ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai Accredited by NBA and NAAC with "A+" and Recognized by UGC (2f&12B)
KOMARAPALAYAM-637303
www.excelinstitutions.com

MASTER OF COMPUTER APPLICATIONS

CURRICULUM & SYLLABUS

REGULATIONS 2023

EXCEL ENGINEERING COLLEGE

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DEPARTMENT OF COMPUTER APPLICATIONS
MCA
REGULATION-2023

PROGRAMME SPECIFIC OBJECTIVES (PSOs):

PSO1: Build strong software using programming and system design.

PSO2: Use new technologies like AI, IoT, and Cloud to solve problems.

PSO3: Show leadership and innovation in real projects and startups.

PROGRAMME OUTCOMES (POS):

At the end of the programme, graduates will be able to:

PO1: Use computer and math knowledge to solve problems.

PO2: Find and understand problems in computing.

PO3: Create software or systems to meet specific needs.

PO4: Do research and analyze data to solve computing issues.

PO5: Use modern tools and software for computing tasks.

PO6: Follow ethics and laws in the computing profession.

PO7: Keep learning new technologies throughout life.

PO8: Manage projects and understand financial aspects.

PO9: Communicate well through reports, talks, and writing.

PO10: Understand how computing affects society and the environment.

PO11: Work well alone or in a team.

PO12: Be creative and use ideas to build useful products or services.

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MCA- I to IV Semesters Curriculum

I– SEMESTER									
Code No.	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course(s)									
23PMC101	Statistics and Numerical Methods	FC	3	1	0	4	40	60	100
23PMC102	Python Programming	PC	3	1	0	4	40	60	100
23PMC103	Advance Data Structures and Algorithms	PC	3	1	0	4	40	60	100
23PMC104	Object Oriented Software Engineering	PC	3	0	0	3	40	60	100
23PMC105	Research Methodology and IPR	RMC	3	0	0	3	40	60	100
23PMCP01	Quantitative Aptitude and Logical Reasoning - I	EC	3	0	0	0	100	0	100
Theory with Practical Courses									
23PMC106	Advance Database Technology	PC	3	0	2	4	50	50	100
Practical Course									
23PMC107	Advance Data Structures and Algorithms Laboratory	PC	0	0	4	2	60	40	100
23PMC108	Python Programming Laboratory	PC	0	0	4	2	60	40	100
TOTAL			**21**	**3**	**10**	**26**	**470**	**430**	**900**

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II-SEMESTER									
Code No.	Course	Category	Periods/Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
23PMC201	Data Communication Networks	PC	3	0	0	3	40	60	100
23PMC202	Advanced Java Programming	PC	3	1	0	4	40	60	100
23PMC203	Cloud Computing Technologies	PC	3	1	0	4	40	60	100
23PMC204	Scripting Languages	PC	3	1	0	4	40	60	100
23PMCAXX	Professional Elective-I	PE	2	0	2	3	40	60	100
23PMCP02	Quantitative Aptitude and Logical Reasoning - II	EC	3	0	0	0	100	0	100
Theory with Practical Courses									
23PMC205	Statistical Computing with R Programming	FC	3	0	2	4	50	50	100
Practical Course									
23PMC206	Scripting Languages Laboratory	PC	0	0	4	2	60	40	100
23PMC207	Advanced Java Programming Laboratory	PC	0	0	4	2	60	40	100
TOTAL			**20**	**3**	**12**	**26**	**470**	**430**	**900**

III–SEMESTER									
Code No.	Course	Category	Periods/ Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
23PMC301	AI and Machine Learning	PC	3	1	0	4	40	60	100
23PMC302	Blockchain and cryptocurrency	PC	3	0	0	3	40	60	100
23PMC303	Internet of Things	PC	3	1	0	4	40	60	100
23PMCAXX	Professional Elective-II	PE	3	0	0	3	40	60	100
23PMCAXX	Professional Elective-III	PE	3	0	0	3	40	60	100
Theory with Practical Courses									
23PMC304	Mobile Application Development	PC	3	0	2	4	50	50	100
Practical Course									
23PMC305	Internet of Things Laboratory	PC	0	0	4	2	60	40	100
23PMC306	Mini Project	EC	0	0	4	2	60	40	100
TOTAL			**18**	**2**	**10**	**25**	**370**	**430**	**800**

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IV–SEMESTER									
Code No.	**Course**	**Category**	**Periods/ Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Practical Course									
23PMC401	Major Project	EC	0	0	24	12	50	50	100
TOTAL			**0**	**0**	**24**	**12**	**50**	**50**	**100**

PROFESSIONAL ELECTIVE – I SEMESTER – II									
Code No.	**Course**	**Category**	**Periods/ Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23PMCA01	Software Testing and Quality Assurance	PE	3	0	0	3	40	60	100
23PMCA02	Data Warehousing and Data Mining	PE	3	0	0	3	40	60	100
23PMCA03	Digital Image Processing	PE	3	0	0	3	40	60	100
23PMCA04	Middleware Technologies	PE	3	0	0	3	40	60	100
23PMCA05	Mobile Computing	PE	3	0	0	3	40	60	100
23PMCA06	Generative AI and Automation	PE	2	0	2	3	40	60	100

PROFESSIONAL ELECTIVE – II SEMESTER – III									
Code No.	**Course**	**Category**	**Periods/ Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
23PMCA21	Supply Chain Management	PE	3	0	0	3	40	60	100
23PMCA22	Organizational Behavior	PE	3	0	0	3	40	60	100
23PMCA23	Management Information Systems	PE	3	0	0	3	40	60	100
23PMCA24	Agile Methodologies	PE	3	0	0	3	40	60	100
23PMCA25	Enterprise Resource Planning	PE	3	0	0	3	40	60	100
23PMCA26	Social Network and Business System	PE	3	0	0	3	40	60	100

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23PMCA27	Ethical Hacking & Cyber Forensics	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE – III SEMESTER – III

Code No.	Course	Category	Periods/ Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
23PMCA41	Service Oriented Architecture	PE	3	0	0	3	40	60	100
23PMCA42	Big Data Analytics	PE	3	0	0	3	40	60	100
23PMCA43	Database Tuning	PE	3	0	0	3	40	60	100
23PMCA44	Software Reliability Engineering	PE	3	0	0	3	40	60	100
23PMCA45	c# and ASP .Net programming	PE	3	0	0	3	40	60	100
23PMCA46	Natural Language Processing	PE	3	0	0	3	40	60	100
23PMCA47	Cyber Security	PE	3	0	0	3	40	60	100
23PMCA48	Computer Graphics and 3D Modeling for XR	PE	3	0	0	3	40	60	100
23PMCA49	Quantum Computing	PE	3	0	0	3	40	60	100

S.No	CATEGORY	CREDITS PER SEMESTER							
		I	II	III	IV	MIN	MAX	TOTAL CREDIT	CREDITS in%
1	FC	04	04			08	8	08	09.0%
2	PC	19	19	17		55	55	55	61.80%
3	PE		03	06		09	9	09	10.10%
4	EC			02	12	14	14	14	15.70%
5	RMC	03				03	03	03	03.40%
TOTAL		26	26	25	12	89	89	89	100

FC - Foundation Course
PC - Professional Course
PE -Professional Elective
EC-Employability Course
RMC-Research Methodology Course

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BRIDGE COURSES

For the MCA Students admitted under Non-Computer Science background category

Semester-I						
Code No.	Course	Category	Periods/ Week			
			L	T	P	C
23PMCB01	Fundamentals of Computers	BC	3	0	0	0
23PMCB02	Mathematical Foundation of Computer Science	BC	3	0	0	0

Semester-II						
Code No.	Course	Category	Periods/ Week			
			L	T	P	C
23PMCB03	Object Oriented Programming Using C++	BC	3	0	0	0
23PMCB04	Computer Organization	BC	3	0	0	0

Bridge Course shall be conducted to the students **admitted under non-computer-science background category**, the grades obtained for the prescribed bridge courses will appear on the grade sheet, but will **not be considered for GPA/CGPA calculation. It will be evaluated internally.**

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23PMC101	Statistics and Numerical Methods	L	T	P	C
		3	1	0	4
Nature of Course	Foundation Course (FC)				
Pre requisites	Fundamentals of Statistics				

Course Objectives

The course is intended

1. To enrolling and studying this course the students will be able to understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically
2. To Summarize and apply the methodologies involved in solving problems related to ordinary and partial differential equations
3. To Develop the art of correlating the data and analyze the data using variance
4. To Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions
5. To be using the skills learned in their interactive and supporting environment Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Classify the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically.	Understand
CO 2	Demonstrate and obtain the differentiation and Integration of functions using the numerical techniques.	Understand
CO 3	Obtain the solutions of all types of differential equations, numerically.	Apply
CO 4	Apply Correlation and Regression to predict the relevant outcome in real life.	Apply
CO 5	Design an experiment for an appropriate situation using ANOVA technique	Analyze

Course Contents

Module – I	SOLUTION OF EQUATIONS, EIGENVALUES AND EIGENVECTORS	9
Solution of algebraic and transcendental equations: Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Power method		
Module – II	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**
Interpolation: Newton's forward and backward interpolation formulae - Numerical differentiation: Newton's forward and backward interpolation formulae. Numerical integration: Trapezoidal rule- Simpson's1/3 rule for single integrals- Two point Gaussian quadrature formula.		

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Module – III	NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS	9

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Solution of first order ordinary differential equations: Fourth order Runge- Kutta method - Solution of partial differential equations: Elliptic equations: Poisson's equation- Parabolic equations by Crank Nicholson method- Hyperbolic equations by explicit finite difference method.		
Module – IV	**CORRELATION AND REGRESSION**	**9**
Correlation- Multiple correlation -Regression – Multiple Regression-Linear fit- Quadratic fit.		
Module – V	**DESIGN OF EXPERIMENTS**	**9**
One way and two way classifications – Completely randomized design – Randomized blockdesign – Latin square design – 2^2 factorial design.		
		Total : 45 Periods

Text Books

1. Steven Chapra , Numerical Methods for Engineers , Tata McGraw Hill Seventh Edition, 2019.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2017.

Reference Books

1. Walpole R.E, Myers R.H, Myers R.S.L and Ye K, Probability and Statistics for Engineers and Scientists, Seventh Edition, Pearsons Education, Delhi, 2018.
2. Burden R. L and Douglas Faires J, Numerical Analysis Theory and Applications, CengageLearning, Ninth Edition, 2019.
3. Gerald C. F and Wheatley P.O, Applied Numerical Analysis, Seventh Edition, Pearson Education,New Delhi, 2019.

Additional References

1. nptel.ac.in/courses/111/105/111105121
2. nptel.ac.in/courses/122/104/122104017

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3		3							2	1	2	1
CO 2	3	2	3		3							2	3	2	3
CO 3	3	2	3		3							2	2	2	2
CO 4	3	2	3		3							2	2	2	2

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CO 5	3	2	3		3							2	3	2	3
	3-High				**2-Medium**				**1-Low**						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyse	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC102	**Python Programming**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Nature of Course	Professional Course (PC)				
Pre requisites	Fundamentals of Object Oriented Programming Language				

Course Objectives

The course is intended

1. To develop Python programs with conditionals, loops and functions.
2. To use Python data structures – lists, tuples, dictionaries.
3. To do input/output with files in Python
4. To use modules, packages and frameworks in python
5. To define a class with attributes and methods in python

On successful completion of the course the students will be able to

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CO.No	Course Outcome	Bloom's Level
CO 1	Develop algorithmic solutions to simple computational problems	Understand
CO 2	Represent compound data using Python lists, tuples and dictionaries.	Understand
CO 3	Read and write data from/to files in Python Programs	Apply
CO 4	Structure simple Python programs using libraries, modules etc.	Apply
CO 5	Structure a program by bundling related properties and behaviours into individual objects.	Analyze

Course Contents

Module – I	**BASICS OF PYTHON**	**9**
Introduction to Python Programming - Python Interpreter and Interactive Mode- Variables and Identifiers - Arithmetic Operators - Values and Types - Statements. Operators - Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements - While Loop - For Loop - Break Statement-Continue statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions		
Module – II	**DATA TYPES IN PYTHON**	**9**
Lists, Tuples, Sets, Strings, Dictionary, Modules: Module Loading and Execution - Packages - Making Your Own Module - The Python Standard Libraries.		
Module – III	**FILE HANDLING AND EXCEPTION HANDLING**	**9**
Files: Introduction - File Path - Opening and Closing Files - Reading and Writing Files -File Position -Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions		
Module – IV	**MODULES, PACKAGES AND FRAMEWORKS**	**9**
Modules: Introduction – Module Loading and Execution – Packages – Making Your Own Module – The Python Libraries for data processing, data mining and visualization- NUMPY, Pandas, Matplotlib, Plotly-Frameworks- -Django, Flask, Web2Py		
Module – V	**OBJECT ORIENTED PROGRAMMING IN PYTHON**	**9**
Creating a Class, Class methods, Class Inheritance, Encapsulation, Polymorphism, class method vs. static methods, Python object persistence.		
		Total : 45 Periods

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Text Books

1. Reema Thareja, “Python Programming using Problem Solving Approach”, Oxford University Press, First edition, 2021

2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, Shroff, O‘Reilly Publishers, 2021 (http://greenteapress.com/wp/thinkpython/)

Reference Books

1. Guido van Rossum, Fred L. Drake Jr., “An Introduction to Python – Revised and Updated for Python 3.2, Network Theory Ltd., First edition, 2021

2. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press, 2021

3. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley India Edition, First Edition, 2020

Additional References

1. https://nptel.ac.in/courses/106106182
2. https://programming-22.mooc.fi/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3		3							2		3	2
CO 2	3	2	3		3							2		3	2
CO 3	3	2	3		3							2		3	2
CO 4	3	2	3		3							2		3	2
CO 5	3	2	3		3							2		3	2
	3-High				**2-Medium**				**1-Low**						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC103	**Advance Data Structures and Algorithms**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Nature of Course	Professional Course (PC)				
Pre requisites	Fundamentals of Data Structures				

Course Objectives

The course is intended

1. To understand the usage of algorithms in computing
2. To learn and use hierarchical data structures and its operations
3. To learn the usage of graphs and its applications
4. To select and design data structures and algorithms that is appropriate for problems
5. To study about NP Completeness of problems

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Design data structures and algorithms to solve computing problems.	Apply
CO 2	Choose and implement efficient data structures and apply them to solve problems.	Apply
CO 3	Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.	Analyze
CO 4	Design one's own algorithm for an unknown problem.	Analyze
CO 5	Apply suitable design strategy for problem solving.	Analyze

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Course Contents

Module – I	**ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS**	**9**
Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms-Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms Program performance measurement - Recurrences: The Substitution Method – The RecursionTree Method- Data structures and algorithms.		
Module – II	**HIERARCHICAL DATA STRUCTURES**	**9**
Binary Search Trees: Basics - Querying a Binary search tree - Insertion and Deletion- Red Black trees: Properties of Red-Black Trees - Rotations - Insertion - Deletion -B-Trees: Definition of B - trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation - Disjoint Sets - Fibonacci Heaps: structure - Merge able-heap operations Decreasing a key and deleting a node-Bounding the maximum degree.		
Module – III	**GRAPHS**	**9**
Elementary Graph Algorithms: Representations of Graphs - Breadth-First Search - Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman- For algorithm Single-Source Shortest paths in Directed Acyclic Graphs Dijkstra's Algorithm Dynamic Programming All Pairs Shortest Paths: Shortest Paths and Matrix Multiplication - The Floyd-Warshall Algorithm		
Module – IV	**ALGORITHM DESIGN TECHNIQUES**	**9**
Dynamic Programming: Matrix-Chain Multiplication - Elements of Dynamic Programming - Longest Common Subsequence- Greedy Algorithms: - Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.		
Module – V	**NP COMPLETE AND NP HARD**	**9**
NP-Completeness: Polynomial Time - Polynomial-Time Verification - NP- Completeness and Reducibility - NP-Completeness Proofs - NP-Complete Problems.		
		Total : 45 Periods

Text Books

1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2020.

