M C A (COMPUTER APPLICATIONS)

LOCF SYLLABUS 2023

Department of Computer Science

School of Computing Sciences

St. Joseph's College (Autonomous)

Tiruchirappalli - 620002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS) POSTGRADUATE COURSES

St. Joseph's College (Autonomous), an esteemed institution in the realm of higher education in India, has embarked on a journey to uphold and perpetuate academic excellence. One of the pivotal initiatives in this pursuit is the establishment of five Schools of Excellence commencing from the academic year 2014-15. These schools are strategically designed to confront and surpass the challenges of the 21st century.

Each School amalgamates correlated disciplines under a unified umbrella, fostering synergy and coherence. This integrated approach fosters the optimal utilization of both human expertise and infrastructure. Moreover, it facilitates academic fluidity and augments employability by nurturing a dynamic environment conducive to learning and innovation. Importantly, while promoting collaboration and interdisciplinary study, the Schools of Excellence also uphold the individual identity, autonomy, and distinctiveness of every department within.

The overarching objectives of these five schools are as follows:

1. Optimal Resource Utilization: Ensuring the efficient use of both human and material resources to foster academic flexibility and attain excellence across disciplines.

2. Horizontal Mobility for Students: Providing students with the freedom to choose courses aligning with their interests and facilitating credit transfers, thereby enhancing their academic mobility and enriching their learning experience.

3. Credit-Transfer Across Disciplines (CTAD): The existing curricular structure, compliant with regulations from entities such as TANSCHE and other higher educational institutions, facilitates seamless credit transfers across diverse disciplines. This underscores the adaptability and uniqueness of the choice-based credit system.

4. Promotion of Human Excellence: Nurturing excellence in specialized areas through focused attention and resources, thus empowering individuals to excel in their respective fields.

5. Emphasis on Internships and Projects: Encouraging students to engage in internships and projects, serving as stepping stones toward research endeavors, thereby fostering a culture of inquiry and innovation.

6. Addressing Stakeholder Needs: The multi-disciplinary nature of the School System is tailored to meet the requirements of various stakeholders, particularly employers, by equipping students with versatile skills and competencies essential for success in the contemporary professional landscape.

In essence, the Schools of Excellence at St. Joseph's College (Autonomous) epitomize a holistic approach towards education, aiming not only to impart knowledge but also to cultivate critical thinking, creativity, and adaptability – qualities indispensable for thriving in the dynamic global arena of the 21st century.

Credit system

The credit system at St. Joseph's College (Autonomous) assigns weightage to courses based on the hours allocated to each course. Typically, one credit is equivalent to one hour of instruction per week. However, credits are awarded regardless of actual teaching hours to ensure consistency and adherence to guidelines.

The credits and hours allotted to each course within a programme are detailed in the Programme Pattern table. While the table provides a framework, there may be some flexibility due to practical sessions, field visits, tutorials, and the nature of project work.

For postgraduate (PG) courses, students are required to accumulate a minimum of 110 credits, as stipulated in the programme pattern table. The total minimum number of courses offered by the department is outlined in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

OBE is an educational approach that revolves around clearly defined goals or outcomes for every aspect of the educational system. The primary aim is for each student to successfully achieve these predetermined outcomes by the culmination of their educational journey. Unlike traditional methods, OBE does not prescribe a singular teaching style or assessment format. Instead, classes, activities, and evaluations are structured to support students in attaining the specified outcomes effectively.

In OBE, the emphasis lies on measurable outcomes, allowing educational institutions to establish their own set of objectives tailored to their unique context and priorities. The overarching objective of OBE is to establish a direct link between education and employability, ensuring that students acquire the necessary skills and competencies sought after by employers.

OBE fosters a student-centric approach to teaching and learning, where the delivery of courses and assessments are meticulously planned to align with the predetermined objectives and outcomes. It places significant emphasis on evaluating student performance at various levels to gauge their progress and proficiency in meeting the desired outcomes.

Here are some key aspects of Outcome-Based Education:

Course: A course refers to a theory, practical, or a combination of both that is done within a semester.

Course Outcomes (COs): These are statements that delineate the significant and essential learning outcomes that learners should have achieved and can reliably demonstrate by the conclusion of a course. Typically, three or more course outcomes are specified for each course, depending on its importance.

Programme: This term pertains to the specialization or discipline of a degree programme.

Programme Outcomes (POs): POs are statements that articulate what students are expected to be capable of by the time they graduate. These outcomes are closely aligned with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs outline the specific skills and abilities that students should possess upon graduation within a particular discipline or specialization.

Programme Educational Objectives (PEOs): PEOs encapsulate the expected accomplishments of graduates in their careers, particularly highlighting what they are expected to achieve and perform during the initial years postgraduation.

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The Learning Outcomes-Centric Framework (LOCF) places the learning outcomes at the forefront of curriculum design and execution. It underscores the importance of ensuring that these outcomes are clear, measurable, and relevant. LOCF orchestrates teaching methodologies, evaluations, and activities in direct correlation with these outcomes. Furthermore, LOCF adopts a backward design approach, focusing on defining precise and attainable learning objectives. The goal is to create a cohesive framework where every educational element is in harmony with these outcomes.

Assessment practices within LOCF are intricately linked to the established learning objectives. Evaluations are crafted to gauge students' achievement of these outcomes accurately. Emphasis is often placed on employing authentic assessment methods, allowing students to showcase their learning in real-life scenarios. Additionally, LOCF frameworks emphasize flexibility and adaptability, enabling educators to tailor curriculum and instructional approaches to suit the diverse needs of students while ensuring alignment with the defined learning outcomes.

Some important terminologies

Core Courses (CC): *These are compulsory courses that students must undertake as essential components of their curriculum, providing fundamental knowledge within their primary discipline. Including core courses is essential to maintain a standardized academic programme, ensuring recognition and consistency across institutions.*

Common Core (CC): *A common core course is a shared educational element encompassing fundamental topics across disciplines within a school. It promotes interdisciplinary comprehension and collaboration among students by providing a foundational understanding of key subjects essential for academic and professional success across diverse fields of study.*

Elective Courses (ES): *Elective courses are offered within the main discipline or subject of study. They allow students to select specialized or advanced options from a range of courses, offering in-depth exposure to their chosen area of study. Typically, ES are more applied in nature and provide a deeper understanding of specific topics.*

Generic Elective Courses (EG): *These elective courses are chosen from disciplines unrelated to the student's main area of study, aiming to broaden their exposure and knowledge base. As per the Choice Based Credit System (CBCS) policy, students may opt for generic elective courses offered by other disciplines within the college, enhancing the diversity of their learning experience.*

Ability Enhancement Course (AE): *AE is designed to enhance skills and proficiencies related to the student's main discipline. It aims to provide practical training and hands-on experience, contributing to the overall development of students pursuing academic programmes.*

Skill Enhancement Course (SE): *SE focus on developing specific skills or proficiencies relevant to students' academic pursuits. While it is open to students from any discipline, SE is particularly beneficial for those within the related academic programme.*

Self-paced Learning (SP): *This course promotes independent learning habits among students and they have to undergo the course outside the regular class hours within a specified timeframe.*

Comprehensive Examinations (CE): *These examinations cover detailed syllabi comprising select units from courses offered throughout the programme. They are designed to assess crucial knowledge and content that may not have been covered extensively in regular coursework.*

Extra Credit Courses: *To support students in acquiring knowledge and skills through online platforms such as Massive Open Online Courses (MOOCs), additional credits are granted upon verification of course completion. These extra credits can be availed across five semesters (2 - 6). In line with UGC guidelines, students are encouraged to enhance their learning by enrolling in MOOCs offered by portals like SWAYAM, NPTEL, and others. Additionally, certificate courses provided by the college are also considered for these extra credits.*

Outreach Programme (OR): *It is a compulsory course to create a sense of social concern among all the students and to inspire them to dedicated service to the needy.*

Course Coding

The following code system (10 alphanumeric characters) is adopted for Postgraduate courses:

23	**UXX**	**0**	**XX**	**00/X**
Year of Revision	PG Department Code	Semester Number	Course Specific Initials	Running Number/with Choice

Course Specific Initials

CC - Core Course
CP - Core Practical
ES - Elective
AE - Ability Enhancement Course
SP - Self-paced Learning
EG - Generic Elective
PW - Project and Viva Voce
CE - Comprehensive Examination
OR - Outreach Programme
IS – Internship

EVALUATION PATTERN
Continuous Internal Assessment

Sl No	Component	Marks Alloted
1	Mid Semester Test	30
2	End Semester Test	30
3	*Three Components (15 + 10 + 10)	35
4	Library Referencing (30 hours)	5
	Total	**100**

Passing minimum: 50 marks

* *The first component is a compulsory online test (JosTEL platform) comprising 15 multiple choice questions (10 questions at K1 level and 5 questions at K2 level); The second and the third components are decided by the course in-charge.*

Question Paper Blueprint for Mid and End Semester Tests

<table>
<tr><td colspan="3">Duration: 2 Hours</td><td colspan="4">Maximum Marks: 60</td></tr>
<tr><td colspan="2" rowspan="2">Section</td><td colspan="4">K levels</td><td rowspan="2">Marks</td></tr>
<tr><td>K1</td><td>K2</td><td>K3</td><td>K4</td><td>K5</td><td>K6</td></tr>
<tr><td colspan="2">A (compulsory)</td><td>7</td><td></td><td></td><td></td><td></td><td></td><td>7 × 1 = 7</td></tr>
<tr><td colspan="2">B (compulsory)</td><td></td><td>5</td><td></td><td></td><td></td><td></td><td>5 × 3 = 15</td></tr>
<tr><td colspan="2">C (either…or type)</td><td></td><td></td><td>3</td><td></td><td></td><td></td><td>3 × 6 = 18</td></tr>
<tr><td rowspan="4">D (2 out of 3)</td><td>For courses with K5 as the highest cognitive level, one K4 and one K5 question is compulsory.
(Note: two questions on K4 and one question on K5)</td><td></td><td></td><td></td><td>1</td><td>1*</td><td></td><td rowspan="4">2 × 10 = 20</td></tr>
<tr><td rowspan="3">For courses with K6 as the highest cognitive level: Mid Sem: two questions on K4 and one question on K5; End Sem: two questions on K5 and one question on K6)</td><td></td><td></td><td></td><td colspan="2">Mid Sem</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">End Sem</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>1</td><td>1*</td></tr>
<tr><td colspan="6">Total</td><td>60</td></tr>
</table>

***** *Compulsory*

Question Paper Blueprint for Semester Examination

Duration: 3 Hours						**Maximum Marks: 100**
UNIT	**Section A** *(Compulsory)*	**Section B** *(Compulsory)*	**Section C** *(Either…or type)*	**Section D** *(3 out of 5)*		
	K1	**K2**	**K3**	**K4**	**K5**	**K6**
UNIT I	2	2	2	2*	2*	1*
UNIT II	2	2	2			
UNIT III	2	2	2			
UNIT IV	2	2	2			
UNIT V	2	2	2			
Marks	**10 × 1 = 10**	**10 × 3 = 30**	**5 × 6 = 30**	**3 × 10 = 30**		

** For courses with K6 as the highest cognitive level wherein one question each on K4, K5 and K6 is compulsory.*
(Note: two questions each on K4 and K5 and one question on K6)

Evaluation Pattern for One/Two-credit Courses

Title of the Course	CIA	Semester Examination	Total Marks
• Ability Enhancement Course	20 + 10 + 20 = 50	50 *(A member from the Department other than the course instructors)*	100
• Self-paced Learning • Comprehensive Examination	25 + 25 = 50	50 *(CoE)*	100
• Internship	100	-	100
• Skill Enhancement Course: Soft Skills	100	-	100
• Project Work and Viva Voce	100	100	100

Grading System

The marks obtained in the CIA and semester for each course will be graded as per the scheme provided in Table - 1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$$SGPA \ and \ CGPA = \frac{\sum_{i=1}^{n} C_i Gp_i}{\sum_{i=1}^{n} C_i}$$

$$WAM = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$$

Where,

Ci - credit earned for the Course i

Gpi - Grade Point obtained for the Course i

Mi - Marks obtained for the Course i

*n - Number of Courses **passed** in that semester*

WAM - Weighted Average Marks

Table - 1: Grading of the Courses for PG

Mark Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
Below 50	0	RA

Table - 2: Grading of the Final Performance for PG

CGPA	Grade	Performance
9.00 and above	O	Outstanding*
8.00 to 8.99	A+	Excellent*
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appear

**The Candidates who have passed in the first appearance and within the prescribed duration of the PG programme are eligible. If the Candidates Grade is O/A+ with more than one attempt, the performance is considered "Very Good".*

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value- driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

1. Graduates will be able to accomplish professional standards in the global environment.
2. Graduates will be able to uphold integrity and human values.
3. Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbibed with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

Programme Specific Objectives (PSOs)

1. Graduates will be able to implement the logic for solving the real life problems by using the knowledge gained
2. Graduates will be able to understand, analyze, design, develop, test, implement and document software systems
3. Graduates will be able to use their creative skill to evolve new ideas, defend their findings at the peer level and able to manage IT and ITES organizations.
4. Graduates will be able to work in public and private sectors satisfying social and environmental obligations with multiple cultures.
5. Graduates will be able to act as socially responsible IT professionals or service minded entrepreneurs.

