeling and influencing the ethical and cultural context	R
CO-02	Respond to ethical crises and proactively address	R,U
CO-03	Understand and implements take holder management decisions	R,A,U
CO-04	Develop the ability, knowledge, and skills for ethical management	R,U
CO-05	Develop practical skills to navigate, resolve and thrive in management situations	R,U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate,S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	L	L	S	S	S	M	L	S	S	S	S
CO-02	M	S	S	S	M	L	S	M	S	L	S	L	S

CO-03	M	S	S	M	L	L	S	S	M	M	S	L	S
CO-04	M	S	S	L	M	S	M	S	S	L	S	M	S
CO-05	S	S	M	S	S	M	S	M	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Notrelevant

Unit I: Ethics and society

9

Ethical Management - Definition, Motivation, Advantages –Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society's expectations-Individual and organizational responsibility to society and the community.

Unit II: Ethical decision making and management in a crisis

9

Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

Unit III: Stakeholders in ethical management

9

Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

Unit IV: Individual variables in ethical management

9

Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical /intuitions/intensity. Utilization of these concepts and competencies for ethical decision - making and management.

Unit V: Practical field-guide, techniques and skills

9

Ethical management in practice,development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively Role modelling and creating a culture of ethical management and human flourishing.

TOTAL:45 HOURS

REFERENCES:

1. Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016.
2. Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.
3. Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.