2. Adam Drozdex, "Data Structures and Algorithms in C++", Cengage Learning, 4th Edition, 2021.

3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2021.

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Reference Books

1. Mark Allen Weiss, “Data Structures and Algorithms in C++”, Pearson Education,3rd Edition, 2020.

2. E. Horowitz, S. Sahni and S. Rajasekaran, “Fundamentals of Computer Algorithms”,University Press, 2nd Edition, 2019.

3.Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2018.

Additional References

1. https://nptel.ac.in/courses/106102064
2. https://nptel.ac.in/courses/106102076

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	2	3							2	2	3	2
CO 2	3	2	3	2	3							2	2	3	2
CO 3	3	2	3	2	3							2	2	3	2
CO 4	3	2	3	2	3							2	2	3	2
CO 5	3	2	3	2	3							2	2	3	2
	3-High				**2-Medium**				**1-Low**						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC104	**Object Oriented Software Engineering**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Course (PC)				
Pre requisites	Basics of Software Engineering				

Course Objectives

The course is intended

1. To understand the phases in object oriented software development
2. To gain fundamental concepts of requirements engineering and analysis.
3. To know about the different approach for object oriented design and its methods
4. To learn about how to perform object oriented testing and how to maintain software
5. To provide various quality metrics and to ensure risk management.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Design object oriented software using appropriate process models.	Understand
CO 2	Differentiate software processes under waterfall and agile methodology.	Understand
CO 3	Design and Develop UML diagrams for software projects.	Analyze

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CO 4	Apply Design Patterns for a software process.	Analyze
CO 5	Categorize testing methods and compare different testing tools for software processes.	Analyze

Course Contents

Module – I	**SOFTWARE DEVELOPMENT AND PROCESS MODELS**	**9**
Introduction to Software Development - Challenges - An Engineering Perspective - Object Orientation - Software Development Process - Iterative Development Process - Process Models - Life Cycle Models - Unified Process - Iterative and Incremental - Agile Processes.		
Module – II	**MODELING OO SYSTEMS**	**9**
Object Oriented Analysis (OOA / Coad-Yourdon), Object Oriented Design (OOD/Booch), Hierarchical Object Oriented Design (HOOD), Object Modeling Technique (OMT) - Requirement Elicitation - Use Cases - SRS Document - OOA - Identification of Classes and Relationships, Identifying State and Behavior – OOD - Interaction Diagrams – Sequence Diagram – Collaboration Diagrams - Unified Modeling Language and Tools.		
Module – III	**DESIGN PATTERNS**	**9**
Design Principles - Design Patterns - GRASP - GoF - Dynamic Object Modeling - Static Object 12 Modeling.		
Module – IV	**SYSTEM TESTING**	**9**
Software testing: Software Verification Techniques - Object Oriented Checklist :- Functional Testing - Structural Testing - Class Testing - Mutation Testing - Levels of Testing - Static and Dynamic Testing Tools - Software Maintenance - Categories - Challenges of Software Maintenance - Maintenance of Object Oriented Software - Regression Testing		
Module – V	**SOFTWARE QUALITY AND METRICS**	**9**
Need of Object Oriented Software Estimation - Lorenz and Kidd Estimation - Use Case Points Method - Class Point Method - Object Oriented Function Point - Risk Management - Software Quality Models - Analyzing the Metric Data - Metrics for Measuring Size and Structure - Measuring Software Quality - Object Oriented Metrics		
		Total : 45 Periods

Text Books

1. Yogesh Singh, RuchikaMalhotra, " Object - Oriented Software Engineering", PHI Learning Private Limited ,First edition,2020
2. Ivar Jacobson. Magnus Christerson, PatrikJonsson, Gunnar Overgaard, "Object Oriented Software Engineering, A Use Case Driven Approach", Pearson Education, Seventh Impression, 2021
3. Craig Larman, "Applying UML and Patterns, an Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson Education, Third Edition, 2019.

Reference Books

1.Grady Booch, 13 Kelli A. Houston, "Object Oriented Analysis & Design with Applications, Third Edition, Pearson Education,2021.
2.Roger S. Pressman, "Software Engineering: A Practitioner's Approach, Tata McGraw-Hill Education, 8th Edition, 2020.

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Additional References

1. https://nptel.ac.in/courses/106105182
2. https://www.mooc-list.com/tags/software-engineering

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	3	2	3							2	2	3	2
CO 2	3	2	3	2	3							2	2	3	2
CO 3	3	2	3	2	3							2	2	3	2
CO 4	3	2	3	2	3							2	2	3	2
CO 5	3	2	3	2	3							2	2	3	2
	3-High				**2-Medium**				**1-Low**						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMC105	Research Methodology and IPR	L	T	P	C
		3	0	0	3
Nature of Course	Research Methodology Course (RMC)				
Pre requisites	Basics of Research Methodology				

Course Objectives

The course is intended

1. To give an overview of the research methodology and explain the technique of defining a research problem
2. To explain the functions of the literature review in research. To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
3. To explain various research designs and their characteristics.
4. To explain the details of sampling designs, and also different methods of data collections.
5. To explain the art of interpretation and the art of writing research reports.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Understand the research problem and research process.	Understand
CO 2	Understand research ethics .	Understand
CO 3	Prepare a well-structured research paper and scientific presentations	Analyze
CO 4	Explore on various IPR components and process of filing.	Analyze
CO 5	Understand the adequate knowledge on patent and rights	Understand

Course Contents

Module – I	RESEARCH DESIGN	6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.		
Module – II	**DATA COLLECTION AND SOURCES**	**6**
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.		
Module – III	**DATA ANALYSIS AND REPORTING**	**6**
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation		
Module – IV	**INTELLECTUAL PROPERTY RIGHTS**	**6**

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Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.		
Module – V	**PATENTS**	**6**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.		
		Total : 30 Periods

Text Books

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2020).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2019.

Reference Books

1. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2018.
2. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2019.

Additional References

1. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
2. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/330

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	2	3						2		3	2	2
CO 2	3	2	3	2	3						2		3	2	2
CO 3	3	2	3	2	3						2		3	2	2
CO 4	3	2	3	2	3						2		3	2	2
CO 5	3	2	3	2	3						2		3	2	2
	3-High				2-Medium				1-Low						

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCP01	**QUANTITATIVE APTITUDE AND LOGICAL REASONING - I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**0**
Nature of Course	Employability Course (EC)				
Pre requisites	Basics Mathematics				

Course Objectives

The course is intended to

1. Learn the basic of ratio and proportion.
2. Calculate different ways of solving problems on ages and chain rule.
3. Grasp average and percentage concepts through shortcuts.
4. Know about coding and decoding through logical way.
5. Learn the logical skills by analyzing the objects

Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	**Solve most of the aptitude topics by knowing ratio and proportion topics.**	**Apply**

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CO2.	**Solve the problems on ages by using logical way of approach.**	**Apply**
CO3.	**Calculate percentages and averages in real life contexts.**	**Apply**
CO4.	**Enhance the logical way of thinking by solving problems codes and rankings concepts.**	**Apply**
CO5.	**Develop their logical thinking.**	**Apply**

Course Contents

Module – I	**RATIO & PROPORTION**	**6**
Ratio And Proportion: Ratio between two or more persons – Miscellaneous problems		
Module – II	**PROBLEM ON AGES & CHAIN RULE**	**6**
Problems On Ages: Ages - Persons in Past - Present - Future. Miscellaneous problem. **Chain Rule:** Definition – Direct proportion and Indirect proportion.		
Module – III	**AVERAGES & PERCENTAGE**	**6**
Averages: Average from total -Total from the average - Miscellaneous problems. **Percentage:** Percentage - Percentage using shortcuts.		
Module – IV	**LOGICAL SEQUENCE OF WORD, CODING AND DECODING, NUMBER RANKING & TIME SEQUENCE TEST**	**6**
Logical Sequence Of Words: Sequence of occurrence of events – Sequence of objects in a class or group – Sequence of increasing/decreasing size, value, intensity, etc. **Coding And Decoding:** Introduction – Description of coding method, Coding patterns – Concepts of coding & decoding – Problems involving coding & decoding method.		
Module – V	**ANALOGY & SPOTTING THE ERROR**	**6**
Analogy: Objectives – 8 Vital Templates of Analogies - Types **. Spotting The Error**: Basic Grammar - Rules of Grammar – Subject Verb Agreement - Parts of Speech - Objectives of Error Spotting – Types of Error Spotting		
		Total : 30 Periods

Text Books

1. Dr.R S Aggarwal, Quantitative Aptitude, Revised and Enlarged Edition, S.Chand Publishing Company Ltd, 2020.
2. Arun Sharma "How to Prepare for Quantitative Aptitude"Eight Edition, McGraw Hill Education, 2021.
3. "Reasoning and Aptitude" for GATE and ESE Prelims, Made Easy Publication,2020.

Reference Books

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2020
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2021.
3. R.V.Praveen,"Quantitative Aptitude and Reasoning"Third Edition, PHI Learning ,2020.

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Additional Reference

1. https://www.youtube.com/watch?v=80QQ97TDZCQ
2. https://www.youtube.com/playlist?list=PLh-uxFrOdsq-e-HWJfz3l6h0cjgwsjiUm

23PMC106	Advance Database Technology	L	T	P	C
		2	0	4	3
Nature of Course	Professional Course (PC)				
Pre requisites	Basics of database				

Course Objectives

The course is intended

1. To understand the working principles and query processing of distributed databases.
2. To understand the basics of spatial, temporal and mobile databases and their applications.
3. To distinguish the different types of NoSQL databases.
4. To understand the basics of XML and create well-formed and valid XML documents.
5. To gain knowledge about information retrieval and web search.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Design a distributed database system and execute distributed queries.	Understand
CO 2	Manage Spatial and Temporal Database systems and implement it in corresponding applications.	Apply
CO 3	Use NoSQL database systems and manipulate the data associated with it.	Apply
CO 4	Design XML database systems and validate with XML schema.	Analyze
CO 5	Apply knowledge of information retrieval concepts on web databases.	Apply

Course Contents

Module – I	DISTRIBUTED DATABASES	6
Distributed Systems – Introduction – Architecture – Distributed Database Concepts – Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control - Distributed Query Processing		
Module – II	**SPATIAL AND TEMPORAL DATABASES**	**6**
Active Databases Model – Design and Implementation Issues - Temporal Databases - Temporal Querying - Spatial Databases: Spatial Data Types, Spatial Operators and Queries - Spatial Indexing and Mining - Applications.		
Module – III	**NOSQL DATABASES**	**6**

NoSQL – CAP Theorem – Sharding - Document based – MongoDB Operation: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding-Cassandra: Data Model, Key Space, Table Operations, CRUD Operations, CQL Types – HIVE: Data types, Database Operations, Partitioning – HiveQL – OrientDB Graph database – OrientDB Features.