PROGRAMME STRUCTURE				
Semester	**Specification**	**Number of Courses**	**Hours**	**Credits**
1 - 4	Core Course	9	39	36
1 - 4	Core Practical	6	19	14
1, 2, 4	Elective	4	18	14
1	Ability Enhancement Course	1	2	1
2	Self-paced Learning	1	-	2
2	Skill Enhancement Course	1	4	3
2, 3	Generic Elective	2	8	6
3	Common Core	1	5	4
3	Internship	1	-	2
2 - 4	Extra Credit Course	3	-	(9)
4	Project Work and Viva Voce	1	25	22
4	Comprehensive Examination	1	-	2
2 - 4	Outreach Programme (SHEPHERD)	-	-	4
	Total	**31**	**120**	**110(9)**

M C A (Computer Applications)							
Course Details					Scheme of Exams		
Sem	**Course Code**	**Title of the Course**	**Hours**	**Credits**	**CIA**	**SE**	**Final**
1	23PCA1CC01	**Core Course - 1:** C++ and Data Structures	4	4	100	100	100
	23PCA1CC02	**Core Course - 2:** Introduction to Computer Architecture	4	4	100	100	100
	23PCA1CC03	**Core Course - 3:** Relational Database Management Systems	4	4	100	100	100
	23PCA1CP01	**Core Practical - 1:** Data Structures Using C++	4	2	100	100	100
	23PCA1CP02	**Core Practical - 2:** RDBMS	4	2	100	100	100
	23PCA1ES01	**Elective - 1:** Accounting and Financial Management	4	3	100	100	100
	23PCA1ES02	**Elective - 2:** Theory of Computation	4	3	100	100	100
	23PCA1AE01	**Ability Enhancement Course**: Programming in Java	2	1	100	-	100
		Total	**30**	**23**			
2	23PCA2CC04	**Core Course - 4:** Programming Smart Devices	4	4	100	100	100
	23PCA2CC05	**Core Course - 5:** Software Engineering	4	3	100	100	100
	23PCA2CC06	**Core Course - 6:** Data Analysis Using Python	4	3	100	100	100
	23PCA2CP03	**Core Practical - 3:** Programming Smart Devices	3	3	100	100	100
	23PCA2CP04	**Core Practical - 4:** Python Programming	2	2	100	100	100
	23PCA2SP01	**Self-paced Learning**: XML*	-	2	50	50	50
	23PCA2ES03A	**Elective - 3:** Internet of Things	5	4	100	100	100
	23PCA2ES03B	**Elective - 3**: Cloud Computing					
	23PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	3	100	-	100
	-	**Generic Elective - 1: (WS)** Refer ANNEXURE 1	4	3	100	100	100
	-	Extra Credit Course (MOOC/Certificate Course) - 1	-	(3)			
		Total	**30**	**27 (3)**			
3	23PCA3CC07	**Core Course - 7:** Distributed Technologies	5	5	100	100	100
	23PCA3CC08	**Core Course - 8:** Computer Networks and Security	5	5	100	100	100
	23PCA3CC09	**Core Course - 9:** Operations Research	5	4	100	100	100
	23PCA3CP05	**Core Practical - 5:** Distributed Technologies	3	3	100	100	100
	23PCA3CP06	**Core Practical - 6:** Web App Development Using MEAN	3	2	100	100	100
	23SCS3CC01	**Common Core:** Design and Analysis of Algorithms	5	4	100	100	100
	-	**Generic Elective - 2 (BS):** Refer ANNEXURE 2	4	3	100	100	100
	23PCA3IS01	Internship	-	2	100	-	100
	-	Extra Credit Course (MOOC/Certificate Course) - 2		(3)			
		Total	**30**	**28 (3)**			
4	23PCA4PW01	Project Work and Viva Voce	25	22	100	100	100
	23PCA4ES04A	**Elective - 4:** Recent Trends in Computer Science - 1 #	5	4	100	100	100
	23PCA4ES04B	**Elective - 4:** Recent Trends in Computer Science - 2 #					
	23PCA4CE01	Comprehensive Examination*	-	2	50	50	50
	-	Extra Credit Course (MOOC / Certificate Course) - 3	-	(3)			
		Total	**30**	**28(3)**			
2 - 4	23PCW4OR01	Outreach Programme	-	4			
1 - 4		**Total (Four Semesters)**	**120**	**110 (9)**			

23PCA1BC01	Bridge Course**	30	2

*for grade calculation 50 marks are converted into 100 in the mark statements

#Blended Learning (online and offline)- The students can opt any of the Elective - 4.

**Mandatory Bridge Course for all Non-Computer Science Stream Students. Two weeks to be conducted outside the class hours and evaluated for 100 marks (Purely Internal).

Passed by	***Board of Studies held on 18.12.2023***
Approved by	***48th Academic Council Meeting held on 27.03.2024***

ANNEXURE 1
Generic Elective - 1 (WS)*

Course Details		
School	**Course Code**	**Title of the Course**
SCS	23PDS2EG01	Discrete Mathematics
	23PCS2EG01	Mobile Adhoc Networks (MANET)
	23PMA2EG01A	Mathematical Foundations for Computer Applications
	23PMA2EG01B	Mathematical Foundations for Computer Science

**Offered to students from other Departments within School*

ANNEXURE 2
Generic Elective - 1 (BS)*

Course Details		
School	**Course Code**	**Title of the Course**
SBS	23PBI3EG02	First Aid Management
	23PBT3EG02	Food Technology
	23PBO3EG02	Horticulture and Landscaping
SLAC	23PEN3EG02	English for Effective Communication
SMS	23PCO3EG02	Basics of TallyPrime
	23PCC3EG02	Dynamics of Human Behaviour in Business
	23PCP3EG02	Social Psychology
	23PEC3EG02	Managerial Economics
	23PHR3EG02	Counselling and Guidance
SPS	23PCH3EG02	Health Science
	23PEL3EG02	Computer Hardware and Networks
	23PPH3EG02A	Physics for Competitive Exams
	23PPH3EG02B	Nanoscience

**Offered to students from other Schools*

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1CC01	**Core Course - 1:** C++ and Data Structures	4	4

Course Objectives
To develop a solid understanding of the fundamental concepts of C++ programming
To gain in object-oriented programming by comprehending the concepts of classes, objects, constructors, and inheritance
To acquire the skills necessary to handle file operations, including opening, closing, updating, and error handling
To master the implementation and application of stack data structure, including infix to postfix conversion, recursion
To attain a thorough understanding of tree and graph data structures, including binary trees, traversals, and graphs

UNIT I: Introduction to C++ **(12 hours)**

Tokens, Keywords, Identifiers, Variables, Operators, Manipulators, Expressions and Control Structures in C++; Pointers - Functions in C++ - Main Function -Function Prototyping - Parameters Passing in Functions - Values Return by Functions - Inline Functions - Friend and Virtual Functions

UNIT II: Classes and Objects **(12 hours)**

Constructors and Destructors; and Operator Overloading and Type Conversions - Type of Constructors - Function overloading. Inheritance: Single Inheritance - Multilevel Inheritance - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance. Pointers, Virtual Functions and Polymorphism; Managing Console I/O operations.

UNIT III: Working with Files **(10 hours)**

Classes for File Stream Operations - Opening and Closing a File - End of File Deduction - File Pointers - Updating a File - Error Handling during File Operations - Command line Arguments.

UNIT IV: Stack **(14 hours)**

Data Structures: Definition of a Data structure - primitive and composite Data Types, Asymptotic notations, Arrays, Operations on Arrays,Order lists. Applications of Stack - Infix to Postfix Conversion, Recursion, Maze Problems - Queues- Operations on Queues, Queue Applications, Circular Queue. Singly Linked List- Operations, Application - Representation of a Polynomial, Polynomial Addition; Doubly Linked List - Operations, Applications.

UNIT V: Trees and Graphs **(12 hours)**

Binary Trees - Conversion of Forest to Binary Tree, Operations - Tree Traversals; Graph - Definition, Types of Graphs, Hashing Tables and Hashing Functions, Traversal - Shortest Path; Dijkstra's Algorithm.

Teaching Methodology	Lecture-based instruction, Demonstration, Group Discussion, Peer Learning, Problems solving, and Project-based learning

Books for Study

1. Horowitz, E., Sahni. S., & Mehta. (2008). *Fundamentals of data structures in C++,* (2nd Ed.). Galgotia.
2. Schildt, H. (1999). *C++ - The complete reference,* (3rd Ed.). Tata McGraw - Hill.
3. Goodrich, M. T., Tamassia, R. & Mount, D. M. (2007). *Data structures and algorithms in C++*. Wiley.

Books for Reference

1. Heileman, G. L. (1996). *Data structures, algorithms and object oriented programming*. Mc-Graw Hill International Editions.
2. Aho, A. V., Ullman, J. D., & Hopcraft, J. E. (1974), *Data structures and algorithms*. Adisson Wesley Publication.
3. Salaria, R. S. (2018). *Data structures and algorithms Using C++*. Kanna Book Publishing.

Websites and eLearning Sources

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.tutorialspoint.com/cplusplus/cpp_data_structures.htm
3. https://www.programiz.com/cpp-programming/data-structure
4. https://www.codecademy.com/learn/learn-c-plus-plus/modules/learn-cpp-data-structures
5. https://cslibrary.stanford.edu/110/BinaryTrees.html

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	define the fundamental concepts of C++ programming	**K1**
CO2	summarize the principles of object-oriented programming.	**K2**
CO3	apply different techniques of C++ to create and manipulate files.	**K3**
CO4	analyze the applications of data structure and develop programs using the data structure	**K4**
CO5	build and manipulate different data structure in C++, applying the same to develop algorithms.	**K5**
CO6	design and implement complex programs that involve multiple concepts, data structures, and algorithms.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**23PCA1CC01**			**Core Course - 1:** C++ and Data Structures						**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	2	2	3	2	3	3	3	**2.3**
CO2	2	2	1	2	3	2	2	3	2	3	**2.2**
CO3	2	2	1	2	3	3	2	2	3	2	**2.2**
CO4	1	2	2	2	3	2	2	3	2	3	**2.2**
CO5	2	2	3	3	2	2	3	2	3	3	**2.5**
CO6	2	2	3	2	2	2	2	3	3	3	**2.4**
									Mean Overall Score		**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1CC02	**Core Course - 2:** Introduction to Computer Architecture	4	4

Course Objectives
Understand the Digital number system and their conversions
Identify the operations of logic Gates and simplify the Boolean expressions using K-Map
Comprehend the fundamental principles of simple Arithmetic Circuits
Realize the design of sequential logic circuits such as Flip Flops, Registers and Counters and its applications
Gain the knowledge about the memory elements like RAM, ROM, and Magnetic Disk memories and Secondary Memories.

UNIT I: Digital and Number System **(12 Hours)**

Data and Information Features of Digital Systems, Number Systems. Decimal, Binary, Octal, Hexadecimal and their inter conversions, Representation of Data: Signed Magnitude, one's complement and two's complement, Binary Arithmetic, Fixed point representation and Floating-point representation of numbers. Codes BCD, XS-3, Gray code, hamming code, alphanumeric codes (ASCII, EBCDIC, UNICODE), Error detecting and error correcting codes

UNIT II: Boolean Algebra **(12 Hours)**

Boolean Algebra: Basic gates (AND, OR, NOT gates), Universal gates (NAND and NOR gates), other gates (XOR, XNOR gates). Boolean identities, De Morgan Laws. Karnaugh maps: SOP and POS forms, Quine McClusky method.

UNIT III: Combinational Circuits **(12 Hours)**

Combinational Circuits: Half adder, full adder, code converters, combinational circuit design, Multiplexers and demultiplexers, encoders, decoders, Combinational design using mux and demux, PLA.

UNIT IV: Sequential Circuit Design **(12 Hours)**

Sequential Circuit Design: Flip flops RS, Clocked RS, D, JK, JK Master Slave, T, Counters, Shift registers and their types, Counters: Synchronous and Asynchronous counters.

UNIT V: ALU Structure & Memory **(12 Hours)**

ALU Structure - Memory: ROM, RAM, PROM, EPROM, EEPROM, and Secondary Memory: Hard Disk and optical Disk, Cache Memory, I/O devices.