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Module – IV	**XML DATABASES**	**6**
Structured, Semi structured, and Unstructured Data - XML Hierarchical Data Model - XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery		
Module – V	**INFORMATION RETRIEVAL AND WEB SEARCH**	**6**
IR concepts – Retrieval Models – Queries in IR system – Text Pre-processing – Inverted Indexing - Evaluation Measures - Web Search and Analytics - Current trends.		
		Total : 30 Periods

Text Books

1.Abraham Silberschatz, Henry F Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020
2.R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education/Addison Wesley, 2020.
3.Guy Harrison, "Next Generation Databases, NoSQL, NewSQL and Big Data", First Edition, Apress publishers, 2021

Reference Books

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann, 2019.
2. Brad Dayley, "Teach Yourself NoSQL with MongoDB in 24 Hours", Sams Publishing, First Edition, 2019
3.C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2020

Additional References

1. https://nptel.ac.in/courses/106105175
2. https://www.classcentral.com/course/advanced-rdb-sql-20181

S.No	List of Exercises	CO Mapping	RBT

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1	**NOSQL Exercises** MongoDB – CRUD operations, Indexing, Sharding Cassandra: Table Operations, CRUD Operations,CQLTypes HIVE:Data types,Database Operations, Partitioning – HiveQL OrientDB Graph database – OrientDB Features	CO1	Apply
2	MySQL Database Creation, Table Creation, Query	CO1	Apply
3	MySQL Replication – Distributed Databases	CO1	Apply
4	Spatial data storage and retrieval in MySQL	CO2	Apply
5	Temporal data storage and retrieval in MySQL	CO3	Apply
6	Object storage and retrieval in MySQL	CO4	Apply
7	XML Databases , XML table creation, XQuery FLWOR expression	CO4	Analyze
8	Mobile Database Query Processing using open source DB (MongoDB/MySQL etc)	CO5	Analyze
			Total : 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	1	3	2	3								3	2	2
CO 2	3	1	3	2	3								3	2	2
CO 3	3	1	3	2	3								3	2	2
CO 4	3	2	3	2	3								3	2	2
CO 5	3	2	3	2	3								3	2	2
	3-High				**2-Medium**				**1-Low**						

Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [50 marks]**	**Final Examinations [50 marks]**

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Remember	0	0
Understand	20	50
Apply	30	50
Analyse	20	50
Evaluate	0	0
Create	0	0

23PMC107	Advanced Data Structures and Algorithms Laboratory	L	T	P	C
		0	0	4	2
Nature of Course	Practical				
Pre requisites	Basics of Data Structures				

Course Objectives

The course is intended

1. To acquire the knowledge of using advanced tree structures
2. To learn the usage of heap structures
3. To understand the usage of graph structures and spanning trees
4. To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
5. To understand the necessary mathematical abstraction to solve problems.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Design and implement basic and advanced data structures extensively	Understand
CO 2	Design algorithms using graph structures	Apply
CO 3	Design and develop efficient algorithms with minimum complexity using design techniques	Apply
CO 4	Develop programs using various algorithms.	Analyze
CO 5	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use	Analyze

List of experiments:

S.No	List of Exercises	CO Mapping	RBT
1	Implementation of recursive function for tree traversal and Fibonacci	CO1	Apply
2	Implementation of iteration function for tree traversal and Fibonacci	CO1	Apply
3	Implementation of Merge Sort and Quick Sort	CO1	Apply
4	Implementation of a Binary Search Tree	CO2	Apply
5	Red-Black Tree Implementation	CO3	Apply
6	Heap Implementation	CO3	Apply
7	Fibonacci Heap Implementation	CO3	Apply
8	Graph Traversals	CO3	Apply
9	Spanning Tree Implementation	CO3	Apply
10	Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)	CO3	Apply
			Total : 60 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	2	3								3	2	2
CO 2	3	1	3	2	3								3	2	2
CO 3	3	1	3	2	3								3	2	2
CO 4	3	2	3	2	3								3	2	2
CO 5	3	2	3	2	3								3	2	2
	3-High				2-Medium				1-Low						

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Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [60 marks]**	**Final Examinations [40 marks]**
Remember	0	0
Understand	20	10
Apply	30	20
Analyse	10	10
Evaluate	0	0
Create	0	0

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23PMC108	Python Programming Laboratory	L	T	P	C
		0	0	4	2
Nature of Course	Practical				
Pre requisites	Basic of Computer Programming				

Course Objectives

The course is intended

1. Develop Python programs with conditionals, loops and functions
2. Represent compound data using Python lists, tuples, dictionaries
3. Read and write data from/to files in Python
4. Implement NumPy, Pandas, Matplotlib libraries
5. Implement object oriented concepts

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Apply the Python language syntax including control statements, loops and functions to solve a wide variety of problems in mathematics and science.	Apply
CO 2	Use the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data	Apply
CO 3	Create files and perform read and write operations	Apply
CO 4	Illustrate the application of python libraries.	Analyze
CO 5	Handle exceptions and create classes and objects for any real time applications	Analyze

List of experiments:

S.No	List of Exercises	CO Mapping	RBT
1	Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).	CO1	Apply
2	Scientific problems using Conditionals and Iterative loops.	CO1	Apply
3	Linear search and Binary search	CO1	Apply
4	Selection sort, Insertion sort	CO2	Apply

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5	Merge sort, Quick Sort	CO3	Apply
6	Implementing applications using Lists, Tuples.	CO3	Analyze
7	Implementing applications using Sets, Dictionaries.	CO3	Analyze
8	Implementing programs using Functions.	CO3	Analyze
9	Implementing programs using Strings.	CO3	Analyze
10	Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)	CO3	Analyze
			Total : 60 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	2	3								3	2	2
CO 2	3	1	3	2	3								3	2	2
CO 3	3	1	3	2	3								3	2	2
CO 4	3	2	3	2	3								3	2	2
CO 5	3	2	3	2	3								3	2	2
	3-High				**2-Medium**				**1-Low**						

Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [60 marks]**	**Final Examinations [40 marks]**
Remember	0	0
Understand	0	0

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Apply	20	20
Analyse	20	10
Evaluate	10	10
Create	10	0

BRIDGE COURSE

23PMC01	Fundamentals of Computers	L	T	P	C
		3	0	0	3
Nature of Course	Bridge Course				
Pre requisites	Nil				

Course Objectives

The course is intended

1. To understand the basic hardware and software of computer.
2. To understand the problem solving techniques.
3. To understand the branching, looping and array concepts.
4. To understand the function and structure of c programs.
5. To understand the office automation.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	The students will be able to examine the basic fundamentals of computer.	Understand
CO 2	The students will be able to use algorithm, flowchart and pseudo code for solving the problems	Understand
CO 3	The students will be able to apply the array concepts for effective program.	Apply
CO 4	The students will be able to build the coding using functions and structure	Apply
CO 5	The students will be able to implement various office automation techniques	Analyze

Course Contents

Module – I	INTRODUCTION TO COMPUTER SOFTWARE AND HARDWARE	9
Computer System - Programming Languages – Hardware and Software – Types of Computer - Generations of Computer - Computer Applications - Data Processing - Computer Networking - Electronic Commerce - Computer Security - Threat - Virus.		
Module – II	**PROBLEM SOLVING TECHNIQUES AND BASIC STRUCTURE OF C**	**9**

Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code. Overview of C: Basic structure of C program, executing a C program. Constant, variable and data types, Operators and expressions.		
Module – III	**BRANCHING, LOOPING AND ARRAY**	**9**
Conditional statement: If, If Else, Nested if…Branching: break , continue , return , and goto. Looping: While, Do While, For Loop. Arrays: One Dimensional Array - Two Dimensional Arrays - Strings and Array of Strings.		
Module – IV	**FUNCTIONS AND STRUCTURES**	**9**
Function General Format - Function Arguments: Pass by Value, Pass by Reference, Calling Functions with Arrays - Arguments to Main Function - Return Statement – Recursion. Structures - Nested Structures - Array of Structures - Passing Structures to Functions - Arrays and Structures with in Structures.		
Module – V	**OFFICE AUTOMATION**	**9**
Word - Spread Sheet - Database - Slide Presentation.		
		Total : 45 Periods

Text Books

1. Herbert Schildt, “C: The Complete Reference”, Fourth Edition, McGraw Hill, 2017.
2. Reema Thareja, “Programming in C”, Second Edition, Oxford University Press, 2016.

Reference Books

1.Kernighan B.W. and Ritchie D.M., “The C Programming Language”, Second Edition, Pearson Education, 2008.

2.Dr. S. S. Shrivastava, “MS Office”, Firewall Media, 2008.

Additional References

1. nptel.ac.in/courses/111/105/111163221
2. nptel.ac.in/courses/122/104/122105076

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2			3							2	2	
CO 2	1	2			3							2	2	
CO 3	1	2			3							2	2	
CO 4	1	2			3							2	2	
CO 5	1	2			3							2	2	
	3-High				2-Medium				1-Low					

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23PMC02	PROGRAMMING IN C	L	T	P	C
		3	0	0	3
Nature of Course	Bridge Course				
Pre requisites	Nil				

Course Objectives

The course is intended

1. To understand the constructs of C Language.
2. To develop C Programs using basic programming constructs
3. To develop C programs using arrays and strings
4. To develop modular applications in C using functions
5. To develop applications in C using pointers and structures

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Demonstrate knowledge on C Programming constructs	Understand
CO 2	Develop simple applications in C using basic constructs	Understand
CO 3	Design and implement applications using arrays and strings	Apply
CO 4	Develop and implement modular applications in C using functions.	Apply
CO 5	Develop applications in C using structures and pointers.	Apply

Course Contents

Module – I	**BASICS OF C PROGRAMMING**	**9**
Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements		
Module – II	**ARRAYS AND STRINGS**	**9**
Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.		
Module – III	**FUNCTIONS AND POINTERS**	**9**

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) - Recursion, Binary Search using recursive functions - Pointers - Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.		
Module – IV	**STRUCTURES AND UNION**	**9**

Structure - Nested structures - Pointer and Structures - Array of structures - Self referential structures - Dynamic memory allocation - Singly linked list - typedef - Union - Storage classes and Visibility.		
Module – V	**FILE PROCESSING**	**9**
Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.		
		Total : 45 Periods

Text books

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.Reference Books

References Books

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 2017.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2019.

Additional References

1. nptel.ac.in/courses/111/105/1111634521
2. nptel.ac.in/courses/122/104/1221050876

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2			3							3	2	
CO 2	1	2			3							3	2	
CO 3	1	2			3							3	2	
CO 4	1	2			3							3	2	
CO 5	1	2			3							3	2	
	3-High				2-Medium				1-Low					

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23PMC201	Data Communication Networks	L	T	P	C
		3	0	0	3
Nature of Course	Professional Course (PC)				
Pre requisites	Computer Networks				

Course Objectives

The course is intended

1. The students will be able to build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry advanced courses in computer networking..
4. Knowledge the routing algorithms advance concepts
5. Understanding the advance protocols

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Understand the fundamental underlying principles of computer networking.	Understand
CO 2	Understand details and functionality of layered network architecture.	Understand
CO 3	Have a good understanding of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.	Understand
CO 4	Knowledge about the organization of computer networks, factors influencing computer network development and the reasons for having variety of different types of networks	Analyze
CO 5	Understand the main protocols such as HTTP, FTP, SMTP, TCP, UDP, IP.	Understand

Course Contents

Module – I	INTRODUCTION	9
Introduction- Computer Networks - Network For Companies - Network For People - Application - Network Hardware-LAN, WAN, MAN, Wireless Networks-Network Software - Protocol Hierarchies - Reference Model-OSI Reference model, TCP/IP Reference - Comparison of OSI & TCP/IP.		
Module – II	**TYPES OF LAYERS**	**9**
The Internet - The ARPANET-NSFNET-Internet Usage- Architecture Of Internet-Connection Oriented Network X.25, Frame relay-ATM-ATM Virtual Circuits-ATM Reference Model -Guided Transmission Media - Magnetic Media - Twisted Pair - Coaxial Cable - Fibre Optics - Wireless Transmission - Data Link Layer - Data Link Layer Design Issues. The Application Layer		

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Module – III	TYPES OF PROTOCOLS	9

Public Switched Telephone Network-Structure Of Telephone System-Switching-Elementary Data Link Protocols-An Unrestricted Simplex Protocol-A Simplex Stop And Wait Protocol-A Simplex Protocol For A Noisy Channel-Sliding Window Protocols-One Bit Sliding Window Protocol-A Protocol Using Go Back N-A Protocol Using Selective Repeat.

Module – IV	ROUTING ALGORITHMS	9

The Network Layer – Design Issues – Routing Algorithm – The Optimality Principle – Shortest Path Routing – Flooding – Distance Vector Routing – Hierarchical Routing – Link State Routing – Broad Cast Routing – Multicast Routing – Congestion Control Algorithm – General Principle Of Congestion Control – Congestion Prevention Policies – Congestion Control In Virtual Circuit Subnets – Congestion Control In Datagram Subnets – Load Scheduling – Jitter Control.

Module – V	TRANSPORT LAYER	9

Transport Layer – Design Issues – Elements Of Transport Protocols – Addressing – Connection Establishment – Connection Release – The Internet Transport Protocol – Network Security – Cryptography

Total : 45 Periods

Text Books:

1. S.Tanenbaum, “Computer Networks”, Pearson Education, Inc, New Delhi, Fourth Edition, 2003.
2.Robert W Sebesta, “Concepts of Programming Languages”, Addison Wesley, 2008.

Reference Books:

1.B. Forouzan, “Introduction to Data Communications in Networking”, Tata McGraw Hill, New Delhi, 2007.
2.F. Halsall, “Data Communications, Computer Networks and Open Systems”, Addison Wessley,Bertsekas and R. Gallagher, “Data Networks”, Prentice hall of India, New Delhi, 2012.

Additional References

1. https://www.youtube.com/results?search_query=Programming+Principles+IIT
2. https://www.youtube.com/results?search_query=C+Programming++IIT

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3		3							2	1	2	1
CO 2	3	2	3		3							2	3	2	3
CO 3	3	2	3		3							2	2	2	2
CO 4	3	2	3		3							2	2	2	2
CO 5	3	2	3		3							2	3	2	3

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	3-High	2-Medium	1-Low

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyse	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC202	**Advanced Java Programming**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Nature of Course	Professional Course (PC)				
Pre requisites	Core Java				

Course Objectives

The course is intended

1. To understand the fundamentals of web programming and client side scripting.
2. To learn server side development using servlets, web sockets.
3. To learn the Spring framework and build applications using Spring.
4. To learn and implement the concept of Java Persistence API.
5. To learn the advanced client side scripting and framework.

On successful completion of the course the students will be able to

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CO.No	Course Outcome	Bloom's Level
CO 1	To write client side scripting.	Understand
CO 2	To implement the server side of the web application.	Understand
CO 3	To implement Web Application using Spring.	Apply
CO 4	To implement a Java application using Java Persistence API.	Apply
CO 5	To implement a full-stack Single Page Application using React, Spring and JPA	Analyze

Course Contents

Module – I	**INTRODUCTION TO WEB & JAVASCRIPT**	**9**
Introduction to Web: Server - Client - Communication Protocol (HTTP), JavaScript Prototypes - Classes - Modules – Fetch API – JS Canvas - Storage: Local Storage, Cookies, IndexedDB, JSON		
Module – II	**SERVER SIDE PROGRAMMING**	**9**
Web Server: Web Containers - Web Components, Servlet: Lifecycle - Request - Servlet Context - Response - Filter - Session - Dispatching Requests, WebSocket, Logging - Log4j2, Build tool - Gradle. Introduction to Spring: IoC Container and Dependency Injection (DI)		
Module – III	**SPRING**	**9**
Spring Configuration and Spring Boot, Spring MVC, Spring Bean Lifecycle – Dispatcher Servlet and Configuration - Interceptors - Annotations, Controllers - Views - Input Validation -File Upload Container, Dependency and IOC .		
Module – IV	**AOP,JAVA PERSISTENCE API AND HIBERNATE**	**9**
Aspect Oriented Programming(AOP) - Entity: Basic, Embeddable and Collection Types – Identifiers - Entity Relationship - Inheritance, Persistence Context and Entity Manager, JPQL, Criteria API, Spring Data JPA - Specification and Projection.		
Module – V	**ADVANCED SPRING PROGRAMMING**	**9**
Spring Boot JDBC - Spring Boot Actuator -Spring Cloud -Spring Boot Testing - Spring Security Architecture , Spring Cache - Building RESTful Web Services		
		Total : 45 Periods

Text Books

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

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Reference Books

1.David R. Heffelfinger, "Java EE 8 Application Development", Packt Publishing, First edition2017

2.Benjamin Muschko, "Gradle in Action", Manning Publications, First edition2014

3.IulianaCosmina, Rob Harrop, Chris Schaefer, Clarence Ho, "Pro Spring 5: An In-Depth Guide to the Spring Framework and Its Tools", Apress, Fifth edition2017

Additional References

1. https://nptel.ac.in/courses/106106182
2. https://programming-22.mooc.fi/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	2	2	2	2							2	1	
CO 2	2	1	2	2	2	2							2	1	
CO 3	2	1	2	2	2	2							2	1	
CO 4	2	1	2	2	2	2							2	1	
CO 5	2	1	2	2	2	2							2	1	
	3-High				**2-Medium**				**1-Low**						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60

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Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC203	Cloud Computing Technologies	L	T	P	C
		3	1	0	4
Nature of Course	Professional Course (PC)				
Pre requisites	Fundamentals of Networking				

Course Objectives

The course is intended

1. To understand the basic concepts of Distributed systems.
2. To learn about the current trend and basics of Cloud computing.
3. To be familiar with various Cloud concepts.
4. To expose with the Server, Network and storage virtualization.
5. To be aware of Microservices and DevOps

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Use Distributed systems in Cloud Environment.	Understand
CO 2	Articulate the main concepts, key technologies, strengths and limitations of Cloud computing	Understand
CO 3	Identify the Architecture, Infrastructure and delivery models of Cloud computing.	Analyze
CO 4	Install, choose and use the appropriate current technology for the implementation of Cloud.	Analyze
CO 5	Adopt Microservices and DevOps in Cloud environments.	Analyze

Course Contents

Module – I	DISTRIBUTED SYSTEMS	9
Introduction to Distributed Systems – Characterization of Distributed Systems – Distributed Architectural Models –Remote Invocation – Request-Reply Protocols – Remote Procedure Call – Remote Method Invocation – Group Communication – Coordination in Group Communication – Ordered Multicast – Time Ordering – Physical Clock Synchronization – Logical Time and Logical Clocks.		
Module – II	**BASICS OF CLOUD COMPUTING**	**9**

Cloud Computing Basics – Desired features of Cloud Computing – Elasticity in Cloud – On demand provisioning - Applications – Benefits – Cloud Components: Clients, Datacenters & Distributed Servers – Characterization of Distributed Systems – Distributed Architectural Models - Principles of Parallel and Distributed computing - Applications of Cloud computing – Benefits – Cloud services – Open source Cloud Software: Eucalyptus, Open Nebula, Open stack, Aneka, Cloudsim.		
Module – III	**CLOUD INFRASTRUCTURE**	**9**
Cloud Architecture and Design – Architectural design challenges – Technologies for Network based system - NIST Cloud computing Reference Architecture – Public, Private and Hybrid clouds – Cloud Models : IaaS, PaaS and SaaS – Cloud storage providers - Enabling Technologies for the Internet of Things – Innovative Applications of the Internet of Things.		
Module – IV	**CLOUD ENABLING TECHNOLOGIES**	**9**
Service Oriented Architecture – Web Services – Basics of Virtualization – Emulation – Types of Virtualization – Implementation levels of Virtualization – Virtualization structures – Tools & Mechanisms – Virtualization of CPU, Memory & I/O Devices – Desktop Virtualization – Server Virtualization – Google App Engine – Amazon AWS - Federation in the Cloud.		
Module – V	**MICROSERVICES AND DEVOPS**	**9**
Defining Microservices - Emergence of Microservice Architecture – Design patterns of Microservices – The Mini web service architecture – Microservice dependency tree – Challenges with Microservices - SOA vs Microservice – Microservice and API – Deploying and maintaining Microservices – Reason for having DevOps – Overview of DevOps – Core elements of DevOps – Life cycle of DevOps –Adoption of DevOps - DevOps Tools – Build, Promotion and Deployment in DevOps.		
		Total : 45 Periods

Text Books

1.Kai Hwang, Geoffrey C. Fox & Jack J.Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, First Edition, 2012
2.Andrew S. Tanenbaum & Maarten Van Steen,"Distributed Systems - Principles and Paradigms", Third Edition, Pearson, 2017.
3.Thomas Erl, Zaigham Mahood & Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, Second Edition, 2013

Reference Books

1.Richard Rodger, "The Tao of Microservices", ISBN 9781617293146, Manning Publications,First Edition, December 2017.
2.Magnus Larsson, "Hands-On Microservices with Spring Boot and Spring Cloud: Build and deploy micro services using spring cloud, Istio and kubernetes", Packt Publishing Ltd, First Edition, September 2019.
3.Jim Lewis, "DEVOPS: A complete beginner's guide to DevOps best practices", ISBN13:978-1673259148, ISBN-10: 1673259146, First Edition,2019

Additional References

1. https://nptel.ac.in/courses/106102064
2. https://nptel.ac.in/courses/106102076

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	2	2	2	2							2	3	
CO 2	2	1	2	2	2	2							2	3	
CO 3	3	1	3	2	2	2							2	3	
CO 4	2	1	2	2	2	2							2	3	
CO 5	2	1	2	2	2	2							2	3	
	3-High				**2-Medium**				**1-Low**						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMC204	Scripting Languages	L	T	P	C
		3	1	0	4
Nature of Course	Professional Course (PC)				
Pre requisites	Fundamentals of Computer Programming				

Course Objectives

The course is intended

1. To study the basics of scripting languages like Java script, Perl, PHP and Ruby.
2. To understand the requirements of Scripting Languages.
3. To identify the uses of Scripting Languages.
4. To introduce in-depth knowledge of programming features of Perl and PHP.
5. To state the implementation and applications of Scripting.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	To comprehend the differences between typical scripting languages, typical system and application programming languages.	Understand
CO 2	To implement the design of programs for simple applications.	Apply
CO 3	To write and apply Perl & PHP scripts.	Apply
CO 4	Gain knowledge of the strengths and weakness of Perl and Ruby.	Apply
CO 5	To create software systems using scripting languages such as Perl, PHP, and Ruby.	Analyze

Course Contents

Module – I	Introduction to Scripts and Scripting Languages-Java Script	9
Scripts and Programs, Uses for Scripting Languages, Web Scripting. Variables, Data Types, Operators, Conditional statements, Loops, Arrays, Functions, Objects-Predefined objects, accessing objects, object Methods.		
Module – II	**JavaScript programming of reactive web pages elements:**	**9**
JavaScript Events-Mouse events, Keyboard events, Form events, window events, Event handlers, Frames, Form object, JavaScript Form Validation.		
Module – III	**PERL**	**9**
Data Types, Variables, Scalars, Operators, Conditional statements, Loops, Arrays, Strings, Hashes, Lists, Built-in Functions, Pattern matching and regular expression operators.		
Module – IV	**PHP**	**9**

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Data Types, Variables, Operators, Conditional statements, Loops, Arrays-Indexed Array, Associative Array, String Functions, Functions-Parameterized Function, Call by Value, Call by Reference, File Handling, PHP Form handling.		
Module – V	**Ruby**	**9**
Data types, Variables, Operators, Conditional statements, Loops, Methods, Blocks, Modules, Arrays, Strings, Hashes, File I/O, Ruby Form handling.		
		Total : 45 Periods

Text Books

1. The World of Scripting Languages, David Barron, Wiley Publications.
2. Learning PHP, MySQL, JavaScript, CSS&HTML5: A Step-by- Step Guide to Creating Dynamic Websites 3rdEdition, O'Reilly Publications.

Reference Books

1. The Ruby Programming Language, David Flanagan and Yukihiro Matsumoto, O'Reilly Publications.
2. Beginning JavaScript with Dom scripting and AJAX, Russ Ferguson, Christian Heilmann, Apress.
3.Programming Perl, Larry Wall, T. Christiansen and J. Orwant, O'Reilly, SPD.
4.Open-source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J. Lee and B. Ware (Addison Wesley) Pearson Education.

Additional References

1. https://nptel.ac.in/courses/106105182
2. https://www.mooc-list.com/tags/scripting

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	2	3	2							2	3	
CO 2	3	2	3	2	3	2							2	3	
CO 3	3	2	3	2	3	2							2	3	
CO 4	3	2	3	2	3	2							2	3	
CO 5	3	2	3	2	3	2							2	3	
	3-High				2-Medium				1-Low						

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**

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Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCP02	**QUANTITATIVE APTITUDE AND LOGICAL REASONING - II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**0**
Nature of Course	Employability Course (EC)				
Pre requisites	Basics Mathematics				

Course Objectives

The course is intended to

1. Learn the basic of numbers and partnership in simplified way.
2. Solve problems using fast track method by learning profit and loss.
3. Teach the numbers systems concepts in fast pace.
4. Know the relationship, direction concepts in easy way.
5. Teach seating arrangements in rows or in small groups

Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	loom's Level
CO1.	Perform arithmetical operations with complex numbers and Data analysis.	Apply
CO2.	Know the tips and tricks of profit and loss through fast track methods.	Understand
CO3.	Develop the student's mental ability of solving aptitude through number systems and speed maths concepts.	Apply
CO4.	Evaluate critically the real life situations by resorting and analyzing analytical reasoning of key issues and factors.	Apply

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CO5.	Analyze the conditions and do interpretation.	Apply

Course contents

Module – I	**PARTNERSHIP & PROBLEMS ON NUMBERS**	**6**
Partnership: Ratio of division of gains: Simple Partnership – Compound Partnership - Working and sleeping partners. Problems On Numbers: Set of numbers – Assume the unknown numbers and form equations		
Module – II	**HEIGHT AND DISTANCE, PROFIT & LOSS**	**6**
Height And Distances: Line of sight - Angle of elevation - Angle of depression. Profit And Loss: Basic definition and types of profit and loss - Concept of discount and marked price - Concept of true v/s false value - Application in data interpretation problems.		
Module – III	**NUMBER SYSTEMS**	**6**
Number Systems: Numbers and types of Numbers – Properties of Numbers -Face value and place value - Divisibility rules – Concept on unit digit and remainder theorem.		
Module – IV	**BLOOD RELATIONSHIP,STATEMENT & ASSUMPTION,SITUATION REACTION TEST & DIRECTION SENSE TEST**	**6**
Blood Relationship: Analysis the gender relationship -Relationship diagram - Family tree. Statement and Assumption, Situation Reaction Test. Direction Sense Test: Distance between the starting and ending points - Sense the direction correctly.		
Module – V	**SEATING ARRANGEMENTS & DATA SUFFICIENCY**	**6**

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Seating Arrangements: Persons seating in the circular – Rectangular – Square. Data Sufficiency: Reasoning ability using a set of directions.
Total : 30 Periods

Text Books

1. Dr.R S Aggarwal, Quantitative Aptitude, Revised and Enlarged Edition, S.Chand Publishing Company Ltd, 2020.
2. Arun Sharma "How to Prepare for Quantitative Aptitude"Eight Edition, McGraw Hill Education,2021.
3. "Reasoning and Aptitude" for GATE and ESE Prelims, Made Easy Publication,2020.

Reference Books

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2020
2. Arun Sharma, How to prepare for Data Interpretation for the CAT, First Edition, Tata McGraw-Hill Publishing Company Ltd, 2021.
3. R.V.Praveen,"Quantitative Aptitude and Reasoning"Third Edition, PHI Learning ,2020.

Additional Reference

1. https://www.youtube.com/watch?v=80QQ97TDZCQ
2. https://www.youtube.com/playlist?list=PLh-uxFrOdsq-e-HWJfz3l6h0cjgwsjiUm

23PMC205	**Statistical Computing with R Programming**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**4**
Nature of Course	Professional Course (PC)				
Pre requisites	Fundamentals of R Programming				

Course Objectives

The course is intended

1. To expose the students to the fundamentals of R Programming Language
2. To impart knowledge on Statistical calculations in R language
3. To introduce the development of statistical test cases
4. To understand the statistical Concepts like distribution and correlation
5. To Understand the liner models and regression

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	List motivation for learning a programming language	Understand
CO 2	Access online resources for R and import new function packages into the R workspace	Apply
CO 3	Import, review, manipulate and summarize data-sets in R	Apply
CO 4	Explore data-sets to create testable hypotheses and identify appropriate statistical tests	Apply

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CO 5	Perform appropriate statistical tests using R Create and edit visualizations	Analyze

Course Contents

Module – I	**INTRODUCTION**	**9**
Introduction, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.		
Module – II	**R PROGRAMMING STRUCTURE**	**9**
R Programming Structures, Control Statements, Loops, – Looping Over Non vector Sets,- If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quick sort Implementation-Extended Extended Example: A Binary Search Tree.		
Module – III	**SIMULATION IN R**	**9**
Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability-Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files		
Module – IV	**STATISTICS INTRODUCTION**	**9**
Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,-ANOVA.		
Module – V	**PATENTS**	**9**
Linear Models, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests.		
		Total : 45 Periods

Text Books

1. Peter Dalgaard, "Introductory Statistics with R (Statistics and Computing) ", Springer, 2004.
2. Torsten Horthron, A Handbook of Statistical Analyses using R, CRC Press, 2014.

Reference Books

1. The Art of R Programming, Norman Matloff, Cengage Learning Siegel, S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill International, Auckland.