Teaching Methodology	Videos, PPT, Demonstration, and Designing Logic Circuit

Books for Study

1. Jain, R. P. (2008). *Modern digital electronics*. McGraw Hill.
2. Gill, N. S., & Dixit, J. B. (2016). *Digital design and computer organization*. University Science Press, Sausalito, CA, United States.
3. Norton, P. (2005). *Introduction to computers*. McGraw Hill.

Books for Reference

1. Malvino & Leach (2014). *Digital principles and applications*. McGraw Hill, New York.
2. Balagurusamy (2009). *Introduction to computers.* McGraw Hill Education, New York.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the fundamentals of digital logic and elements of a digital computer	**K1**
CO2	demonstrate the logics of sequential and combinational circuits	**K2**
CO3	solve the problems on logic circuits using digital logics	**K3**
CO4	classify the digital logics of sequential and combinational circuits	**K4**
CO5	interpret the functioning of logic circuits and memory elements	**K5**
CO6	design digital circuit based on the given constraints	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
1	**23PCA1CC02**			**Core Course - 2:** Introduction to Computer Architecture					**4**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	2	3	2	3	2	3	**2.5**
CO2	3	3	3	2	1	3	3	3	2	2	**2.5**
CO3	2	3	3	2	1	2	3	3	2	2	**2.3**
CO4	3	3	3	2	1	3	3	3	2	2	**2.5**
CO5	3	3	3	1	1	2	3	3	2	2	**2.3**
CO6	3	3	3	2	3	3	2	3	2	3	**2.7**
										Mean Overall Score	**2.56 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1CC03	**Core Course - 3:** Relational Database Management Systems	4	4

Course Objectives
To learn the fundamentals of data models, SQL and to represent a database system using ER Diagrams
To study relational database design concepts and normalization procedures
To understand the fundamental concepts of transaction processing, concurrency control techniques and recovery procedures
To understand the internal storage structure using different file systems and indexing techniques which will help in physical database design
To gain fundamental knowledge on other databases like Distributed, XML and Objectrelational databases

UNIT I: Relational Databases **(12 Hours)**

Purpose of Database System - Views of data - Data Models - Database System Architecture - Introduction to relational databases - Relational Model - Keys - Relational Algebra - SQL fundamentals - Advanced SQL features - Embedded SQL- Dynamic SQL.

UNIT II: Database Design **(12 Hours)**

Entity-Relationship model - E-R Diagrams - Enhanced- ER Model - ER-to-Relational Mapping - Functional Dependencies - Non-loss Decomposition - First, Second, Third Normal Forms, Dependency Preservation - Boyce/Codd Normal Form - Multi-valued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form

UNIT III: Transactions **(12 Hours)**

Transaction Concepts - ACID Properties - Schedules - Serializability - Concurrency Control - Need for Concurrency - Locking Protocols - Two Phase Locking - Deadlock - Transaction Recovery - Save Points - Isolation Levels - *SQL Facilities for Concurrency and Recovery.*

UNIT IV: Implementation Techniques RAID **(12 Hours)**

File Organization - Organization of Records in Files - Indexing and Hashing -Ordered Indices - B+ tree Index Files - B tree Index Files - Static Hashing - Dynamic Hashing - *Query Processing Overview - Algorithms for SELECT and JOIN operations - Query optimization using Heuristics and Cost Estimation.*

UNIT V: Advanced Topics **(12 Hours)**

Distributed Databases: Architecture, Data Storage, Transaction Processing - Object-based Databases: Object Database Concepts, Object- Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery - *Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.*

Teaching Methodology	a) Provide Exercises for SQL Queries, Data Modeling and b) Normalization c) Assign group work to design relational databases d) Conduct regular quizzes to evaluate the knowledge level of the students e) Provide students with relevant OER references

Books for Study

1. Silberschatz, A., Korth, H. F., & Sudharsha. S. (2011). *Database System Concepts,* (6th Ed.). Tata McGraw Hill.
2. Elmasri, R., & Navathe, S. B. (2011). *Fundamentals of Database Systems,* (6th Ed.). Pearson Education.

Books for Reference

1. Date, C. J., Kannan, A., & Swamynathan. S. (2006). *An Introduction to Database Systems,* (8th Ed.). Pearson Education.
2. Ramakrishnan, R. (2015). *Database Management Systems,* (4th Ed.). McGraw Hill, College Publications.
3. Gupta, G. K. (2011). *Database Management Systems*. Tata McGraw Hill.

Websites and eLearning Sources

1. https://www.w3schools.com/sql/
2. https://www.studytonight.com/dbms/database-normalization.php
3. https://www.databasejournal.com/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the key concepts and terminologies in relational and advanced Database systems	**K1**
CO2	interpret the implementation scenarios of database design transactions and storage mechanisms in relational data model	**K2**
CO3	map ER Model to relational model, normalize data and formulate SQL queries	**K3**
CO4	classify data accessing strategies in different types of database systems	**K4**
CO5	appraise how advanced databases differ from traditional databases	**K5**
CO6	build a complete relational database design with proper normalizations	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
1	**23PCA1CC03**			**Core Course - 3:** Relational Database Management Systems					**4**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	1	2	2	2	3	2	2	**2.2**
CO2	3	3	2	1	1	3	2	3	2	2	**2.2**
CO3	3	2	3	1	1	3	3	3	2	2	**2.3**
CO4	2	3	3	1	3	1	3	2	2	3	**2.3**
CO5	3	2	3	2	2	2	2	3	1	2	**2.2**
CO6	3	3	3	2	3	3	2	3	2	3	**2.4**
										Mean Overall Score	**2.26 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1CP01	**Core Practical - 1:** Data Structures Using C++	4	2

C++

1. Class and Objects
2. Functions
3. Constructors
4. Inheritance
5. Pointers
6. File Handling

Data Structures

7. Array
8. Stack and Queue
9. Linked List
10. 10.Binary Tree Traversals

Semester	Course Code	Title of the Course	Hours	Credits
1	23PCA1CP02	**Core Practical - 2:** RDBMS	4	2

SQL

1. DDL, DML and DCL Queries
2. Set Operations
3. Views
4. Joins
5. Sub Queries
6. Indexes, Sequence and Synonyms

PL/SQL

7. Cursors
8. Functions and Procedures
9. Packages
10. Triggers

FORMS AND REPORTS

11. Forms - Menus, Buttons, LOVs, Master-Detail form design
12. Simple Report Design

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1ES01	**Elective - 1:** Accounting and Financial Management	4	3

Course Objectives
To understand the fundamental principles of accounting
To develop the ability to analyze and interpret financial statements
To critically analyze and provide recommendations to improve the operations of organizations
To acquire the skills to prepare functional budgets and understand their characteristics.
To develop a comprehensive understanding of project appraisal techniques

UNIT I: Introduction to the Principles of Accounting **(12 hours)**

Principles of double entry -Assets and Liabilities - Accounting records and systems - Trial balance and preparation of financial statements - Trading, Manufacturing, Profit and Loss accounts, Balance Sheet including adjustments (Simple problems only).

UNIT II: Analysis and Interpreting Accounts and Financial Statements **(12 hours)**

Ratio analysis - Use of ratios in interpreting the final accounts (trading accounts and loss a/c and balance sheet) - final accounts to ratios as well as ratios to final accounts.

UNIT III: Break-even analysis and Marginal Costing **(12 hours)**

Meaning of variable cost and fixed cost - Cost-Volume -Profit analysis - calculation of breakeven point, Profit planning, sales planning and other decision - making analysis involving break - even analysis - Computer Accounting and algorithm.(differential cost analysis to be omitted)

UNIT IV: Budget/Forecasting **(12 hours)**

Preparation of and Characteristics of functional budgets, Production, sales, Purchases, cash and flexible budgets.

UNIT V: Project Appraisal **(12 hours)**

Method of capital investment decision making: Payback method , ARR method - Discounted cash flows - Net Present values - Internal rate of return - Sensitivity analysis - Cost of capital

Teaching Methodology	Lecture-based Teaching, Case-Studies and Problem Solving, Problem-based learning

Books for Study

1. Shukla, M. C., & Grewal, T. S. (1991). *Advanced Accounts*, S. Chand & Co.
2. Gupta, R. L., & Radhaswamy, M. (1991). *Advanced Accounts* Vol. II, Sultan Chand & Sons.
3. Maheswari, S. N. (2021). *Principles of Management Accounting*. Sultan Chand.
4. Ramachandran, R., & Srinivasan, S. (2017). *Management Accounting (Theories, Problems & Solutions),* (6th ed.). Sriram Publications.

Books for Reference

1. Kuchhal, S. C. (1980). *Financial Management*. Chaitanya.
2. Mohan, M. & Goyal, S. N. (1987). *Principles of Management Accounting*. Arya Sahithya Bhawan.
3. Hingorani, N. L. & Ramanthan, A. R. (1992). *Management Accounting,* (5th Ed.). Sultan Chand.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall and comprehend the fundamental principles, concepts, and terminology of accounting	**K1**
CO2	explain the purpose and significance of financial statements in business decision-making	**K2**
CO3	solve accounting problems and make informed decisions based on financial data and analysis	**K3**
CO4	compare the findings from financial analysis and provide insights and recommendations for management	**K4**
CO5	assess the effectiveness of budgeting and forecasting in planning and controlling financial activities	**K5**
CO6	elaborate the importance of ethical considerations in accounting practices and decision-making	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**23PCA1ES01**			**Elective - 1:** Accounting and Financial Management						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	2	3	2	2	2	1	**2.2**
CO2	3	3	1	3	2	2	3	2	2	1	**2.2**
CO3	1	2	3	2	2	2	3	2	3	2	**2.2**
CO4	3	3	1	2	1	1	2	3	2	3	**2.1**
CO5	2	3	2	3	3	3	2	2	2	2	**2.4**
CO6	2	3	2	3	3	3	2	2	2	2	**2.4**
									Mean Overall Score		**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1ES02	**Elective - 2:** Theory of Computation	4	3

Course Objectives
To give an overview of the theoretical foundations of computer science from the perspective of formal languages
To illustrate finite state machines to solve problems in computing
To explain the hierarchy of problems arising in theory of computation
To familiarize various types of gramma
To use basic concepts of formal languages and finite automata techniques

UNIT I: Review of Mathematical Theory **(12 Hours)**

COMBINATORICS Review of Permutation and Combination - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion - generating function - Recurrence relations. Statements - Connectives - Truth Tables - Normal forms - Predicate calculus - Inference - Theory for Statement Calculus and Predicate Calculus

UNIT II: Regular Languages and Finite Automata **(12 Hours)**

Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output - Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union- intersection and complement of regular languages, NonDeterministic Finite Automata, Conversion from NFA to FA- Non-Deterministic Finite Automata, Conversion of NFA- to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages - pumping lemma.

UNIT III: Context free grammar (CFG) **(12 Hours)**

Definitions and Examples, Unions Concatenations and Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity, Unambiguous CFG and Algebraic Expressions, Backaus Naur Form (BNF), Normal Form - CNF.

UNIT IV: Pushdown Automata, CFL and NCFL **(12 Hours)**

Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.

UNIT V: Turing Machine (TM) **(12 Hours)**

TM Definition, Model of Computation, Turing Machine as Language Acceptor, TM that Compute Partial Function, Church Turing Thesis, Combining TM, Variations Of TM, NonDeterministic TM, Universal TM, Recursively and Enumerable Languages, Context sensitive languages and Chomsky hierarchy.

Note: Emphasis is given only on basic concepts and problems (No Proof and Derivations)

Teaching Methodology	Chalk and Talk, Videos, PPTs, Group Discussion and Problem solving

Books for Study

1. Tremblay, J. P., & Manohar, R. (1997). *Discrete Mathematical Structures with Applications to Computer Science*. TATA McGraw-Hill Edition.
2. Hopcroft, J. E., & Ullman, J. D. (1979). *Introduction to Automata Theory, Languages and Computation*. Narosa Publishing House.
3. Linz, P. (2016). *An Introduction to Formal Languages and Automata,* (6th ed.). Jones & Bartlett Learning.

Books for Reference

1. Mishra, K. L. P. & Chandrashekaran, N. (2003). T*heory of Computer Science- Automata Languages and Computation,* (2nd ed.). Prentice Hall.
2. Hopcroft, J. E., Motwani, R. & Ullman, J. D. (2007). *Introduction to Automata Theory Languages and Computation,* (3rd ed.). Pearson Education.