2.www.r-project.org

Additional References

1. **https://onlinecourses.nptel.ac.in/noc22_ge08/preview**
2. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/330

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S.No	List of Exercises	CO Mapping	RBT
1	**Statistical Computing with R Programming** Download and install R-Programming environment and install basic packages using install. Packages () command in R.	CO1	Apply
2	Learn all the basics of R-Programming (Data types, Variables, Operators etc,.)	CO2	Apply
3	Write a program to find list of even numbers from 1 to n using R-Loops.	CO2	Apply
4	Create a function to print squares of numbers in sequence.	CO3	Apply
5	Write a program to join columns and rows in a data frame using cbind() and rbind() in R.	CO3	Apply
6	Implement different String Manipulation functions in R.	CO4	Apply
7	Implement different data structures in R (Vectors, Lists, Data Frames)	CO4	Analyze
8	Write a program to read a csv file and analyze the data in the file in R.	CO5	Analyze
9	Create pie chart and bar chart using R.	CO5	Analyze
10	Create a data set and do statistical analysis on the data using R.	CO5	Analyze
			Total : 30 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	1	3	2	3	2							3	2	2
CO 2	3	1	3	2	3	2							3	2	2
CO 3	3	1	3	2	3	2							3	2	2
CO 4	3	2	3	2	3	2							3	2	2

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CO 5	3	2	3	2	3	2							3	2	2
	3-High				**2-Medium**				**1-Low**						

Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [50 marks]**	**Final Examinations [50 marks]**
Remember	0	0
Understand	0	0
Apply	30	50
Analyse	20	50
Evaluate	0	0
Create	0	0

23PMC206	**Scripting Languages Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
Nature of Course	Professional Course (PC)				
Pre requisites	Fundamentals of Computer Programming				

Course Objectives

The course is intended

1. To study the basics of scripting languages like Java script, Perl, PHP and Ruby.
2. To understand the requirements of Scripting Languages.
3. To identify the uses of Scripting Languages.
4. To introduce in-depth knowledge of programming features of Perl and PHP.
5. To state the implementation and applications of Scripting.

On successful completion of the course the students will be able to

CO.No	**Course Outcome**	**Bloom's Level**
CO 1	To comprehend the differences between typical scripting languages, typical system and application programming languages.	Understand
CO 2	To implement the design of programs for simple applications.	Apply
CO 3	To write and apply Perl & PHP scripts.	Apply
CO 4	Gain knowledge of the strengths and weakness of Perl and Ruby.	Apply
CO 5	To create software systems using scripting languages such as Perl, PHP, and Ruby.	Analyze

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List of experiments:

<table>
<tr><th>S.No</th><th>List of Exercises</th><th>CO Mapping</th><th>RBT</th></tr>
<tr><td>1</td><td>JavaScript Program to Get the First and Last Item in an Array</td><td>CO1</td><td>Understand</td></tr>
<tr><td>2</td><td>JavaScript Program to Add New Elements at the Beginning of an Array</td><td>CO1</td><td>Apply</td></tr>
<tr><td>3</td><td>JavaScript Program to Remove Elements from an Array</td><td>CO1</td><td>Apply</td></tr>
<tr><td>4</td><td>JavaScript Program to Replace All Occurrences of a String</td><td>CO2</td><td>Apply</td></tr>
<tr><td>5</td><td>R JavaScript Program to Check if the Given Date is Weekend</td><td>CO2</td><td>Apply</td></tr>
<tr><td>6</td><td>Write a Java script codes to handle the following events:
<table>
<tr><td>Mouse down</td><td>On mouse down</td></tr>
<tr><td>Mouse move</td><td>On mouse move</td></tr>
<tr><td>Mouse out</td><td>On mouse out</td></tr>
<tr><td>Mouse over</td><td>On mouse over</td></tr>
<tr><td>Mouse up</td><td>On mouse up</td></tr>
<tr><td>reset</td><td>On reset</td></tr>
<tr><td>select</td><td>On select</td></tr>
<tr><td>submit</td><td>On submit</td></tr>
<tr><td>unload</td><td>On unload</td></tr>
</table></td><td>CO3</td><td>Apply</td></tr>
<tr><td>7</td><td>Write a simple PERL script that should print the string “Hello World”.</td><td>CO3</td><td>Apply</td></tr>
<tr><td>8</td><td>Write a Perl script that prints your name and your area of interest in VLSI Domainand run the script.</td><td>CO3</td><td>Apply</td></tr>
<tr><td>9</td><td>Write a script that will calculate the circumference of a circle.</td><td>CO3</td><td>Apply</td></tr>
<tr><td>10</td><td>Create a copy of the perl script "circle" under lab2 and rename it to circle_1.Then modify the new script "circle_1" such that it prompts for and accept a radius from the person running the program and then calculates the circumference</td><td>CO3</td><td>Apply</td></tr>
<tr><td>11</td><td>Write a script that prompts for and reads two numbers and prints out the product of the two numbers multiplied together in separate lines</td><td>CO3</td><td>Apply</td></tr>
<tr><td>12</td><td>write a php program to design personal information</td><td>CO3</td><td>Apply</td></tr>
</table>

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13	Create a PHP page for login page with sql connection.	CO3	Apply
14	Write a php program to Read from existing file.	CO3	Apply
15	Write a Ruby program which accept the user's first and last name and print them in reverse order with a space between them.	CO3	Analyze
16	Write a Ruby program to check three numbers and return true if one or the other is small, but not both. A number is called "small" if it is in the range 1..10 inclusive	CO3	Analyze
17	Write a Ruby program to check whether a string 'Java' appears at index 1 in a given sting	CO3	Analyze
18	Write a Ruby program to check two given integers and return the larger value. However if the two values have the same remainder when divided by 5 then return the smaller value and if the two values are the same	CO3	Analyze
			Total : 60 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	1	3	2	3	2							3	2	2
CO 2	3	1	3	2	3	2							3	2	2
CO 3	3	1	3	2	3	2							3	2	2
CO 4	3	2	3	2	3	2							3	2	2
CO 5	3	2	3	2	3	2							3	2	2
	3-High				**2-Medium**				**1-Low**						

Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [60 marks]**	**Final Examinations [40 marks]**
Remember	0	0
Understand	20	0
Apply	30	20
Analyse	10	10

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Evaluate	0	0
Create	0	0

23PMC207	Advanced Java Programming Laboratory	L	T	P	C
		0	0	4	2
Nature of Course	Practical				
Pre requisites	Basic of Computer Programming				

Course Objectives

The course is intended

1. Develop Python programs with conditionals, loops and functions
2. Represent compound data using Python lists, tuples, dictionaries
3. Read and write data from/to files in Python
4. Implement NumPy, Pandas, Matplotlib libraries
5. Implement object oriented concepts

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Apply the Python language syntax including control statements, loops and functions to solve a wide variety of problems in mathematics and science.	Apply
CO 2	Use the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data	Apply
CO 3	Create files and perform read and write operations	Apply
CO 4	Illustrate the application of python libraries.	Analyze
CO 5	Handle exceptions and create classes and objects for any real time applications	Analyze

List of experiments:

S.No	List of Exercises	CO Mapping	RBT
1	Create an event registration application using javascript. It should implement different widgets for registration form and registered records view using tabs. It should perform the form validation.	CO2	Apply
2	Create a javascript application in an Object Oriented way using Classes and Modules. It should also use browser storage for persistence.	CO3	Apply

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3	Build a web application using Gradle. The server side of the application should implement RESTful APIs using Servlet and do necessary logging. The client side of the application should be a single page application which consumes the RESTful APIs through AJAX.	CO3	Apply
4	Build a chat application using WebSocket.	CO3	Apply
5	Create a Spring MVC application. The application should handle form validation, file upload, session tracking.	CO3	Apply
6	Implement a RESTful Spring Boot application using Spring REST, Spring Security and Spring Cache.	CO4	Analyze
7	Design a system using JPA and Hibernate. The system should have multiple entities and relationships between the entities. The database schema should be generated through Hibernate. Provide RESTful endpoints for CRUD operations for the defined entities. Also, support pagination and searching using JPA's JPQL and Criteria API.	CO4	Create
8	Create a Spring RESTful Application with Spring Data JPA. Support pagination and searching using Specifications.	CO4	Create
9	Create a React application with different components and interactions between the components.	CO5	Create
10	Develop a full-stack application using React and Spring. Make use of Spring REST, Spring Security, Spring Data JPA, Hibernate, Spring Boot, Gradle and ReactJS state and component mechanism	CO5	Evaluate
			Total : 60 Periods

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	1	2	2	2	2							3	2	2
CO 2	2	1	2	2	2	2							3	2	2
CO 3	2	1	2	2	2	2							3	2	2
CO 4	2	1	2	2	2	2							3	2	2

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CO 5	2	1	2	2	2	2							3	2	2
	3-High				**2-Medium**				**1-Low**						

Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [60 marks]**	**Final Examinations [40 marks]**
Remember	0	0
Understand	0	0
Apply	20	20
Analyse	20	10
Evaluate	10	10
Create	10	0

Professional Elective I –Semester II

23PMCA01	**Testing and Quality Assurance**	**L**	**1**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective				
Pre requisites	Software Engineering				

Course Objectives

The course is intended to

1. To know the behaviour of the testing techniques and to design test cases to detect the errors in the software
2. To get insight into the levels of testing in the user environment
3. To understand standard principles to check the occurrence of defects and its removal.
4. To Knowledge the behaviour of techniques use specialized testing cases
5. To understand the quality of metrics to ensure the performance

Course Outcomes

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

Co.No	**Course Outcome**	**Bloom's Level**
CO1.	Able to test the software by applying various testing techniques.	Apply
CO2.	Able to debug the project and to test the entire computer based systems at all levels.	Apply
CO3.	Able to test the applications in the specialized environment using various automation tools	Analyze
CO4.	Able to evaluate the web applications using bug tracking tools.	Analyze
CO5.	Able to apply quality and reliability metrics to ensure the performance of the software	Apply

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Module – I	**TESTING TECHNIQUES & TEST CASE DESIGN**	**9**
Using White Box Approach to Test design - Test Adequacy Criteria - Static Testing Vs. Structural Testing Code Functional Testing - Coverage and Control Flow Graphs - Covering Code Logic - Paths – Their Role in White box Based Test Design – Code Complexity Testing – Evaluating Test Adequacy Criteria. Test Case Design Strategies - Using Black Box Approach to Test Case Design - Random Testing - Requirements based testing - Boundary Value Analysis -Decision tables		
Module – II	**LEVELS OF TESTING**	**9**
The Need for Levels of Testing- Unit Test Planning -Designing the Unit Tests - The Test Harness Running the Unit tests and Recording Results - Integration Tests - Designing Integration Tests – Integration Test Planning – Scenario Testing – Defect Bash Elimination. System Testing – Acceptance testing - Performance testing - Regression Testing - Internationalization testing - Ad- hoc testing - Alpha, Beta Tests- Testing OO systems		
Module – III	**TESTING FOR SPECIALIZED ENVIRONMENT**	**9**
Testing Client / Server Systems – Testing in a Multiplatform Environment - Testing Object Oriented Software-Object Oriented Testing - Testing Web based systems - Web based system - Web Technology Evolution Traditional Software and Web based Software.		
Challenges in Testing for Web-based Software - QualityAspects - Web Engineering - Testing of Web based Systems. Case Study for Web Application Testing.		
Module – IV	**TEST AUTOMATION**	**9**
Selecting and Installing Software Testing Tools - Software Test Automation - Skills needed for Automation -Scope of Automation - Design and Architecture for Automation - Requirements for a Test Tool - Challengesin Automation - Tracking the Bug - Debugging - Case study using Bug Tracking Tool.		
Module – V	**SOFTWARE TESTING AND QUALITY METRICS**	**9**
Six-Sigma – TQM - Complexity Metrics and Models – Quality Management Metrics - Availability Metrics - Defect Removal Effectiveness - FMEA - Quality Function Deployment - Taguchi Quality Loss Function – Cost of Quality. Case Study for Complexity and Object Oriented Metrics.		
		Total : 45 Periods

Text Books:

1. Adithya P. Mathur, " Foundations of Software Testing - Fundamentals algorithms and techniques",Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008
2. Dale H. Besterfiled , "Total Quality Management", Pearson Education Asia, Third Edition, IndianReprint (2011).

Reference Books:

1. Edward Kit, " Software Testing in the Real World - Improving the Process", Pearson Education, 1995
2.Glenford J. Myers, Tom Badgett, Corey Sandler, "The Art of Software Testing", 3rd Edition, John Wiley& Sons Publication, 2012

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2										3	2	
CO2	3	3	2										2	2	
CO3	3	2	2										2	2	
CO4	3	3	2										3	2	
CO5	3	2	2										2	2	
	3	High				2	Medium					1	Low		

Formative assessment			
loom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class/ Assignment	5	
	Attendance	5	

Summative Assessment

Bloom's Category	**Internal Assessment Examinations**			**xamination (100)**
	IAE1 (5)	**IAE2 (10)**	**AE3 (10)**	
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA02	**Data Warehousing and Data Mining**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
lature of Course	Professional Elective				
Pre requisites	Fundamentals of Programming				

Course Objectives

The course is intended to

1. To expose the students to the concepts of Data warehousing Architecture.
2. To make the students understand data mining principles and techniques and use it as a cutting edge business intelligence tool.
3. To develop the understanding of different types of mining methods and

current trends in data mining.
4. To explore the knowledge of high dimensional system
5. To evolve the multi dimensional intelligent systems models

Course Outcomes

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

Co.No	Course Outcome	Bloom's Level
CO1.	Able to Pre process the data for mining applications.	Apply
CO2.	Able to Apply the association rules for mining the data.	Apply
CO3.	Able to Design and deploy appropriate classification techniques	Analyze
CO4.	Able to Cluster the high dimensional data for better organization of the data.	Analyze
CO5.	Able to Discover the knowledge imbibed in the high dimensional system.	Apply

Course Contents

Module – I	**DATA WAREHOUSE**	**9**
Data warehouse - Operational Database Systems vs Data Warehouses – Data warehousing Components - Building a Data warehouse -– Mapping the Data Warehouse to a Multiprocessor Architecture -DBMS Schemas for Decision Support-Data Extraction,Cleanup, and Transformation tools -Metadata - Online Analytical Processing		
Module – II	**DATA MINING & DATA PREPROCESSING**	**9**
Data Mining Introduction - Data - Kinds of Data - Data objects and attribute types - Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives - Integration of a Data Mining System with a Data Warehouse - Issues - Data Preprocessing.		
Module – III	**ASSOCIATION RULE MINING**	**9**
Introduction - Association Rule Mining - Frequent Itemset Mining Methods – Mining Frequent Itemsets with and without Candidate Generation - Pattern Mining in Multilevel, Multidimensional Space - Constraint-Based Frequent Pattern Mining - Pattern Exploration and Application.		
Module – IV	**CLASSIFICATION & PREDICTION**	**9**
Classification vs. Prediction – Data preparation for Classification and Prediction – Classification by Decision Tree Induction – Bayesian Classification – Rule Based Classification - Bayesian Belief Networks - Classification by Back Propagation - Support Vector Machines - Associative Classification -Lazy Learners - Other Classification Methods – Prediction.		
Module – V	**CLUSTERING**	**9**

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Cluster Analysis – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High- Dimensional Data – Constraint-Based Cluster Analysis – Outliers and Outlier analysis – Outlier detection methods.
Total : 45 Periods

Text Books:

1. Alex Berson and Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012

Reference Books:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining",
2. K.P. Soman, Shyam Diwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	2	
CO2	3	3	2										2	2	
CO3	3	2	2										2	2	
CO4	3	3	2										3	2	
CO5	3	2	2										2	2	
	3	High				2	Medium					1	Low		

Formative assessment			
loom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class/ Assignment	5	
	Attendance	5	

Summative Assessment

Bloom's Category	Internal Assessment Examinations		xamination (100)
	IAE1 (5)	IAE2 (10)	AE3 (10)
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMCA03	Digital Image Processing	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Fundamentals of Image Processing				

Course Objectives:

The course is intended to

1. To develop the understanding of the techniques involved in human resource management.
2. To expose the students to the current development and maintenance strategies of human resources.
3. To make the students examine current issues, trends, practices and processes in HRM
4. To enable the students to apply management skills and knowledge in a realistic environment.
5. To enable the image image comparisons techniques segmentations

Course Outcomes

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

Co.No	Course Outcome	Bloom's Level
CO1.	Identify the primary elements of Digital Image Fundamentals	Understand
CO2.	Outline the components and the goals of Image Enhancement.	Understand
CO3.	Understand the concept of Image Restoration	Understand
CO4.	Understand the practices used in Image segmentation	Understand
CO5.	Able to identify Image Compression techniques	Analyze

Course Contents

Module – I	DIGITAL IMAGE FUNDAMENTALS	9
Elements of digital image processing systems, Video on and Digital Camera working principles, Elements of visual perception, brightness, contrast, saturation, mach band effect, color image fundamentals – RGB, HIS models, image sampling, Quantization, dither		
Module – II	**IMAGE ENHANCEMENT**	**9**
Histogram equalization and specification techniques, Noise distributions, Spatial average DirectionalSmoothing,Median,Geometric mean,Harmonic mean, Contra harmonic mean filters, Homomorphism filtering, Color image enhancement.		
Module – III	**IMAGE RESTORATIN**	**9**
Image Restoration - degradation model, Unconstrained restoration, Lagrange multiplier and Constrained restoration, Inverse filtering-removal of blur caused by uniform linearmotion, Wiener filtering, Geometric transformations-spatial transformations.		
Module – IV	**IMAGE SEGMENTATION**	**9**
Edge detection, Edge linking via Hough transform - Thresholding - Region based segmentation - Region growing – Region splitting and Merging segmentation by morphological water sheds - basic concepts – Damconstruction - Watershed segmentation algorithm.		

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Module – V	IMAGE COMPRESSION	9
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector standard, MPEG.		
		Total : 45 Periods

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson, Second Edition,2004.
2. Anil K. Jain, , Fundamentals of Digital Image Processing', Pearson 2002.

REFERENCES:

1. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB',Pearson Education, Inc., 2004.
3. William K. Pratt, , Digital Image Processing' , John Wiley, New York, 2002

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	2	
CO2	3	3	2										2	2	
CO3	3	2	2										2	2	
CO4	3	3	2										3	2	
CO5	3	2	2										2	2	
	3	High				2	Medium					1	Low		

Formative assessment			
loom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class/ Assignment	5	
	Attendance	5	

Summative Assessment

Bloom's Category	Internal Assessment Examinations			xamination (100)
	IAE1 (5)	IAE2 (10)	AE3 (10)	
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40

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Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMCA04	Middleware Technologies	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Basics of Computer Programming				

Course Objectives

1. The course is intended to
2. To provide a sound knowledge in various middleware technologies for distributed applications.
3. To introduce application inter-operability, Scalability, and integrate legacy facilities.
4. To familiarize the various server concepts and peer-to-peer connectivity.
5. To Build the applications for client tier and business logic concepts
6. To create the applications CORBA Concepts

Course Outcomes

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

Co.No	Course Outcome	Bloom's Level
CO1.	Understand about the Client/Server concepts	Understand
CO2.	Design the EJB Architecture 3.Building an application with EJB.	Analyze
CO3.	Understand about the CORBA concepts 5.Study about implementations in Components.	Understand
CO4.	Understand about the Client/Server concepts	Understand
CO5.	Design the EJB Architecture 3.Building an application with EJB.	Analyze

Course Contents

Module – I	CLIENT / SERVER CONCEPTS	9
Client - Server - File Server, Database server, Group server, Object server, Web server .Middleware – General middleware – Service specific middleware. Client / Server Building blocks – RPC – Messaging –Peer – to- Peer.		
Module – II	**EJB ARCHITECTURE**	**9**
EJB - EJB Architecture - Overview of EJB software architecture - View of EJB –Conversation – Building and Deploying EJBs – Roles in EJB.		
Module – III	**EJB APPLICATIONS**	**9**
EJB Session Beans – EJB entity beans – EJB clients – EJB Deployment – Building an application with EJB.		
Module – IV	**CORBA**	**9**
CORBA - Distributed Systems – Purpose - Exploring CORBA alternatives –Architecture overview – CORBA and networking model – CORBA object model – IDL – ORB - Building an application with CORBA.		
Module – V	**COM**	**9**

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COM – Data types – Interfaces – Proxy and Stub – Marshalling – Implementing Server / Client – Interface Pointers – Object Creation, Invocation , Destruction – Comparison COM
CORBA – Introduction to .NET – Overview of .NET architecture – Marshalling – Remoting.
Total : 45 Periods

Text Books:

1. Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client/Server Survival Guide", GalgotiaPublications Pvt. Ltd., 2002.
2. Tom Valesky,"Enterprise Java Beans",Pearson Education, 2002.
3. Jason Pritchard,"COM and CORBA side by side", Addison Wesley,2000

Reference Books:

1. Chris Britton, Peter Bye, "IT Architecture And Middleware, A Staligies For Building Large IntegratedSystem", Addition Wesley, 2004.
2. Jesse Liberty, "Programming C#", 2nd Edition, O'Reilly Press, 2002.
3. N. Wallace, :COM/DCOM Blue Book", Dreamtech Press, 2000.

Web reference:

1. http://www.cse.wustl.edu/~jain/tutorials/ftp/t_2tcp.pdf
2. http://ftp1.digi.com/support/documentation/0190074_j.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	2	
CO2	3	3	2										2	2	
CO3	3	2	2										2	2	
CO4	3	3	2										3	2	
CO5	3	2	2										2	2	
	3	High				2	Medium					1	Low		

Formative assessment			
loom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class/ Assignment	5	
	Attendance	5	

Summative Assessment

Bloom's Category	Internal Assessment Examinations			xamination (100)
	AE1 (5)	AE2 (10)	AE3 (10)	
Remember	0	0	0	0
Understand	10	10	10	10

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Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA05	**Mobile Computing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective				
Pre requisites	Basics of Mobile Computing				

Course Objectives

The course is intended to

1. To impart the knowledge on the GSM, SMS, GPRS Architecture.
2. To expose about wireless protocols -WLN, Bluetooth, WAP, Zig Beeissues.
3. To introduce the concept of Network, Transport Functionalities of Mobile communication.
4. To gain the knowledge of Adhoc and wireless sensor networks.
5. To impart the knowledge about Mobile Application Development.

Course Outcomes

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

Co.No	Course Outcome	Bloom's Level
CO1.	Gain the knowledge about various types of Wireless Data Networks and VoiceNetworks.	Understand
CO2.	Understand the architectures, the challenges and the Solutions of WirelessCommunication.	Understand
CO3.	Realize the role of Wireless Protocols in shaping the future Internet.	Analyze
CO4.	Gain the knowledge about Mobile Ad-Hoc and Sensor Networks.	Understand
CO5.	Able to develop simple Mobile Application Using Android.	Understand

Course Contents

Module – I	**Wireless Communication Fundamentals, Architecture**	**9**
Frequencies Spectrum- Multiplexing- Spread spectrum-GSM vs CDMA - 2G Mobile Wireless Services - Comparison of 2G and 3 G - GSM Architecture-Entities-Call Routing-PLMN-Address and identifiers- Network Aspects-Mobility Management-Frequency Allocation-Authentication and Security-SMS Architecture		
Module – II	**Mobile Wireless Short Range Networks**	**9**
Introduction-WLAN Equipment-WLAN Topologies-WLAN Technologies-IEEE 802.11 Architecture-WLAN MAC-Security of WLAN, Power Management-Standards- WAP Architecture-WAP 2.0-BluetoothenabledDevices Network-Layers in Bluetooth Protocol-Security in Bluetooth- IrDA- ZigBee		
Module – III	**Mobile IP Network Layer, Transport Layer**	**9**
Introduction-WLAN Equipment-WLAN Topologies-WLAN Technologies-IEEE 802.11 Architecture-WLANMAC-Security of WLAN, Power Management-Standards- WAP Architecture- WAP 2.0-Bluetoothenabled Devices Network-Layers in Bluetooth Protocol-Security in Bluetooth- IrDA- ZigBee		

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Module – IV	Mobile Ad-Hoc, Sensor Networks	9
Introduction to Mobile Ad hoc Network- MANET-Routing and Routing Algorithm-Security – Wireless SensorNetworks-Applications- Distributed Network and Characteristics-Communication Coverage- Sensing Coverage-Localization- Routing -Function Computation- Scheduling		
Module – V	**Mobile Application Development**	**9**
Mobile Applications Development -Application Development Overflow-Techniques for Composing Applications - Understanding the Android Software Stack – Android Application Architecture – Developing for Android – The Android Application Life Cycle – The Activity Life Cycle – Creating Your First Android Activity		
		Total : 45 Periods

Text Books:

1. Asoke K Talukder, HasanAhmed,Roopa R Yavagal "Mobile Computing", Tata McGraw Hill Publicatons.
2. Raj Kamal "Mobile Computing" Oxford Higher Education, Second Edition, 2012

Reference Books:

1. Vijay K Garg "Wireless Communications & Networking" Morgan Kaufmann Series, 2010.
2. JochenSchillar "Mobile Communications" Pearson Education second Edition
3. DonnFelker ,'Android Application Development For Dummies', Wiley, 2010

Web reference:

1. https://onlinecourses.nptel.ac.in/noc16_cs13,"MobileCommunications" by Prof. Pushpendra Singh,Ph.D, IIT Delhi
2. https://onlinecourses.nptel.ac.in/noc16_cs13/, "Mobile Development Platform" by Dr.Ranjan Bose, IIT Delhi.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3	2	
CO2	3	3	2										2	2	
CO3	3	2	2										2	2	
CO4	3	3	2										3	2	
CO5	3	2	2										2	2	
	3	High				2	Medium					1	Low		

Formative assessment			
loom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Tutorial Class/ Assignment	5	
	Attendance	5	

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Bloom's Category	Internal Assessment Examinations			xamination (100)
	IAE1 (5)	IAE2 (10)	IAE3 (10)	
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA06	GENERATIVE AI AND AUTOMATION	L	T	P	C
		2	0	2	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Basic Programming Knowledge and Logic Skills				

Course Objectives

The course is intended to

1. Introduce the fundamentals and evolution of generative AI technologies and models.
2. Explore free AI tools for literature review, research mapping, and reference management.
3. Develop skills in drafting, paraphrasing, and editing academic content using AI assistants.
4. Enable creation of visual content and formatting through AI-based platforms.
5. Examine ethical considerations and predict future trends in generative AI applications

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO1	Understand the fundamentals and evolution of generative AI, including neural networks and transformer models.	Understanding
CO2	Demonstrate the ability to search, identify, and organize relevant literature using AI-based free tools.	Apply
CO3	Apply AI tools to paraphrase, draft, and refine grammatically sound academic content.	Apply
CO4	Generate structured visuals, charts, and formatted content using AI-based and open-source platforms.	Apply
CO5	Analyze ethical concerns, limitations, and future implications of AI-generated content and human-AI collaboration.	Analyze

Course Contents

Module – I	**INTRODUCTION TO GENERATIVE AI**	**9**
Fundamentals and evolution of generative AI -Neural networks- Deep learning, and transformer models-AI Applications- ChatGPT- Gemini –Ideamap – Scribbr- Research Question Generator-Connected Papers-Research Rabbit-SciSpace		
Module – II	**AI TOOLS FOR LITERATURE REVIEW AND REFERENCE MANAGEMENT**	**9**
Elicit-Consensus-Inciteful-Semantic Scholar-Scite.ai- Zotero-Mendeley, -Meta (Facebook AI), Litmaps- Lens.org-OpenAlex- Researcher App.		
Module – III	**DRAFTING, PARAPHRASING, AND GRAMMAR ENHANCEMENT**	**9**
Quillbot-Grammarly-Hemingway Editor-Writefull-Trinka AI- LanguageTool- Slick Write-Paraphraser.io-Rewordify-Jenni.ai.		
Module – IV	**VISUALIZATION AND CONTENT FORMATTING**	**9**
AutoGPT-OpenDevin-AgentGPT-LangChain-FlowiseAI-Phidata,Julep-PrivateGPT, Jasper AI, DocGPT -ChromaDB., Stable Diffusion WebUI-ComfyUI -OpenLLM -DeepSpeed-Canva-Visme.		
Module – V	**ETHICS, CHALLENGES, AND FUTURE TRENDS**	**9**
Ethical concerns – bias, misinformation, privacy & intellectual property rights. Future trends - AI democratization and human-AI collaboration, Societal impact of generative AI.		
		Total : 45 Periods

TEXT BOOKS

1. Sam Anand, Generative AI with Python: Building Smart Applications Using GPT and More, Packt Publishing, 2023.
2. Joseph René Corbeil & Maria Elena Corbeil (Eds.), Teaching and Learning in the Age of Generative AI, 1st Edition, 2025, Routledge.
3. Numa Dhamani & Maggie Engler, Introduction to Generative AI, O'Reilly Media, 2025.
4. David M. Patel, Artificial Intelligence and Generative AI for Beginners: The Complete Guide, Tech Explorers Press, 2025.