Websites and eLearning Source

1. https://nptel.ac.in/courses/106106049

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	familiarize with the basics of Theory of Computation	**K1**
CO2	apply the principles of languages and finite automata to solve problems related to regular expressions, regular languages, finite automata with output, memory requirements, and operations on languages	**K2**
CO3	demonstrate proficiency in grammars by defining and constructing grammars for various languages, understanding the concepts of ambiguity, unambiguity, and normal forms	**K3**
CO4	understand the concept and functionality of machines as a model of computation, including language acceptance, computation of partial functions	**K4**
CO5	apply critical thinking and problem-solving skills to analyze complex computational problems and devise appropriate solutions using the concepts learned in theory of computation	**K5**
CO6	demonstrate advanced knowledge and understanding of theoretical aspects of computation, including advanced topics such as advanced combinatorics, advanced formal languages, complexity theory, and computability theory	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**23PCA1ES02**			**Elective - 2:** Theory of Computation						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	2	3	2	1	3	**2.3**
CO2	1	2	2	3	2	2	2	3	2	3	**2.2**
CO3	2	2	3	3	3	1	3	3	3	2	**2.5**
CO4	2	3	3	2	2	3	3	2	3	2	**2.5**
CO5	1	2	2	2	3	2	3	3	3	3	**2.4**
CO6	1	2	2	3	2	2	3	2	2	3	**2.2**
										Mean Overall Score	**2.35 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1AE01	**Ability Enhancement Course:** Programming in Java	2	1

Course Objectives
To understand the fundamentals of Object-Oriented Programming
To familiar with the syntax and structure of Java programming
To explore the different data types and operators in Java
To understand the significance of decision-making statements in Java programming
To gain knowledge about classes and objects in Java

UNIT I: Introduction to OOPS **(6 hours)**

Paradigms of Programming Languages -Basic concepts of Object Oriented Programming - Differences between Procedure Oriented Programming and Object Oriented programming - Benefits of OOPs - Application of OOPs.

UNIT II: Introduction to Java **(6 hours)**

History - Java features - Java Environment - JDK - API. Introduction to Java: Types of java program - Creating and Executing a Java program - Java Tokens- Java Virtual Machine (JVM) - Command Line Arguments -Comments in Java program.

UNIT III: Data types and Operators **(6 hours)**

Constants - Variables - Data types - Scope of variables - Type casting - Operators: Special operators - Expressions - Evaluation of Expressions.

UNIT IV: Looping Statements and Arrays **(6 hours)**

Decision making and branching statements- Decision making and Looping- break - continue statement- Arrays: One Dimensional Array - Multidimensional Array.

UNIT V: Class and objects **(6 hours)**

Defining a class - Methods - Creating objects- Accessing class members - Constructors - Method overloading - Static members - this keyword - Inheritance: Defining inheritance - types of inheritance - JDBC Connectivity.

List of Practical's

1. Write a Java program to find area and perimeter of circle.
2. Write a java Program to find factorial of a given number.
3. Write a java program to find simple and compound Interest 4. Write a Java program to find sum of n numbers using array
4. Write a simple Java program using class & objects.

Teaching Methodology	PPT, Demonstration

Books for Study

1. Balagurusamy, E. (2014). *Programming with Java,* (5th Ed.). Tata McGraw Hill Education (India) Private Limited.
2. Sagayaraj. *et al.* (2018). *Java Programming for Core and Advanced Learners*. Universities Press (India) Private Limited.

Books for Reference

1. Schildt, H. (2007). *The complete reference Java,* (7th Ed.). Tata McGraw Hill Education (India) Private Limited.
2. Muthu, C. (2011). *Programming with Java,* (2nd Ed.). Vijay Nicole Imprints Private Limited.

Websites and eLearning Sources

1. https://www.javatpoint.com/java-tutorial
2. https://www.geeksforgeeks.org/java/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the fundamentals concepts in java programming.	**K4**
CO2	understand the different types of inheritance.	**K5**
CO3	apply the object-oriented programming concepts to write simple java programs.	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
1	**23PCA1AE01**		**Ability Enhancement Course:** Programming in Java							**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	1	1	3	3	3	2	3	**2.3**
CO2	3	3	2	2	1	3	2	3	2	2	**2.32**
CO3	3	3	3	2	2	3	3	2	2	2	**2.5**
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2CC04	**Core Course - 4:** Programming Smart Devices	4	4

Course Objectives
To learn the fundamental elements of React Native application
To create an elegant UI design using React Native elements
To understand and use various device facilities in the React Native application
To learn the art of communicating with web servers from React Native application
To gain knowledge on deployment of React Native application in Android play store and iOS app store

UNIT I: Learning the basics **(12 Hours)**

Introduction to React - Virtual Document Object Model (DOM) - One-way data flow - Introduction to components - Props and state -Introduction to React Native - The installation of React Native - First application - The anatomy of a React Native application - Debug your application.

UNIT II: UI Design **(12 Hours)**

React Navigation - Flex box - Touchable Highlight - List View - Scroll View - Animations - Image scrolling and swiping.

UNIT III: Device Capabilities **(12 Hours)**

Map View and Geo Location - Async Storage - Native Alert - Web View - Deep linking.

UNIT IV: Communicating with Servers **(12 Hours)**

XML Http Request - Web Socket - Fetch - Getting data from a server - Saving data to a server - Creating APIs with Node/Express - Integrating RN app with Node server.

UNIT V: React Native Application Distribution **(12 Hours)**

The Apple and Google Play distribution systems - Creating a build for iOS or Android - Beta testing.

Teaching Methodology	Live Demonstration of App development, Hands-on Labs, Group Projects and Collaborations, Industry Experts Lecture

Books for Study

1. Paul, A., & Nalwaya, A. (2019). *React Native for Mobile Development* (6th ed.). Tata McGraw Hill.
   - **UNIT I** : Chapters 1 and 2
   - **UNIT II** : Chapter 4
   - **UNIT III** : Chapter 5
   - **UNIT IV** : Chapter 6
   - **UNIT V** : Chapter 9

Books for Reference

1. Masiello, E., & Friedmann, J. (2017). *Mastering React Native*. Birmingham.
2. Eisenman, B. (2016). *Learning React Native - Building Mobile Applications with JavaScript*. O'Reilly Media.
3. Dabit, N. (2019). *React Native in Action - Developing iOS and Android apps with JavaScript*. Manning Publication & Co.

Websites and eLearning Sources

1. React Native Official Documentation - https://reactnative.dev/
2. React Native Elements - https://reactnativeelements.com/
3. React Native Navigation - https://reactnavigation.org/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K- Level)**
CO1	recall the features of React Native in the making of cross-platform Mobile applications.	**K1**
CO2	understand the concepts used in smart devices by creating simple applications using react native.	**K2**
CO3	construct powerful and elegant mobile applications using React components.	**K3**
CO4	test mobile apps that interact with APIs on the server-side.	**K4**
CO5	evaluate the use of features in building mobile applications.	**K5**
CO6	develop applications and deploy them on iOS App Store and Android Play Store.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PCA2CC04**			**Core Course - 4:** Programming Smart Devices						**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	2	3	2	2	2	3	**2.4**
CO2	2	3	3	2	3	2	3	2	2	3	**2.5**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	2	3	3	2	2	3	**2.5**
									Mean Overall Score		**2.45 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2CC05	**Core Course - 5:** Software Engineering	4	3

Course Objectives
To understand the fundamental principles and evolving nature of software engineering.
To develop proficiency in requirements engineering and the elicitation of software requirements.
To acquire design concepts and skills, emphasizing architectural design and user interface design.
To learn diverse testing strategies applicable to conventional, object-oriented, web, and mobile applications.
To gain knowledge of project management concepts and the effective application of metrics for process improvement and software quality assurance.

UNIT I : The Nature of Software **(12 Hours)**

The Changing Nature of Software - Software Engineering: Defining the Discipline - The Software Process - Software Engineering Process - Software Development Myths. Process Models: Prescriptive Process Models - Specialized Process Models - The Unified Process - Personal and Team Process Models - Process Technology - Product and Process. Agile Development: Meaning of Agility and Cost of Change - Agile Process - Extreme Programming - Other Agile Process Models - A Tool Set for the Agile Process.

UNIT II: Understanding Requirements **(12 Hours)**

Requirements Engineering - Establishing Groundwork - Eliciting Requirements - Developing Use Cases - Building the analysis Model - Negotiating Requirements - Requirements Monitoring - Validating Requirements - Avoiding common mistakes. Scenario-Based Methods: Requirements Analysis - Scenario-Based Modeling - UML models that supplement the use cases. Class-Based Methods: Identifying Analysis Classes - Specifying Attributes - Defining Operations - Class-Responsibility - Collaborator Modeling - Associations and Dependencies - Analysis Packages.

UNIT III: Design Concepts **(12 Hours)**

The Design Process - Design Concepts - The Design Model. Architectural Design: Software Architecture - Architectural Genres - Architectural Styles - Architectural Considerations - Architectural Decisions - Architectural Design - Assessing Alternative Architectural Design. User Interface Design: The Golden Rules - User Interface Analysis and Design - Interface Analysis - Interface Design Steps - WebApp and Mobile Interface Design - Design Evaluation.

UNIT IV: Software Testing Strategies **(12 Hours)**

A Strategic Approach to Software Testing - Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Test Strategies for WebApp - Test Strategies for Mobile App - Validation Testing - System Testing - The Art of Debugging. Testing Conventional Applications: Software Testing Fundamentals - Internal and External Views of Testing - White-Box Testing - Basis Path Testing - Control Structure Testing - Black-Box Testing - Model Based Testing - Testing Documentation and help facilities - Testing for Real Time Systems - Pattern for Software Testing.

UNIT V: Project Management Concepts **(12 Hours)**

The Management Spectrum - People - The Product - The Process - The Project - W5H Principle - Critical Process. Process and Project Metrics: Metric in the Process and Project Domains - Software Measurement - Metrics for Software Quality - Integrating Metrics within the Software Process - Metrics for small Organizations - Establishing a Software Metrics Program.

Teaching Methodology	Lectures and Presentations, Interactive Discussions, Case Studies, Collaborative Learning

Books for Study

1. Pressman, R. S., & Maxim, B. (2019). *Software Engineering*, (8th Ed.). McGraw Hill.

Books for Reference

1. Pressman, R. S. (2019). *Software Engineering*, (9th Ed.). McGraw Hill.
2. Sommerville, I. (2018). *Software Engineering*, (10th Ed.). Pearson India.
3. Fairley, R. (2017). *Software Engineering Concepts*. McGraw Hill.

Websites and e-Learning Sources

1. https://www.tutorialspoint.com/software_engineering/index.html
2. https://www.javatpoint.com/software-engineering

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-level)**
CO1	recall the basic concepts of Software Engineering	**K1**
CO2	interpret the necessities to develop the Software	**K2**
CO3	apply the methods and techniques in practical projects	**K3**
CO4	compare the various software development methods and understand the context in which each approach might be applicable in real world concept.	**K4**
CO5	evaluate the effectiveness of an organization's software development practices and suggest improvements	**K5**
CO6	build the tools and techniques for large-scale software systems development	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**	**Credits**	
2	**23PCA2CC05**			**Core Course - 5:** Software Engineering					**4**	**3**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2CC06	**Core Course - 6:** Data Analysis Using Python	4	3

Course Objectives
To understanding of fundamental data types, operations, functions, modules, packages and built-in modules in Python.
To apply Regular Expression Modifiers, creating tables and connecting to databases.
To acquire skills on NumPy and effectively working with NumPy structured arrays.
To import data manipulation skills using Pandas and perform vectorized string operations.
To enhance data visualizing skills using Matplotlib and Seaborn.

UNIT I: Introduction to Python **(12 Hours)**

Features of Python - Data Types and Operations: Numbers-Strings-List-Tuple-Set-Dictionary. Functions: Function Definition -Function Calling -Function Arguments-Anonymous Functions. Modules and Packages: Built-in Modules - Creating Modules - import Statement - Locating Modules - Namespaces and Scope - dir() function - reload() function - Packages in Python -Date and Time Modules.

UNIT II: Regular Expressions and Database Programming **(12 Hours)**

match () function - search() function - Search and Replace - Regular Expression Modifiers: Option Flags-Regular Expression Patterns - findall() method-compile() method. Database Programming: Connecting to a Database-Creating Tables-Insert, Update, Delete and Read Operation- Disconnecting from a Database.

UNIT III: Numpy **(12 Hours)**

Introduction to Numpy-Basics of NumPy Array-Computation on NumPy Array - Aggregations - Broadcasting - Comparisons, Masks and Boolean Logic- Sorting Arrays - NumPy Structured Array.

UNIT IV: Pandas **(12 Hours)**

Data Manipulation with Pandas: Introducing Panda Objects - Data Indexing and Selection -Operating Data on Pandas - Handling Missing Data - Hierarchical Indexing -Combining Data Sets- Vectorized String Operations- Working with Time Series.

UNIT V: Matplotlib **(12 Hours)**

Visualization with Matplotlib: Simple Line Plots-Simple Scatter Plots-Density and Contour Plots-Histograms, Binnings and Density-Customizing Plot Legends -Customising Colorbars-Multiple Subplots-Textand Annotation-Three Dimension Plottingin Matplotlib-Geographic Data with Base Map-Visualization with Seaborn.

Teaching Methodology	Lecture-based instruction, Demonstration, Group Discussion, Peer Learning, Problems solving, and Project-based learning,

Books for Study

1. Jose, J., & Sojan Lal, P. (2016). *Introduction to Computing and Problem Solving with PYTHON*. Khanna Book Publishing Co. (P) Ltd.
   UNIT I: Chapter 3 (3.1, 3.2), Chapter 4 (4.1-4.6), Chapter 6 (6.1-6.4), Chapter 7 (7.1-7.9)
   UNIT II: Chapter 11 (11.1-11.5, 11.9, 11), Chapter 12 (12.1-12.6, 12.8)
2. Vander Plas, J. (2016). *Python Data Science Handbook: Essential Tools for Working with Data* (1st Ed.). O'Reilly Media.
   UNIT III: Chapter 2 UNIT IV: Chapter 3 UNIT V: Chapter 4

Books for Reference

1. Chun, W. J. (2006). *Core Python Programming*, (2nd Ed.). Prentice Hall Publication.
2. Budd, T. A. (2011*). Exploring Python*. Tata McGraw Hill.
3. Boschetti, A., & Massaron, L. (2018). *Python Data Science Essentials*, (3rd Ed.). Pack Publishing.

Websites and eLearning Sources

1. https://realpython.com/
2. https://towardsdatascience.com/
3. https://jupyter.org/
4. https://pandas.pydata.org/pandas-docs/stable/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-level)**
CO1	acquire knowledge about various programming constructs and libraries like Numpy, Pandas and Matplotlib used for data analysis in Python.	**K1**
CO2	explain the basic concepts of object-oriented & procedural programming and concepts used in various data analysis libraries like Numpy, Pandas and Matplotlib available in Python.	**K2**
CO3	apply core Python concepts to write simple programs and various libraries like Numpy, Pandas and Matplotlib used in Python for performing data analysis.	**K3**
CO4	discover how to implement core python concepts in various domains and data analysis using various libraries like Numpy, Pandas and Matplotlib.	**K4**
CO5	assess simple Python applications to perform data analysis using various libraries.	**K5**
CO6	develop Python applications and perform data analysis using various libraries like Numpy, Pandas and Matplotlib.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PCA2CC06**			**Core Course - 6:** Data Analysis Using Python						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	1	3	3	2	2	2	**2.3**
CO2	3	3	2	2	1	3	3	3	2	3	**2.5**
CO3	3	3	2	2	1	3	3	2	2	3	**2.4**
CO4	3	3	3	2	1	3	3	3	2	3	**2.6**
CO5	3	3	3	2	1	3	3	3	2	3	**2.6**
CO6	3	3	3	2	1	3	3	3	2	3	**2.6**
Mean Overall Score											**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	**23PCA2CP03**	**Core Practical - 3:** Programming Smart Devices	**3**	**3**

List of Exercises

1. Creating a simple React Native application
2. Responsive UI design with Flex
3. UI design with components
4. Use of front-end tools and event handling
5. Implementation of touch
6. Navigation among screens
7. Swipe feature implementation
8. Creation of API using Node/Express
9. Accessing APIs from React Native application
10. Implementation of interaction with Firebase
11. Implementation of interaction with RDBMS (MySQL)

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2CP04	**Core Practical - 4:** Python Programming	2	2

List of Exercises

Basic Python Programs

1. Flow controls, Functions and String Manipulation
2. Operations on Tuples and Lists
3. Operations on Sets and Dictionary
4. Regular Expressions
5. Database Operations

Data Analysis - NumPy

6. NumPy Arrays,
7. Sorting and Searching on Arrays

Data Analysis - Pandas

8. Data Series
9. Data Frame
10. Combining and Merging Data Sets
11. Handling Missing Values, Filter, Grouping and Aggregation

Visualization - MatplotLib & Seaborn

12. MatPlotLib - Line Chart, Scatter Plot, Histogram
13. Seaborn - Boxplot, HeatMap

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2SP01	**Self-paced Learning:** XML	-	2

Course Objectives
To understand the concepts of XML Markup.
To apply XML Validation Techniques.
To explore XML Transformation with XSLT.
To apply XML in Real-world Scenarios.
To Integrate XML with Programming Languages.

UNIT I: Introducing XML

An Eagle's Eye View of XML - XML Document - Structuring Data - Attributes, Empty - Element Tags and XSL - Well-formedness.

UNIT II: Document Type Definition

Validity - Element Declarations - Attribute Declarations - Entity Declarations -- Namespaces.

UNIT III: Style Languages

CSS Style Sheets - CSS Layouts - CSS Text Styles - XSL Transformations - XSL Formatting Objects.

UNIT IV: Supplemental Technologies

XLinks - Xpointers - Xinclude - Schemas.

UNIT V: XML Applications

Chemical Markup Language - Mathematical Markup Language - RSS Classic literature - Synchronized Multimedia Integration Language - Open Software Description -Scalable Vector Graphics- Music XML - Voice XML.

Teaching Methodology	Online, PPT

Books for Study

1. Harold, E. R. (2004). *XML Bible,* (3rd Ed.). John Wiley & Sons Inc.

Books for Reference

1. Fawcett, J., Quin, L. R. E., & Ayers, D. (2012). *Beginning XML* (5th Ed.). John Wiley & Sons Inc.
2. Powell, T. A. (2010). *The Complete Reference XML* (5th Ed.). The McGraw-Hill Companies.
3. Holzner, S. (2004). *XML in 21 Days* (3rd Ed.). Sams Publishing.

Websites and eLearning Sources

1. https://www.w3.org/TR/xml/
2. https://developer.mozilla.org/en-US/docs/Web/XML/XML_introduction

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2ES03A	**Elective - 3:** Internet of Things	5	4

Course Objectives
To grasp the core concepts and technologies behind the Internet of Things (IoT) and explore practical applications.
To learn the principles for creating connected devices, focusing on communication technologies and gateway-level data management.
To gain proficiency in communication protocols and web connectivity solutions for connected devices.
To Analyze IP addressing, MAC layer, and application protocols for efficient data handling and processing.
To learn to collect, store, and process data using cloud platforms in IoT applications, leveraging cloud computing paradigms and service models.

UNIT I: Internet of Things: An Overview **(15 Hours)**

Internet of Things - IoT Conceptual Framework - IoT Architectural View - Technology Behind IoT - Sources of IoT - M2M Communication - Examples of IoT.

UNIT II: Design Principles for Connected Devices **(15 Hours)**

Introduction - IoT/M2M Systems Layers and Design Standardisation - Communication Technologies - Data Enrichment, Data Consolidation and Device Management at Gateway.

UNIT III: Design Principles for Web Connectivity **(15 Hours)**

Introduction - Web Communication Protocols for Connected Devices - Message Communication Protocols for Connected Devices - Web Connectivity for Connected Devices Network using Gateway, SOAP, REST, HTTP RESTful and WebSockets.

UNIT IV: Internet Connectivity Principles **(15 Hours)**

Introduction - Internet Connectivity - Internet Based Communication - IP Addressing in IoT - Media Access Control - Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others. Data Acquiring, Organising, Processing and Analytics: Data Acquiring and Storage - Organising the Data Analytics.

UNIT V: Data Collection, Storage and Computing using Cloud Platforms **(15 Hours)**

Cloud Computing Paradigm for Data Collection, Storage and Computing - Everything as a Service and Cloud Service Models. Sensor and Wireless Sensor Networks: Sensor Technology - Participatory Sensing, Industry IoT and Automative IoT - Actuator - Sensor Data Communication Protocols - Radio Frequency Identification Technology - Wireless Sensor Networks Technology.

Teaching Methodology	Tutorials, Demonstration & IoT Simulations

Books for Study

1. Kamal, R. (2017). *Internet of Things: Architecture and Design Principles*, (1st Ed.). McGraw Hill Education (India) Private Limited.
   UNIT I: Chapter 1
   UNIT II: Chapter 2
   UNIT III: Chapter 3
   UNIT IV: Chapters 4, 5
   UNIT V: Chapters 6, 7

Books for Reference

1. Vasudevan, S. K., Nagarajan, A. S., & Sundaran, R. M. D. (2020). *Internet of Things* (2nd Ed.). Wiley Publication.
2. Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., & Henry, J. (2017). *IoT fundamentals: Networking technologies, protocols, and use cases for the Internet of Things.* Cisco Press.
3. Hassan, Q. F. (2018). *Internet of Things A to Z: Technologies and Applications*. Wiley Publication. IEEE Press

Websites and eLearning Sources

1. https://www.shiksha.com/online-courses/industrial-internet-of-things-iiot-course-courl405
2. https://www.tinkercad.com/
3. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
4. https://www.oracle.com/in/internet-of-things/what-is-iot/
5. https://www.ibm.com/topics/internet-of-things

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recognize key IoT concepts and terminologies to establish a foundational understanding of the Internet of Things.	**K1**
CO2	apply design principles to create connected devices, demonstrating the practical application of IoT/M2M system layers and communication technologies.	**K2**
CO3	implement web connectivity solutions for connected devices, utilizing a range of communication protocols and demonstrating proficiency in IoT network design.	**K3**
CO4	analyze and evaluate internet connectivity principles, including IP addressing, MAC layer, and application protocols, demonstrating critical thinking skills.	**K4**
CO5	synthesize data acquisition, organization, and processing techniques for IoT applications, showcasing advanced problem-solving abilities.	**K5**
CO6	evaluate the integration of cloud computing paradigms for efficient data management in IoT applications, demonstrating a comprehensive understanding and the ability to make informed decisions.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PCA2ES03A**			**Elective - 3:** Internet of Things						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	1	3	2	3	2	2	**2.3**
CO2	3	3	3	3	2	3	3	3	2	2	**2.7**
CO3	2	3	2	2	1	3	3	2	2	1	**2.1**
CO4	3	3	3	2	2	3	3	3	3	2	**2.7**
CO5	3	3	3	3	2	3	3	3	3	2	**2.8**
CO6	3	3	2	2	2	2	3	3	2	3	**2.5**
									Mean Overall Score		**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PCA2ES03B	**Elective - 3:** Cloud Computing	5	4

Course Objectives
To comprehend cloud computing fundamentals like virtualization, resource pooling and on-demand self-service.
To apply public, private, and hybrid cloud architectures to solve real-world problems and design efficient solutions.
To gain practical skills in deploying, managing, and optimizing cloud applications and infrastructure.
To develop a deep understanding of cost management in cloud environments and design them for cloud services.
To explore advanced cloud topics including security, scalability, virtual networks, and compliance for comprehensive cloud solution analysis.

UNIT I: Fundamentals of Cloud Computing **(15 Hours)**

Origin and Influences - Business Drivers - Technology Innovations - Basic Concepts - Scaling - Risks and Challenges - Roles and Boundaries - Cloud Characteristics - Cloud Delivery Models - Cloud Deployment Models - Internet Architecture - Data Center Technology - Virtualization Technology - Web Technology.

UNIT II: Cloud Computing Mechanisms **(15 Hours)**

Cloud Infrastructure Mechanisms - Logical Network Perimeter - Cloud Storage Device - Cloud Usage Monitor - Specialized Cloud Mechanisms - Cloud Management Mechanisms - Fundamental Cloud Security - Cloud Security Mechanisms.

UNIT III: Cloud Computing Architecture **(15 Hours)**

Fundamental Cloud Architectures - Advanced Cloud Architectures - Specialized Cloud Architectures.

UNIT IV: Working with Clouds **(15 Hours)**

Delivery Model Considerations - Consumer Perspective - Cost Metrics and Pricing Models - Cost Management Considerations - Service Quality Metrics.

UNIT V: Virtual Networks and other aspects of Cloud **(15 Hours)**

Virtual Machines - Approaches to Virtualization - Properties of Full Virtualization - Organization of VM Systems - Levels of Trust - Virtual I/O Devices - VM Migration - Live Migration - Running Virtual Machines in an Application - Hosted Hypervisor. Edge Computing and IIoT - Latency of Cloud - Edge to Fog Hierarchy - Communication for IIoT - Decentralization.

Teaching Methodology	Videos, PPT, Case Studies, Demonstration, and Hands on sessions

Books for Study

1. Erl, T., Mahmood, Z., & Puttini, R. (2013). *Cloud Computing Concepts, Technology & Architecture*. Prentice Hall. (UNIT I, II, III and IV)
2. Comer, D. E. (2021). *The Cloud Computing Book: The Future of Computing Explained,* (1st Ed.). CRC Press. (Unit V).