REFERENCE BOOKS

1. Amit Bahree, Generative AI in Action, Manning Publications, 1st Edition, 2024.
2. Amit Babcock and Raghav Bali, Generative AI with Python and PyTorch – Second Edition, Packt Publishing, 2024.
3. Raghvendra Kumar, Sandipan Sahu, and Sudipta Bhattacharya, The Pioneering Applications of Generative AI, IGI Global, 2024.
4. Parmy Olson, Supremacy: AI, ChatGPT and the Race That Will Change the World, Pan Macmillan, 2024.

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5. Karen Hao, Empire of AI: Dreams and Nightmares in Sam Altman's OpenAI, Penguin Press, 2025.

ADDITIONAL REFERENCES

https://cloud.google.com/use-cases/free-ai-tools

https://microsoft.github.io/generative-ai-for-beginners/

https://developer.ibm.com/technologies/generative-ai/tutorials

https://www.forbes.com/sites/rachelwells/2024/12/02/7-free-generative-ai-courses-for-2025/

https://github.com/steven2358/awesome-generative-ai

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)														
COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
O 1	3	2	2	2	1	1						2	1	2
O 2	2	2	2	3	1	2						2	2	2
O 3	2	2	2	3	1	2						2	2	3
O 4	2	3	2	3	1	2						3	3	3
O 5	1	1	1	1	1	1						2	1	1
	3-High			2-Medium						1-Low				

Formative Assessment			
Blooms Taxonomy	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	Internal Assessment Examinations (IAE)			Final Examinations (FE)
	IAE – I (5)	IAE – II (10)	IAE – III (10)	60
Remember	0	0	0	0
Understand	10	10	10	10
Apply	30	30	30	40
Analyze	10	10	10	10
Evaluate	0	0	0	0
Create	0	0	0	0

BRIDGE COURSE

23PMCB03	OBJECT ORIENTED PROGRAMMING USING C++	L	T	P	C
		3	0	0	0
Nature of Course	Bridge Course				
Pre requisites	Basics of Programming in C				

Course Objectives

The course is intended

1. To learn about basic concepts in C++.
2. To learn about operator and expressions concepts.
3. To provide knowledge of flow control statements
4. To learn about object, classes, constructor and destructor.
5. To learn about arrays and functions.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	The students will be able to understand about basics concepts of C++.	Understand
CO 2	The students will be able to understand about operators and expressions concepts	Understand
CO 3	The students will be able to flow control statements	Understand
CO 4	The students will be able to understand about object, classes, constructor and destructor concepts.	Understand
CO 5	The students will be able to understand about Arrays and Functions.	Understand

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Course Contents

Module – I	**OVERVIEW OF C++**	**9**
History of C++ - OOPs Concept - Procedural VS OOP Programming - Keywords - Data Types - Constants - Variables- Operators - Expressions. Control Flow Statements.		
Module – II	**ARRAYS , FUNCTIONS AND FILES**	**9**
Array- one dimensional of array-two dimensional array - Functions - Declaration of Functions – Files and its Operations.		
Module – III	**OBJECT, CLASS AND CONSTRUCTOR**	**9**
Create object, Create class, Declaration of class, Scope of class, nested class, Inner Class. ConstructorIntroduction of Constructor – Types of Constructor – Destructor.		
Module – IV	**INHERITANCE**	**9**
Inheritance - Inheritance Types: Single Inheritance, Multiple Inheritance, Multi level Inheritance, Hybrid Inheritance, Hierarchical Inheritance.		
Module – V	**POLYMORPHISM**	**9**
Polymorphism - Function overloading-Function overriding - operator overloading.		
		Total : 45 Periods

Text Books

1. E. Balagurusamy, “Object Oriented Programming with C++”, Eighth Edition, 2021.

Reference Books

1. Herbert Schildt , “C++ : The Complete Reference”, Fourth Edition, 2017.

Additional References

1.nptel.ac.in/courses/111/105/1111663425
2.nptel.ac.in/courses/122/104/1221053234

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	3							3	2	
CO 2	1	2	1	2	3							3	2	
CO 3	1	2	1	2	3							3	2	
CO 4	1	2	1	2	3							3	2	

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CO 5	1	2	1	2	3							3	2	
	3-High				**2-Medium**				**1-Low**					

23PMCB04	**COMPUTER ORGANIZATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**0**
Nature of Course	Bridge Course				
Pre requisites	Nil				

Course Objectives

The course is intended

1. To impart the knowledge in the field of digital electronics.
2. To impart knowledge about the various components of a computer and its internals.
3. To realize the functionality of the ALU and Addressing modes.
4. To learn about Processor basics and Design
5. To learn about Memory and I / O Systems.

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	The students will be able to design digital circuits by simplifying the Boolean functions	Understand
CO 2	The students will be able to understand the organization and working principle of computer.	Understand
CO 3	The students will be able to understand logic units and Instructions of computer.	Understand
CO 4	The students will be able to know on the processor organization and design	Understand
CO 5	The students will be able to understand mapping between virtual and physical memory	Understand

Module – I	**DIGITAL FUNDAMENTALS**	**9**
Number Systems and Conversions – Boolean Algebra and Simplification – Minimization of Boolean Functions – Logic Gates – NAND – NOR Implementation.		
Module – II	**BASIC STRUCTURE OF COMPUTERS**	**9**
Functional units – Basic operational concepts – Bus structures – Performance and Metrics – Instruction and instruction sequencing – Hardware – Software Interface.		
Module – III	**ADDRESSING MODES AND ALU**	**9**
Addressing modes – Instructions sets – RISC and CISC – ALU design – Fixed point and Floating point operation.		

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Module – IV	PROCESSOR DESIGN	9
Processor basics - CPU Organization - Data path design - Control design - Basic concepts - Hard wired control - Micro programmed control - Pipeline control.		
Module – V	**MEMORY AND I/O SYSTEM**	**9**
Memory systems - Virtual memory - Caches - Design methods - Associative memories - Input / Output system - Programmed I / O - DMA and Interrupts.		
		Total : 45 Periods

Text Books

1. Morris Mano, "Digital Design", Fourth Edition, Prentice Hall of India, 2007.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.

Reference Books

1. Charles H. Roth, Jr., "Fundamentals of Logic Design", Eighth Edition, Jaico Publishing House, Mumbai, 2004.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Fourth Edition, Morgan Kaufmann, 2010.

Additional References

1. nptel.ac.in/courses/111/105/1111865656
2. nptel.ac.in/courses/122/104/1226545463

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	3	2	3							3	2	
CO 2	1	2	3	2	3							3	2	
CO 3	1	2	3	2	3							3	2	
CO 4	1	2	3	2	3							3	2	
CO 5	1	2	3	2	3							3	2	
	3-High				2-Medium				1-Low					

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23PMC301	AI & MACHINE LEARNING	L	T	P	C
		3	1	0	4
Nature of Course	Professional Course (PC)				
Pre requisites	To learn about basics of Python & Mathematics				

Course Objectives

The course is intended to

1. Understand fundamental concepts in Artificial Intelligence.
2. Learn about various searching methods
3. Study the techniques of knowledge representation.
4. Introduce applications of machine learning and case studies
5. Provide an insight to different supervised learning techniques Merits and demerits

Course Outcomes

On successful completion of the course the students will be able to

CO.No	Course Outcome	Bloom's Level
CO 1	Gain the advanced data analysis skills	Understand
CO 2	Create AI/ML solutions for various business problems	Understand
CO 3	Able to build and deploy production grade AI/ML applications	Apply
CO 4	Able to apply AI/ML methods	Apply
CO 5	Able to techniques and tools	Analyze

Course Contents

Module – I	INTRODUCTION	9
Intelligent Agents - Agents and environments - Good behaviour - The nature of environments Structure of agents-Problem Solving- problem solving agents - example problems - searching for Solutions - uniformed search strategies - avoiding repeated states - searching with partial information		
Module – II	**SEARCHING TECHNIQUES**	**9**
Informed search and exploration – Informed search strategies – heuristic function - local search algorithms and optimistic problems - local search in continuous spaces - online search agents and unknown environments - Constraint satisfaction problems (CSP) - Backtracking search and Local search for CSP		
Module – III	**NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS**	**9**

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Introduction to Logical Agents- First order logic – Syntax and semantics for first order logic - Using first order logic - Knowledge engineering in first order logic - Inference in First order logic – prepositional versus first order logic – unification and lifting – forward chaining – backward chaining -Resolution -Knowledge representation - Ontological Engineering.

Module – IV	**INTRODUCTION TO MACHINE LEARNING**	**9**
What and Why? Designing a learning system, Issues. Examples of Machine Learning Applications, Overview: Supervised Learning, Learning Associations, Classification, Regression, Unsupervised learning and Reinforcement Learning.		
Module – V	**SUPERVISED LEARNING AND UNSUPERVISED LEARNING**	**9**
Generative vs discriminative learning, Gaussian mixture models, Decision Tree learning, Neural Networks, Support vector machines, Instance based learning, Ensemble learning. Discovering clusters, Discovering latent factors, Discovering graph structure, Dimensionality reduction, Case Studies: Classification, Regression and clustering and anomaly detection.		
Total : 45 Periods		

Text Books

1. Stuart Russell, Peter Norvig, ¯Artificial Intelligence – A Modern Approach‖, 3rd Edition, Pearson Education / Prentice Hall of India, 2020.
2. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series" , 3rd Edition, MIT Press, 2019.

Reference Books

1. Nils J. Nilsson, ¯Artificial Intelligence: A new Synthesis‖, Harcourt Asia Pvt.Ltd., 2021.
2. Elaine Rich and Kevin Knight, Artificial Intelligence‖, 2nd Edition, Tata McGraw-Hill 2018.
3. JasonBell, ¯Machine learning Developers and Technical Professionals,1st Edition, Wiley, 2019

Additional References

1. https://nptel.ac.in/courses/106105077/
2. https://nptel.ac.in/courses/106105152/

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and ProgrammeSpecific Outcomes (PSO's)														
COs	**PO's**												**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	3	2	3	3	3							2	3	1
CO 2	3	2	3	2	3							2	3	2
CO 3	3	2	3	2	3							2	3	1
CO 4	3	2	3	2	3							2	3	2
CO 5	3	2	3	2	3							2	3	2
	3-High				**2-Medium**				**1- Low**					

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**E – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC302	**BLOCKCHAIN AND CRYPTOCURRENCY**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
Nature of Course	Professional Course (PC)				
Pre requisites	A foundational knowledge of cryptography, data structures, distributed systems and Java Programming				

Course Objectives

The course is intended to

1. Decompose a blockchain system's fundamental components, how they fit together and examine a decentralization using blockchain.
2. Explain how Crypto currency works, from when a transaction is created to when it is considered part of the blockchain.
3. Explain the components of Ethereum and programming languages for Ethereum.
4. Study the basics Hyperledger and Web3.
5. Provide details of alternative blockchain and blockchain projects in different perspective

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Course Outcomes

On successful completion of the course the students will be able to

CO No	Course Outcomes	Bloom's Level
CO1	Understand the technology components of Blockchain and how it works behind – the scenes.	Understand
CO2	Be aware of different approaches to developing Decentralized applications.	Apply
CO3	Establish deep understanding of the Ethereum model, its consensus model and code execution.	Apply
CO4	Understand the architectural components of a Hyperledger and its development framework.	Apply
CO5	Aware of the Alternative blockchains and emerging trends in blockchain	Analyze

Course Contents

Module – I	**BASICS OF BLOCKCHAIN**	**9**
Distributed Database, Two General Problem, Byzantine General Problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, and Zero Knowledge Proof		
Module – II	**TECHNOLOGY STACK**	**9**
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain		
Module – III	**DISTRIBUTED CONSENSUS**	**9**
Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.		
Module – IV	**CRYPTOCURRENCY**	**9**
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin		
Module – V	**CRYPTOCURRENCY REGULATION**	**9**
Stakeholders, Roots of Bitcoin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.		
Total : 45 Periods		

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Text Books

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2020.
2. Kumar Saurabh, AshutoshSaxena, Blockchain Technology: Concepts and Applications, Wiley, 2020

Reference Books

1. Andreas Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly Media; 1st edition, 2019
2. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger", Yellow paper.2020.
3. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.