Books for Reference

1. Buyya, R., Broberg, J., & Broberg, J. (2011). *Cloud Computing: Principles and Paradigms*. Wileys.
2. Baron, S. (2020). *AWS: The Complete Beginner's Guide to Mastering Amazon Web Services*. Independently Published.

3. Vergadia, P. (2022). *Visualizing Google Cloud: Illustrated References for Cloud Engineers & Architects: 101 Illustrated References for Cloud Engineers and Architects*, (1st Ed.). John Wiley & Sons Inc.

Websites and eLearning Sources

1. https://docs.aws.amazon.com/
2. https://cloud.google.com/docs
3. https://learn.microsoft.com/bs-latn-ba/azure/cloud-services/
4. https://www.vmware.com/in/products/workstation-pro.html

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	recall fundamental cloud computing concepts, such as its origins and key drivers.	**K1**
CO2	explain the core mechanisms of cloud computing, including storage, security, and network components.	**K2**
CO3	design practical cloud solutions based on specific requirements, leveraging knowledge of architecture and mechanisms.	**K3**
CO4	evaluate the risks and challenges associated with cloud adoption and propose mitigation strategies.	**K4**
CO5	critically evaluate the security mechanisms and best practices for securing cloud environments.	**K5**
CO6	create comprehensive cloud strategies that incorporate advanced technologies and address complex challenges.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**23PCA2ES03B**			**Elective - 3:** Cloud Computing					**5**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	3	3	3	2	3	**2.7**
CO2	2	3	2	2	3	2	3	2	2	2	**2.3**
CO3	3	3	2	2	3	2	2	3	2	2	**2.3**
CO4	2	2	2	3	2	3	2	2	2	3	**2.3**
CO5	3	3	2	2	1	1	2	3	2	3	**2.2**
CO6	3	3	2	2	2	2	2	2	2	2	**2.2**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	3

Course Objectives
To provide a focused training on soft skills for students in colleges for better job prospects
To communicate effectively and professionally
To help the students take active part in group dynamics
To familiarize students with numeracy skills for quick problem solving
To make the students appraise themselves and assess others

Unit I: Effective Communication & Professional Communication **(12 Hours)**

Definition of communication, Barriers of Communication, Non-verbal Communication; Effective Communication - Conversation Techniques, Good manners and Etiquettes; Speech Preparations & Presentations; Professional Communication.

Unit II: Resume Writing & Interview Skills **(12 Hours)**

Resume Writing: What is a résumé? Types of résumés, - Chronological, Functional and Mixed Resume, Purpose and Structure of a Resume, Model Resume.

Interview Skills: Types of Interviews, Preparation for an interview, Attire, Body Language, Common interview questions, Mock interviews & Practicum

Unit III: Group Discussion & Personal effectiveness **(12 Hours)**

Basics of Group Discussion, Parameters of GD, Topics for Practice, Mock GD & Practicum & Team Building.

Personal Effectiveness: Self Discovery; Goal Setting with questionnaires & Exercises

Unit IV: Numerical Ability **(12 Hours)**

Introducing concepts Average, Percentage; Profit and Loss, Simple Interest, Compound Interest; Time and Work, Pipes and Cisterns.

Unit V: Test of Reasoning **(12 Hours)**

Introducing Verbal Reasoning: Series Completion, Analogy; Data Sufficiency, Assertion and Reasoning; and Logical Deduction. Non-Verbal Reasoning: Series; and Classification

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Book for study

1. Melchias G., Balaiah, J. & Joy, J. L. (Eds). (2018). *Winner in the Making: A Primer on soft Skills.* Trichy, India: St. Joseph's College.

Books for References

1. Aggarwal, R. S. (2010). *A Modern Approach to Verbal and Non-Verbal Reasoning.* S. Chand.
2. Covey, S. (2004). *7 Habits of Highly effective people.* Free Press.
3. Gerard, E. (1994). *The Skilled Helper* (5th Ed.). Brooks/Cole.
4. Khera, S. (2003). *You Can Win.* Macmillan Books.
5. Murphy, R. (1998). *Essential English Grammar*, (2nd Ed.). Cambridge University Press.
6. Sankaran, K., & Kumar, M. (2010). *Group Discussion and Public Speaking* (5th Ed.). M.I. Publications.
7. Trishna, K. S. (2012). *How to do well in GDs & Interviews*? (3rd Ed.). Pearson Education.
8. Yate, M. (2005). *Hiring the Best: A Manager's Guide to Effective Interviewing and Recruiting*

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	recall various soft skill sets	**K1**
CO2	understand personal effectiveness in any managerial positions	**K2**
CO3	apply verbal and non-verbal reasoning skills to solve problems	**K3**
CO4	differentiate problems at work and home; and design solutions to maintain work-life balance	**K4**
CO5	assess growth and sustainability and infuse creativity in employment that increases professional productivity	**K5**
CO6	construct plans and strategies to work for better human society	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**23PSS2SE01**			**Skill Enhancement Course:** Soft Skills					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	3	2	3	**2.7**
CO2	3	3	3	2	3	3	3	3	3	3	**2.9**
CO3	3	2	2	3	3	3	3	3	3	3	**2.8**
CO4	3	3	2	2	3	3	3	3	3	3	**2.8**
CO5	3	3	3	2	2	3	3	3	3	3	**2.8**
CO6	3	3	3	2	2	3	3	3	3	3	**2.8**
										Mean Overall Score	**2.8 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	23PCA3CC07	**Core Course -7:** Distributed Technologies	5	5

Course Objectives
To learn the concept of client server computing and various architectures
To study and experience the presentation and interaction concepts in distributed computing
To understand the features of components with the implementation of EJBs
To learn the database operations with Mongo DB and to experience the development APIs with Node and Express
To study the features of Angular in developing the SPAs and the technique of its interaction with Node server

UNIT I: Introduction Client-Server Technology **(15 Hours)**

Client server computing- classification of client server system- client server advantages and disadvantages. J2EE architecture - MVC architecture - .NET Framework.

UNIT II: Presentation Services **(15 Hours)**

Servlet - JSP - Javamail - Interaction services: RMI - XML and XSLT.

UNIT III: Component model: EJB **(15 Hours)**

Session Beans: Stateless and Stateful - Entity Beans- CMP and BMP - Web Services Architecture.

UNIT IV: Creation of application with node and Express **(15 Hours)**

Introduction - DATA MODEL with MONGODB: Connecting Express Application to MongoDB using Mongoose - Model the Data - Simple Mongoose Schema - MongoDB Shell to create MongoDB Database REST API: EXPOSE MONGODB DATABASE TO APPLICATION: Setting up API in Express - GET Methods: Reading Data from Mongo DB - POST Methods: Adding Data to MongoDB DELETE Method: Deleting Data from MongoDB.

UNIT V: Angular JS **(15 Hours)**

Angular environment setup - creation of an angular project, elements and execution - Flex - components and component communication- front-end tools - event handling - navigation - services - routing - Http client.

Teaching Methodology	Videos, PPT, Demonstration

Books for Study

1. Subhash, C.Y. (2009). *An Introduction to Client Server Computing*. New Age International (P) Limited.
   UNIT I Chapter 1
2. Couch, J., & Daniel, H. S. (2002). *J2EE Bible*. Wiley India (P) Ltd.
   UNIT I Chapter 1
   UNIT II Chapter 3, 5, 14 and 18
   UNIT III Chapter 16
3. Holmes, S. (2016). *Getting MEAN with Mongo, Express, Angular, and Node*. Manning Publications.
   UNIT IV Chapter 2 (Sec 5, 6)
4. Study Material for Unit V.

Books for Reference

1. Bodoff, S., Green, D., & Jendrock, E. (2002). *The J2EE tutorial*. Addison-Wesley.
2. Tremblett, P. (2001). *Instant Enterprise Java - Bean*. Tata McGraw Hill Publishing Company.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the concepts of distributed systems	**K1**
CO2	understand the services required for distributed systems	**K2**
CO3	create applications for the implementation of server	**K3**
CO4	evaluate and compare the technologies associated with presentation and interaction services.	**K4**
CO5	design applications that involve presentation, interaction, persistence and component technologies	**K5**
CO6	deploy applications using distributed technologies	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
3	**23PCA3CC07**			**Core Course - 7:** Distributed Technologies					**5**		**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes(PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	1	2	2	3	3	1	3	**2.2**
CO2	3	3	3	2	3	2	3	1	2	3	**2.5**
CO3	2	1	3	3	2	2	3	3	1	2	**2.2**
CO4	3	2	1	1	3	3	2	3	1	2	**2.1**
CO5	2	3	1	2	3	3	2	3	1	2	**2.2**
CO6	3	2	1	1	3	3	2	3	1	2	**2.1**
									Mean Overall Score		**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	23PCA3CC08	**Core Course - 8:** Computer Networks and Security	5	5

Course Objectives
To make students understand the profound influence and importance of computer networks and the Physical Layers.
To study the design issues principles of Data Link Layer and MAC Sublayer
To impart knowledge on various Routing and Congestion Control Algorithms in Network Layer.
To learn the important concepts of Transport Layer and its protocols.
To give an overview of the applications of Network and network related Security issues.

UNIT I: Introduction & The Physical Layer **(15 Hours)**

Uses of Computer Networks - Network Hardware - Network Software - Reference Models (OSI & TCP/IP Models) - Physical Layer: The Theoretical Basis for Data Communication - Guided Transmission Media -Wireless Transmission -Communication Satellites -The public switched Telephone Network.

UNIT II: Data Link Layer & MAC **(15 Hours)**

The Data Link Layer: Design Issues - Error Detection and Correction- Elementary Data Link Protocols -Sliding Window Protocols.MAC Sublayer Concepts: The Channel Allocation Problem - Multiple Access Protocols - Ethernet - Wireless LANS- Bluetooth - RFID.

UNIT III: Network Layer **(15 Hours)**

The Network Layer: Design Issues - Routing Algorithms: The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing, - Congestion Control Algorithms.

UNIT IV: The Transport Layer **(15 Hours)**

The Transport Layer: The Transport Service - Elements of Transport Protocols -Congestion Control - The Internet Transport Protocols: UDP - The Internet Transport Protocols: TCP.

UNIT V: Application Layer and Network Security **(15 Hours)**

The Application Layer: DNS - Electronic Mail - The world wide web - streaming audio and video. Network Security: Cryptography- Symmetric Key Algorithms -Public Key Algorithms - Digital Signatures.

Book for Study

1. Andrew, S. T., & David, J. W. (2019). *Computer Networks*, (5th Ed.). Pearson Education.
   UNIT I: Chapter 1 (1.1 - 1.4), Chapter 2 (2.1 - 2.4, 2.6)
   UNIT II: Chapter 3 (3.1 - 3.4), Chapter 4 (4.1 - 4.4, 4.6, 4.7)
   UNIT III: Chapter 5 (5.1 - 5.3)
   UNIT IV: Chapter 6 (6.1 - 6.5)
   UNIT V: Chapter 7 (7.1 - 7.4), Chapter 8 (8.1 - 8.4)

Books for Reference

1. Ahuja, V. (1985). *Design and Analysis of Computer Communication Networks*. McGraw Hill
2. Andrew, S. T. (1999). *Computer Networks*. Prentice Hall of India.
3. Behrouz, A. F. (2006). *Data Communications and Networking*, (4th Ed.). McGraw Hill.
4. Gregory, B. W., Eric, A. F., & Udo, W. P. (2017). *Computer System and Network Security*. CRC Press.

Websites and eLearning Sources

1. https://www.techtarget.com/searchnetworking/definition/network-security
2. https://www.geeksforgeeks.org/data-link-layer
3. https://www.geeksforgeeks.org/network-layer-services-packetizing-routing

4. https://www.geeksforgeeks.org/physical-layer-in-osi-model
5. https://www.javatpoint.com/computer-network-security

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the fundamental knowledge in computer network communication and security	**K1**
CO2	summarize the technical aspects of every layer of OSI reference model	**K2**
CO3	identify the issues in the layers of OSI reference model	**K3**
CO4	analyze the technical factors involved in network communication	**K4**
CO5	evaluate the network security issues and propose appropriate security solutions	**K5**
CO6	acquire the importance and necessity of network and security issues in real time situation	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**23PCA3CC08**			**Core Course - 8:** Computer Networks and Security						**5**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	1	2	2	2	2	1	**1.9**
CO2	3	2	3	2	1	3	2	2	2	1	**2.1**
CO3	3	2	3	2	1	3	3	2	2	1	**2.2**
CO4	3	3	3	3	2	3	3	3	2	1	**2.6**
CO5	3	3	3	2	1	3	3	3	3	2	**2.6**
CO6	3	3	3	2	1	3	3	3	3	2	**2.6**
										Mean Overall Score	**2.33 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	23PCA3CC09	**Core Course - 9:** Operations Research	5	4

Course Objectives
To formulate and solve linear programming problems
To impart knowledge in duality concept, transportation problem and assignment problem.
To capable of utilizing project scheduling techniques like PERT and CPM
To gain insights into the principles of Queueing Theory
To give solid foundation in game theory.

UNIT I: Linear Programming **(15 Hours)**

Formulations and Graphical solution to L.P. Problem- Simplex method - Degeneracy, Unbounded and infeasible solution - Two Phase Method.

UNIT II: Linear Programming (contd.) **(15 Hours)**

Duality-Primal and Dual Computations - Dual Simplex Method - Transportation problem and its solution - Assignment problem and its solution by Hungarian method.

UNIT III: PERT - CPM **(15 Hours)**

Phases of project scheduling - Arrow Diagram - Critical Path Method - Probability Considerations in Project Scheduling.

UNIT IV: Queueing Theory **(15 Hours)**

Queueing System - Characteristics of Queuing system - classification of queues - Poisson Queues - M/M/1 and M/M/C Queueing Models.

UNIT V: Game Theory **(15 Hours)**

Introduction - Two-Person Zero - Sum Games-Some Basic Terms - The Maximin- Minimax Principles - Games without Saddle points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games- Dominance Property.

Teaching Methodology	Lecture-based Instruction, PPT, Demonstration

Book for Study

1. Swarup, K., Gupta, P. K., & Man Mohan. (2013). *Operations Research*. Sultan Chand & Sons.
   UNIT I: Chapter 1 (Sec: 1:1-1:6, 1:10),
   Chapter 2
   Chapter 3 (Sec: 3:1-3:5),
   Chapter 4 (Sec: 4:1, 4:3, 4:4(only Two-Phase Method), and 4:5).
   UNIT II: Chapter 5 (Sec: 5:1-5:5, 5:7, 5:9),
   Chapter 10 (Sec: 10:1, 10:5-10:6, 10:8-10:10, 10:12-10:13, 10:15)
   UNIT III: Chapter 25 (Sec 25:1-25:7)
   UNIT IV: Chapter 21 (Sec: 21:1-21:9)
   UNIT V: Chapter 17 (Sec: 17:1-17:7

Books for Reference

1. Taha, A.H. (1987). *Operations Research-An Introduction,* (5th Ed.). Macmillan Publishing Co.
2. Gupta, P. K., Mohan, M. (1987). *Operations Research and Quantitative Analysis,* (1st Ed.). Sultan Chand & Sons.
3. Kalavathy, S. (2013). *Operations Research*. Vikas Publishing House Pvt. Ltd.

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the basic concepts of LPP, TP, AP, CPM, PERT, Queue and game theory	**K1**
CO2	understand the characteristics and relationships in LPP, TP, AP, CPM, PERT, Queue and game theory	**K2**
CO3	identify the activities, models, methods and procedures in LPP, TP, AP, CPM, PERT, Queue and game theory	**K3**
CO4	analyze and apply the procedure for problem solving in LPP, TP, AP, CPM, PERT, Queue and game theory	**K4**
CO5	select the suitable LPP, TP, AP, CPM, PERT, Queue and game theory to solve real-life problems	**K5**
CO6	discuss the usage of LPP, TP, AP, CPM, PERT, Queue and game theory for solving business problems	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**23PCA3CC09**			**Core Course - 9:** Operations Research						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	2	3	3	2	2	2	**2.4**
CO2	2	3	2	2	2	3	3	2	2	3	**2.4**
CO3	2	2	2	3	3	3	2	2	2	2	**2.3**
CO4	2	3	2	3	3	2	2	3	3	2	**2.5**
CO5	2	3	2	2	3	3	2	3	3	2	**2.5**
CO6	2	2	2	3	3	3	2	2	2	2	**2.3**
									Mean Overall Score		**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	23PCA3CP05	**Core Practical - 5:** Distributed Technologies	3	3

List of Exercises

1. RMI-Invocation of server side methods.
2. Servlets and JDBC
3. JSP - Use of script let.
4. JSP-use of java beans.
5. EJB-Session Bean.
6. EJB-Entity Bean.
7. XML Document Creation.
8. Presentation with XSLT.
9. AJAX: Dynamic client-server interaction.
10. Developing a web based application using the concepts studied.

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23PCA3CP06	**Core Practical - 6:** Web App Development Using MEAN	3	2

List of Exercises

Angular

1. Single Page Application with Multiple components and flex
2. Navigation and Event Handling
3. Services and Routing
4. Template driven and Reactive forms

Node and Express

5. Creation of Node server with APIs
6. Creation of APIs with different methods (get, post, head etc) and testing them with Postman
7. Express based Routing

MongoDB & RDBMS (My SQL)

8. 8. Data Modeling - CRUD Operations
9. 9. Connecting APIs with MongoDB
10. Connecting APIs with Relational Database

Project

11. Consuming APIs from Angular based SPA with CORS and HTTP

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23SCS3CC01	**Common Core:** Design and Analysis of Algorithms	5	4

Course Objectives
To develop the ability to analyze the running time and prove the correctness of basic algorithms.
To impart the students the knowledge of design and analysis of algorithms
To give importance to finding the complexity (order) of algorithms.
To understand the searching and sorting methods.
To designing algorithms for the various mathematical problems

UNIT I: Introduction to Algorithms **(15 Hours)**

Algorithm Definition - Algorithm Specification: Pseudo Code Conventions, Recursive Algorithms - Performance Analysis: Space Complexity, Time Complexity, Asymptotic Notations.

UNIT II: Divide and Conquer **(15 Hours)**

The General Method-Binary Search - Finding the Maximum and Minimum - Merge Sort - Quick Sort.

UNIT III: The Greedy Method **(15 Hours)**

Knapsack Problem - Job Sequencing with Deadlines - Minimum Cost Spanning Trees: Prims Algorithm, Kruskal's Algorithm - Single Source Shortest Paths.

UNIT IV: Dynamic Programming **(15 Hours)**

The General Method - Multistage Graphs - All-Pairs Shortest Paths - Optimal Binary Search Trees - 0/1-knapsack - Reliability Design - The Traveling Salesperson Problem.

UNIT V: Basic Traversal and Search Techniques **(15 Hours)**

Techniques for Graphs: Breadth First Search and Transversal, Depth First Search and Transversal-Backtracking: The General Method - The 8-Queens Problem.

Teaching Methodology	Chalk and Talk, PPT.

Book for Study

1. Horowitz, E., Sahni, S., & Rajasekaran, S. (2009). *Fundamentals of Computer Algorithms,* (2nd Ed.). Universities Press.

Unit I *Chapter 1 Sec 1.1,1.2, 1.3.1- 1.3.3*
Unit II *Chapter 3 (Sec 3.1-3.5)*
Unit III *Chapter 4 (Sec 4.2,4.4,4.5.1,4.5.2,4.8)*
Unit IV *Chapter 5 (Sec 5.1, 5.2,5.3,5.5,5.7,5.8,5.9)*
Unit V *Chapter 6,7(Sec 6.2.1, 6.2.2,7.1, 7.2)*

Books for Reference:

1. Bhasin, H. (2015). *Algorithms Design and Analysis.* Oxford University Press.
2. Rajesh, K. S. (2015). *Analysis and Design of Algorithm, A Beginner's Approach.* Wiley.
3. Thomas, H. C., Charles, E. L., Ronald, L. R., & Clifford Stein. (2012). *Introduction to Algorithms,* (3rd Ed.). PHI Learning Private Limited.

Course Outcomes		
CO No.	**CO-Statements** On Successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	choose the algorithmic procedure to determine the computational complexity of algorithms	**K1**
CO2	explain the stepwise procedure to solve the sorting and searching problems	**K2**
CO3	develop a deeper understanding of the building blocks of algorithms	**K3**
CO4	analyse an algorithm to discover its suitability for various applications	**K4**
CO5	explain various algorithms and methods of analysis	**K5**
CO6	Design the algorithms for solving different types of problems	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**23SCS3CC01**			**Common Core:** Design and Analysis of Algorithms						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	1	2	1	3	3	3	2	2	**2.2**
CO2	3	3	1	2	1	3	3	3	2	2	**2.3**
CO3	3	2	2	3	2	3	3	3	2	3	**2.6**
CO4	3	2	2	3	1	3	3	3	2	3	**2.5**
CO5	3	3	2	3	1	3	3	3	2	3	**2.6**
CO6	3	3	2	3	1	3	3	2	2	3	**2.5**
										Mean Overall Score	**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	23PCA3IS01	Internship	-	2

In the third semester of the MCA programme, students could embark on a one-month industry internship. This experience allows them to me apply their theoretical knowledge in a real-world setting, bridging the gap between classroom learning and professional experience. The internship program me for MCA students in Semester 3 is a crucial component of their academic journey. It provides a platform for practical application, ensuring a well-rounded education that prepares students for successful careers in the field of computer science. Adherence to the outlined process is crucial to the successful completion of the internship and subsequent academic progress.

Internship Process

1. **Internship Duration**
   The third semester is dedicated to a one-month internship in an organization equipped to facilitate MCA internships. The internship will be carried out immediately after the second semester examinations.
2. **Organization Selection**
   Students are responsible for choosing an organization and providing the relevant details to their project guide and Head of the Department.
3. **Requisition Letter**
   A requisition letter, endorsed by the HoD, is sent to the chosen organization, seeking approval for the internship. Students are permitted to send only one requisition letter at a time.
4. **Letter of Acceptance**
   Before commencing the internship, students must secure a formal letter of acceptance from the chosen organization.
5. **Approval Criteria**
   The project guide and HoD reserve the right to approve or suggest changes to the selected organization. This might occur if the company lacks the requisite computing infrastructure
6. **Commencement of Internship**
   Only upon receipt of the acceptance letter are students permitted to leave the College and join the chosen organization. The acceptance letter serves as confirmation of the organization's commitment to facilitate the student's MCA internship.
7. **External Guide Evaluation**
   The evaluation by the external guide in the organization carries a weightage of ten percent towards the final assessment.
8. **Joining Report and Progress Updates**
   Students are expected to join the organization within a week and submit a joining report by a specified date. They must subsequently email their progress reports to their guides every fifteen days.
9. **Review and Manuscript Submission**
   The review is conducted by the respective guides at the end of the internship. Alongside the review, students must submit a report detailing their internship experience in a prescribed format.
10. **Viva-Voce Examination**
    The viva-voce examination for the internship is conducted by both internal and external examiners in the date specified by the Head of the Department.

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**23PCA4PW01**	Project Work & Viva-Voce	**25**	**22**

PROJECT

The fourth semester is allotted to do a project work in an organization with sufficient infrastructure to carry out the MCA project work. The students would choose an organization and submit the details of the organization to the project guide and HoD. The students should send a requisition letter from the HoD to the organization and should get the letter of acceptance from the organization. The students can send only one such requisition letter at a time. Only after non-acceptance of the company, the student can request another organization for doing the project work. The guide and HoD have to approve the company / organization. In case of any change suggested by the guide or HoD, the student should change the organization. The change would be suggested by the guide & HoD if they find the company not having sufficient infrastructure for computing and an external guide in the organization with required educational qualification such as MCA or ME / MTech who can be external guides in the organization. Only upon the receipt of the acceptance letter, the student will be relieved from the College to join the company. They should submit the acceptance letter from the organization for having accepted the student for pursuing his/her MCA project work. The marks awarded by the external guide in the organization carries a weightage of ten percent.

The students would join the organization in the first week of December and send their joining report on or before the fixed date as fixed by the Department. The students will be supplied with all the details of what are to be done before and after joining the company. They should appear for first review mid-way and they will report the progress of their project work in the presence of their classmates and guide.

The students should send emails to their guides every fifteen days about their progress after joining the organization. Failure to submit the joining report and failure to be present for the first review (except under exempted circumstances by the Department of Computer Science due to long distance) will result in non-acceptance of their project work and such students would repeat the same procedure in the next academic year with the approval of the Principal, Controller of Examinations and the Department of Computer Science after the payment of the fees of the particular semester.

The students appear for the second review during the end semester examinations in the college along with the manuscript of the project work. The manuscript should be prepared along with the guidelines supplied to them by the Department; students should submit two volumes to the Department before the date fixed by the Department. The viva-voce of the project work would be conducted by both the internal and the external examiners along with semester examinations of the College.

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	23PCA4ES04A	**Elective - 4:** Recent Trends in Computer Science - 1	5	4

Course Objectives
To understand the concepts of data science.
To impart basic knowledge on edge computing.
To appreciate virtual reality modeling.
To expose applications of augmented reality.
To educate the importance of blockchain technology.

UNIT I: Data Science **(15 Hours)**

Introduction to Data Science - Case for Data Science - Data Science Classification - Data Science Algorithms - Data Science Process: Prior Knowledge - Data Preparation - Modelling - Application - Knowledge - Data Exploration: Objective of Data Exploration - Datasets - Descriptive Statistics - Data Visualization - Roadmap for Data Exploration.

UNIT II: Edge Computing **(15 Hours)**

Edge Computing Concept- Edge Computing Architecture, Edge Devices, Edge Server Cluster -Cloud Server - Background Essentials: IoT Devices, Sensors, RFID, actuators- Networking Architecture - Network Management and Control - Edge Computing State-of-the-Art- Interfaces and Devices - Edge Computing Simulators - Edge Data Analytics- Potential of Edge Analytics.

UNIT III: Virtual Reality **(15 Hours)**

Defining Virtual and Augmented Reality: Looking at Some Other Types of Virtual and Augmented Reality - Taking a Quick History Tour - Evaluating the Technology Hype Cycle - Exploring the Current State of Virtual Reality: Looking at the Available Form Factors - Focusing on Features - Considering Controllers - Recognizing the Current Issues with VR - Assessing Adoption Rates - Consuming Content in Virtual Reality: Exploring Consumer-Grade Virtual Reality - Identifying Near-Future Hardware - Comparing Current and Future Options.

UNIT IV: Augmented Reality **(15 Hours)**

Exploring the Current State of Augmented Reality: Looking at the Available Form Factors - Considering Controllers - Recognizing the Current Issues with Augmented Reality - Assessing Adoption Rates - Consuming Content in Augmented Reality: Exploring Consumer-Grade Augmented Reality - Identifying Near-Future Hardware - Comparing Current and Future Options.

UNIT V: Blockchain Technology **(15 Hours)**

Origin of Blockchain - Blockchain Solution - Components of Blockchain - Block in a Blockchain - The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction - Decentralization and Distribution - Types of Blockchain - Consensus Protocol.

Teaching Methodology	Videos, PPT, Demonstration.

Books for Study

1. Kotu, V., & Deshpande, B. (2018). *Data Science: Concepts and Practice*. Elsevier Science Publisher.
   UNIT I: Chapters 1, 2 & 3.
2. Kumari, M., Anith, K., Sadasivam, G. S., Dharani, D., & Niranjanamurthy. (2021). *Edge Computing: Fundamentals, Advances and Applications (Advances in Industry 4.0 and Machine Learning).* Taylor & Francis Ltd.
   UNIT II: Chapter 2, Chapter 3(Sec.:3.8, 3.9, 3.12)
3. Paul Mealy. *(2018). Virtual and Augmented Realities for Dummies.* John Wiley & Sons, Inc., NJ.
   UNIT III: Chapters 1, 2 & 4
   UNIT IV: Chapters 3 & 5

4. Chandramouli, S., Asha, A. G., Abhilash, K. A., & Meena Karthikeyan. (2021). *Blockchain Technology*. Universities Press (India) Private Limited.
   UNIT V: Chapter 1 & 2

Books for Reference

1. Hurley, R. (2020). *Data Science A Comprehensive Guide to Data Science, Data Analytics, Data Mining, Artificial Intelligence, Machine Learning, and Big Data.* Ationa Publications.
2. Steven, M. L. (2020). *Virtual Reality*. Cambridge University Press.
3. Schmalstieg, D., & Hollerer, T. (2016). *Augmented Reality*. Pearson Education.
4. Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). *Bitcoin and cryptocurrency technologies: a comprehensive introduction.* Princeton University Press.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	define and explain the fundamental concepts of recent trends in Computer Science.	**K1**
CO2	explain the technical aspects of the recent developments in Computer Science.	**K2**
CO3	apply the recent technologies for application development	**K3**
CO4	compare the various technologies for understanding the nuances of each technology	**K4**
CO5	choose the right technology for sustainable development	**K5**
CO6	create innovative applications using the recent trending technologies.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**23PCA4ES04A**			**Elective - 4:** Recent Trends in Computer Science - 1						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	3	3	3	2	3	**2.7**
CO2	3	2	3	2	2	2	2	2	3	2	**2.3**
CO3	2	3	2	3	3	3	2	2	2	2	**2.4**
CO4	2	2	3	2	3	2	2	3	3	3	**2.5**
CO5	3	3	2	1	2	2	2	3	3	2	**2.3**
CO6	2	2	3	2	2	3	3	2	2	3	**2.4**
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	23PCA4ES04B	**Elective - 4:** Recent Trends in Computer Science - 2	5	4

Course Objectives
To describe the concept of Computer Forensics and the types of Computer Forensics Technology.
To explain the basic concepts and technical aspects of Robotics.
To elucidate the basics of Big Data Technologies.
To investigate the various Email related issues and apply appropriate technologies to solve them.
To inculcate the values and ethics in engineering profession.

UNIT I: Computer Forensics Fundamentals **(15 Hours)**

Concept of Computer Forensics - Use of Computer Forensics in Law Enforcement - Computer Forensics Assistance to Human Recourses/Employment Proceedings - Computer Forensics Services - Benefits of Professional Forensics Methodology - Steps taken by Computer Forensics Specialists. Types of Computer Forensics Technology: Types of Military Computer Forensic Technology - Types of Law Enforcement - Types of Business Computer Forensic Technology - Specialized Forensics Techniques - Hidden Data - Spyware and Adware - Encryption Methods and Vulnerabilities - Protecting Data from being compromised - Internet Tracing Methods - Security and Wireless Technologies - Avoiding Pitfalls with Firewalls - Biometric Security Systems.

UNIT II: Robotics **(15 Hours)**

History of Robotics and Early Robots, Robots developed lately, Types of Robots, Future of Robots. Fundamentals of Robotics and Industrial Robots. Types and Applications: Domestic Invasion, Robot Wars, Precision Surgeons.

UNIT III: Big Data **(15 Hours)**

Overview of Big Data - History of Data Management - Evolution of Big Data - Structuring Big Data - Types of Data - Elements of Big Data - Big Data Analytics - Careers in Big Data - Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data - Introducing Hadoop - Cloud Computing and Big Data - In-Memory Computing Technology for Big Data. Understanding Hadoop Ecosystem: Hadoop Ecosystem - Hadoop Distributed File System - MapReduce - Features of MapReduce -Hadoop YARN - Hbase - Features of HBase - Hive - Pig and Pig Latin - Sqoop - ZooKeeper - Flume - Oozie.

UNIT IV: E-Mail Investigations **(15 Hours)**

The role of E-Mail in Investigations - The role of Client and Server in E-Mail - Investigating E-Mail Crimes and Violations - Understanding E-Mail Server - Using Specialized E-Mail Forensics Tools.

UNIT V: Ethics in Engineering Profession **(15 Hours)**

Engineering Profession - Technology and Society - Engineering as Social - Engineering Professionals - Engineering Ethics and Role of Engineers.

Teaching Methodology	Videos, PPTs, Demonstration.

Books for Study

1. Vacca, J. R. (2005). *Computer Forensics: Computer Crime Scene Investigation,* (2nd Ed.). Charles River Media, Inc., Boston.
   UNIT I: Chapter 1 (Pages 1 - 18), Chapter 2 (Pages 35 -72)
2. Singh, U. (2019). *Fundamentals of Robotics: Kitabwale*. New Delhi.
   UNIT II: Chapter 1, 2 and 3.
3. Book, B. (2016). *Big Data (Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization)*. Dreamtech Press.
   UNIT III: Chapters 1, 3 and 4.

4. Nelson, B., Phillips, A., & Steuart, C. (2010). *Guide to Computer Forensics and Investigations.* Cengage Learning India Private Limited, Delhi.
   UNIT IV: Chapter 12
5. Subramanian, R. (2017). *Professional Ethics.* Oxford University Press.
   UNIT V: Chapter 4

Books for Reference

1. Buhler, P. Khattak, W., & Erl, T. (2016). *Big Data Fundamentals: Concepts, Drivers & Techniques*. Prentice Hall Publications.
2. Mohanty, S., Jagadeesh, M., & Srivatsa, H. (2013). *Big Data Imperatives: Enterprise Big Data Warehouse,* BI Implementations and Analytics. Published by Apress Media.
3. Deb, S. R., & Deb, S. (2010). Robotics *Technology and Flexible Automation*. McGraw Hill Education Pvt. Ltd.

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	understanding the field of Computer Forensics and recall the types of Computer Forensics Technology	**K1**
CO2	designing the basic concepts and technical aspects of recent trends in computer science	**K2**
CO3	identifying the various recent techniques used in the real time applications	**K3**
CO4	analysing the various issues and apply appropriate technologies to solve them	**K4**
CO5	choosing the suitable technology mega trends for shaping the future of society	**K5**
CO6	develop applications for solving real life problems using recent technologies.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
4	**23PCA4ES04B**			**Elective - 4:** Recent Trends in Computer Science - 2					**5**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO**	**PO**	**PO**	**PO**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO**	
CO1	3	3	2	2	2	3	3	3	2	2	**2.5**
CO2	3	3	3	2	2	2	3	3	3	2	**2.6**
CO3	3	3	2	3	2	3	3	3	2	2	**2.6**
CO4	3	2	3	2	1	2	2	3	2	2	**2.2**
CO5	3	2	3	2	1	2	3	3	3	1	**2.3**
CO6	3	3	2	2	2	3	3	3	2	2	**2.5**
										Mean Overall Score	**2.45 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**23PCA4CE01**	Comprehensive Examination	-	2

UNIT I: Database Management Systems

Database System Concepts & Architecture - Data Modelling - SQL -Normalization - Transaction Processing and Concurrency Control - Database Recovery Techniques -Data Warehousing and Data Mining - Big Data and NoSQL.

UNIT II: Data Structures and Algorithms

Array and its Applications - Stack, Queue, Linked List - Trees, Binary Tree - Sets and Graphs.

UNIT III: Software Engineering

Software Process Models - Software Requirements - Software Design - Software Testing.

UNIT IV: Computer Networks

Data Communication - Network Models, OSI and TCP/IP Layers

UNIT V: Recent Trends in Computer Science

Cloud Computing - Internet of Things - Artificial Intelligence - Machine Learning

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	23PCA1BC01	Bridge Course	30	2

Course Objectives
To provide the basic Concepts in Information Technology
To provide the concepts of mathematical logic and discrete structures
To provide the techniques for solving problems
To understand the fundamental syntax and concepts of C programming, Control statements and Looping structures
To write programs using various control structures, strings, arrays and pointers.

UNIT I: Fundamentals of Information Technology

Introduction to Computers - Generation of Computers - Classification of Digital Computer - Anatomy of Digital Computer. CPU and Memory - Secondary Storage Devices - Input Devices - Output Devices. Introduction to Computer Software - Programming Language - Operating Systems - Introduction to Database Management System.

UNIT II: Mathematical Foundations for Computer Science

Mathematical Logic: Statements and Notation - Connectives-Statement. Formulas and Truth Tables - Tautologies - Equivalence of Formulas - Duality Law. Tautological implications.

UNIT III: Problem Solving Techniques

Algorithms - Flow charts - Developing algorithms and flowcharts for solving simple problems using sequential, selection and iterative programming Structures.

UNIT IV: Programming in C

Structure of a C program - Data Types - Constants and Variables - Operators and Expressions - Control structures - Looping structures. Arrays - Functions - Built-in-functions - User defined functions - Scope of Variables - Passing Arrays to function - Strings and pointers.

UNIT V: Coding Practices

Simple Programs using Operators - Branching structures - Looping structures - Arrays Strings - Functions - Structures - Union - Pointers.

Teaching Methodology	Lecture-based instruction, Demonstration

Books for Study

1. Leon, A., & Leon, M. (2009). *Fundamentals of Information Technology*, (2nd Ed.). Vikas Publishing House Pvt. Ltd. (UNIT I)
2. Tremblay, J. P., & Manohar, R. (2008). *Discrete Mathematical Structures with Applications to Computer Science*, (1st Ed.). McGraw-Hill International Edition, India. (UNIT II)
3. Jaiswal, S. (2009). *Information Technology Today*, (4th Ed.). Galgotia Publications, New Delhi, India. (UNIT III)
4. Balagurusamy, E. (2016). *Programming in ANSI C*, (7th Ed.). Tata McGraw Hill Education Private Limited, India. (UNIT IV, V)

Books for Reference

1. Gottfried, B., & Schaum's. (2018). Outline Programming with C, (4th Ed.). Tata McGraw Hill Education Private Limited, India.
2. Kernighan., & Ritchie. (1998). The C Programming Language, (2nd Ed.). Prentice Hall, India.
3. Kanetkar, Y. (2021). Let Us C, (18th Ed.). BPB Publications, India.