Additional References

1. https://archive.nptel.ac.in/courses/106/104/106104220/
2. https://www.udemy.com/course/bitcoin-and-cryptocurrency-bootcamp

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)														
COs	**PO's**												**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 6	3	2	3	3	3							2	3	1
CO 7	3	1	3	2	2							2	3	2
CO 8	3	2	2	2	3							2	3	2
CO 9	3	2	3	2	2							2	3	2
CO 10	3	2	3	2	3							2	3	1
	3-High				**2-Medium**				**2- Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	
Summative Assessment			

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Bloom's Category	Internal Assessment Examinations (IAE)			Final Examinations (FE)
	IAE – I (5)	IAE – II (10)	IAE – III (10)	60
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC303	INTERNET OF THINGS	L	T	P	C
		3	1	0	4
Nature of Course	Professional Course				
Pre requisites	To knowledge of networking, sensing, databases, programming				

Course Objectives

The course is intended to

1. Understand the fundamentals of Internet of Things.
2. Build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
3. Learn communication protocols that is frequently used in IoT ecosystems.
4. Explore the ways of processing enormous amount of data generated in IoT based systems.
5. Understand the role of cloud computing in IoT and to become familiar with various cloud offerings

Course Outcomes

On successful completion of the course the students will be able to

CO No	Course Outcomes	Bloom's Level
CO1	Understand the enabling technologies and reference models of IoT.	Understand
CO2	Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.	Apply
CO3	Apply appropriate protocols in various parts of IoT based systems.	Apply
CO4	Understand Big Data tools and technologies and apply them in IoT based systems.	Apply
CO5	Design and deploy IoT based systems and connect them to cloud offerings.	Analyze

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Course Contents

Module – I	**ENABLING TECHNOLOGIES AND REFERENCE MODELS**	**9**
Sensors and Actuators – Centralized Sensing vs Distributed Sensing – Making Physical Objects as Smart Objects - Enabling Technologies - Wireless Sensor Networks, Cloud Computing and Data Analytics - IoT vs M2M - Possible IoT Reference Models - Domain Specific IoTs - Levels of IoT Based Systems.		
Module – II	**DESIGN OF END DEVICES**	**9**
Microprocessors vs. Microcontrollers – Open Source Movement in Hardware – Engineering vs Prototyping - Software Development Lifecycle for Embedded Systems - Arduino IDE - Programming and Developing Sketches - Arduino Rest APIs - Raspberry Pi - Interfaces - Python Packages of Interests for IoT		
Module – III	**IoT PROTOCOLS**	**9**
MAC Layer Protocols - IEEE 802.15.4 - G and E Variants of IEEE 802.15.4 - IEEE 802.11ah - IEEE 1901.2a - LoRaWAN - 6LoWPAN - From 6LoWPAN to 6Lo - NBIoT - REST Based Protocols - SCADA, CoAP and MQTT		
Module – IV	**INDUSTRIAL IoT**	**9**
Industrial IoT adoption - IIoT Challenges, Drivers and Taxonomies - Industry 4.0- Areas of IIoT Adoption -Tools and Technologies assisting IIoT - Case studies, Retail Industry, Home automation, Manufacturing Automation, Energy management, Health care and Workflow Management.		
Module – V	**IoT ANALYTICS**	**9**
Lambda Architecture – Flexible Netflow Architecture – Providing Multiservice in IoT using FNF Components. Cloud Storage Models and Communication API - WAMP AutoBahn - Xively Cloud - Python Web Application Framework - Django -IBM Watson - AWS for IoT - Case Studies.		
		Total : 45 Periods

Text Books

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A Hands-On Approach”, Universities Press, 2020.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2021.
3. David Hanes, Gonzalo Salguerio, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT

Reference Books

1. Perry Lea, “Internet of Things for Architects”, PACKT, 2020.
2. Ravi Ramakrishnan, Lovleen Gaur, “Internet of Things: Approach and Applicability in Manufacturing”, CRC press, Taylor, and Francis First Edition, 2019.

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Additional References

1. https://archive.nptel.ac.in/courses/106/105/106105166/
2. https://www.udemy.com/course/internet-of-things-the-mega-course

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)														
COs	**PO's**												**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	3	2	3						2	3	2
CO2	3	2	3	2	2	2						3	3	1
CO3	3	2	2	2	3	3						2	2	2
CO4	3	2	2	2	2	3						2	3	2
CO5	3	3	3	2	3	3						2	3	2
	3-High				**2-Medium**				**3- Low**					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMC304	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	2	3

Nature of Course	Professional Course (PC)
Pre requisites	To learn about basics of Java

Course Objectives

The course is intended to

1. Understand the fundamentals of Flutter
2. Build a dart flow statements with asynchronous programming and widget tree of dart
3. Learn Intermediate flutter using widgets and checking animations to an apps.
4. Explore the ways of processing navigation and effects layouts
5. Deploy database and become familiar with various formats to cloud environment

Course Outcomes

On successful completion of the course the students will be able to

CO No	Course Outcomes	Bloom's Level
CO1	sketch the internal and external packages of flutter framework	Understand
CO2	use various features in Dart Programming Language	Apply
CO3	develop an application using various components in Flutter Framework	Apply
CO4	make use of navigation, effects and layouts during app development	Apply
CO5	construct a web based mobile application that accesses database and cloud	Apply

Course Contents

Module – I	FLUTTER INTRODUCTION	6
Introducing Flutter – Widget Lifecycle Events- Widget Tree and Element Tree- Installing the Flutter SDK – Creating a Hello World APP: Setting Up the Project – Hot Reload – Themes to style – Stateless and stateful widgets – External Packages		
Module – II	**LEARNING DART**	**6**
Variables – Operators – Flow Statements – Functions – Packages – Classes – Asynchronous Programming – Creating a Starter Project Template – Understanding the Widget Tree: Building the full widget tree – building a shallow Widget Tree.		
Module – III	**INTERMEDIATE FLUTTER**	**6**
Common Widgets: Using Basic Widgets: SafeArea – Container – Text – RichText – Column – Row – Buttons – Images and Icons – Decorators – Form Widgets – Checking Orientation. Adding Animation to an APP: Animated Container – Animated CrossFade – Animated Opacity- Animation Controller		
Module – IV	**NAVIGATION, EFFECTS AND LAYOUTS**	**6**

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Navigator – Hero Animation – BottomNavigationBar – BottomAppBar – TabBar and TabBarView – Drawer and ListView – Card – ListView and ListTile – Gridview – Stack – CustomScrollView with Slivers - High-Level View of the Layout - Creating the LayoutSetting Up GestureDetector - Draggable and Dragtarget widgets - Moving and Scaling.		
Module – V	**DATABASE AND CLOUD DEPLOYMENT**	**6**
Saving Data with Local Persistence: JSON Format – Database Classes – Formatting Dates – Sorting – Retrieving Data – Adding the Firebase and Firestore Backend: Firebase and Cloud Firestore - Configuring the Firebase Project - Adding a Cloud Firestore Database and Implementing Security.		
		Total : 30 Periods

Text books:

1.Marco L. Napoli "Beginning Flutter A Hands On Guide To App Development", 1stEdition, John Wiley & Sons, 2020

2.Alessandro Biessek, "Flutter for Beginners: An introductory guide to building cross- platform mobile applications with Flutter and Dart 2", Packt Publishing, 1st Edition, 2019

Reference books:

1. Frank Zammetti, "Practical Flutter", 1st Edition, Apress, 2019

Additional References

1. https://archive.nptel.ac.in/courses/106/106/106106156/
2. https://www.udemy.com/topic/google-flutter/

List of Exercises:-

S.No	List of Exercises	CO Mapping	RBT
1	Write a dart program to implement string and array concept	CO1	Apply
2	Write a dart program using OOPS concept	CO1	Apply
3	Develop a dart program using list and set objects	CO2	Apply
4	Write a dart programs using Iterating Collections	CO2	Apply
5	Develop an application in android studio to understand the basics of the Flutter application	CO3	Apply
6	Develop a Flutter App by applying the Widgets, layouts and user management	CO3	Apply

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7	Write a Flutter code to perform navigation through screens	CO4	Apply
8	Develop an application using importing external libraries	CO4	Apply
9	Design a code to work with JSON data in Flutter	CO5	Apply
10	Implement session management using packages for login page	CO5	Apply

Total: 30 Periods

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3					2	2		2	2	2
CO2	3	3	3	3	3	2			2	3		2	2	2
CO3	3	3	3	3	3	2			2	3		2	2	2
CO4	3	3	3	3	3	2			2	3		2	2	2
CO5	3	3	3	3	3	2			2	3		2	2	2
	3-High				2-Medium				4- Low					

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMC305	**INTERNET OF THINGS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Nature of Course	Professional Course (PC)
Pre requisites	To learn about basics of Java

Course Objectives

The course is intended to

1. To familiarize the students to the basics of Internet of things and protocols.
2. It expose the students to some of the electrical engineering application areas where Internet of Things can be applied.
3. Implement interfacing of various sensors with Arduino/Raspberry Pi.
4. Demonstrate the ability to transmit data wirelessly between different devices
5. Design IoT systems for various real time applications

Course Outcomes

On successful completion of the course the students will be able to

CO No	Course Outcomes	Bloom's Level
CO1	Understand the enabling technologies and reference models of IoT.	Understand
CO2	Design portable IoT devices using Arduino IDE/ Raspberry Pi	Apply
CO3	Apply appropriate protocols in various parts of IoT based systems.	Apply
CO4	Understand Big Data tools and technologies and apply them in IoT based systems.	Apply
CO5	Design and deploy IoT based systems and connect them to cloud offerings.	Apply

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List of Exercises:

S.No	List of Exercises	CO Mapping	RBT
1	Familiarization with Arduino and perform necessary software installation.	CO1	Apply
2	To interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.	CO1	Apply
3	To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED when push button is pressed or at sensor detection.	CO2	Analyze
4	To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings.	CO2	Apply
5	To interface motor using relay with Arduino and write a program to turn ON motor when push button is pressed.	CO3	Analyze
6	To interface OLED with Arduino and write a program to print temperature and humidity readings on it.	CO3	Analyze
7	To interface Bluetooth with Arduino and write a program to send sensor data to smartphone using Bluetooth.	CO4	Apply
8	To interface Bluetooth with Arduino and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.	CO4	Apply
9	Write a program on Arduino to upload temperature and humidity data to thing speak cloud.	CO5	Apply
10	Write a program on Arduino connecting with Bluetooth device and signal transmission through Android smart phone to lightning the Colour LEDs RED, YELLOW,BLUE.	CO4	Apply
11	Write a program on Arduino to find soil moisturizing by using moisturizing sensor.	CO4	Apply
12	Write a program on Arduino connecting with Flame sensor to identify Fire & activate alarms.	CO4	Apply

Total Periods: 60

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lapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2								2	3	2
CO2	3	3	3	2	2								2	3	2
CO3	3	3	3	2	2								2	3	2
CO4	3	3	3	2	2								2	3	2
CO5	3	3	3	3	2								2	3	2
	3	High				2	Medium				1	Low			

Summative Assessment		
Bloom's Category	**Rubric based Continuous Assessment [50 marks]**	**Final Examinations [50 marks]**
Remember	0	0
Understand	0	0
Apply	30	50
Analyse	20	50
Evaluate	0	0
Create	0	0

23PMC306	**MINI PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
Nature of Course	Employability Course				
Pre requisites	To practice the knowledge in real world applications				

Course Objectives The course is intended to

1. Acquire practical knowledge within the chosen area of technology for project
2. Develop comprehensive and systematic approach of mini project.
3. Contribute as an individual or in a team in development of technical projects.
4. Develop effective communication skills for presentation.
5. Design a effective manner of database design.

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Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Understand the project development life cycle	Understand
CO2.	Develop the code for available information	Apply
CO3.	How to implement and debug the project	Apply
CO4.	Create applications	Apply
CO5.	Develop a database applications	Analyze

S. No.	RULES
1	Team Project with a maximum of four in a team
2	Students shall select a domain and develop an application with social relevance
3	Documentation is to be based on the standards
4	Evaluation pattern is like Lab examination
5	Need to submit a report, presentation with demo.
6	User Based Testing and feedback from the benefited society required

Total Periods:60

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	3								2	3	2
CO2	3	3	3	2	3								2	3	2
CO3	3	3	3	2	3								2	3	2
CO4	3	3	3	2	3								2	3	2
CO5	3	3	3	3	3								2	3	2
	3	High				2	Medium				1	Low			

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Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**ubric based Continuous Assessment[50 marks]**	**Final Examination [50 marks]**
Remember		
Understand	10	10
Apply	20	20
Analyze	20	20
Evaluate		
Create		

Professional Elective II –Semester III

23PMCA21	**SUPPLY CHAIN MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To learn about Supply Chain Management				

Course Objectives

The course is intended to

1. Describe the various streams of the supply chain
2. Describe the drivers of the supply chain
3. Describe the concepts employed in the supply chain
4. Explain about the strategies employed in the supply chain
5. Import a innovations idea of approach of SCM

Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Identify and explore the importance of supply chain management	Understand
CO2.	Design the supply chain network design	Apply
CO3.	Design the material flow of retail store	Apply
CO4.	strategies about the information flow	Apply
CO5.	Study about innovations in supply chain management	Apply

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Course Contents

Module – I	**INTRODUCTION**	**9**
Supply Chain – Fundamentals – Decision Phases - Process view – Importance- Competitive and supply chain strategies - Achieving strategic fit - Expanding Strategic scope - Drivers of Supply Chain Performance – A framework for Structuring drivers. Obstacles to achieving strategic fit.		
Module – II	**SUPPLY CHAIN NETWORK**	**9**
The role of distribution - Factors influencing network design - Distribution network - Value distribution - Distribution network in practice. The role of network - Factors influencing network design decisions – Frame work for network design decisions – The impact of globalization on supply chain networks.		
Module – III	**MANAGING MATERIAL FLOW**	**9**
Types of inventory – Inventory related costs – Drivers of transportation decisions – Devising a strategy for transportation - Vehicle scheduling - Transportation costs in E-Retailing. Network operations planning – Design problem – Design and operations model – Location of service systems.		
Module – IV	**MANAGING INFORMATION FLOW**	**9**
The role of forecasting – qualitative forecasting – quantitative methods – time series forecasting models –enabling supply chain management through information technology – strategic management framework for it adoption in supply chain management - supply chain management application marketplace future trends..		
Module – V	**SUPPLY CHAIN INNOVATIONS**	**9**
Internal integration – External integration – Building partnership and trust in a supply chain - Industry level initiatives - Supply chain mapping - Supply chain process restructuring - Postpone the posint of differentiation. High demand uncertainty environment – Illustration of responsive supply chain approach – supply chain disruptions and its impact to on business.		
		Total : 45 Periods

Text books:

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy Planning and Operation, PHI Learning / Pearson Education, Third Edition, 2007.
2. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, 1st Edition, 2009.

Reference books:

1. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education,5 th Edition, 2007.
2. Rahul .V. Altekar, Supply chain management concepts and cases, PHI 2005.
3. Joel D. Wisner, G. Keong Leong, Keah - Choon Tan, Principles of Supply Chain Management - A Balanced Approach, South - Western, Cengage Learning 2008.

Additional resources:

1. http://nptel.ac.in/courses/110106045/1“Operations and Supply Chain Management”,Prof.G. Srinivasan”, IIT Madras.
2. https://onlinecourses.nptel.ac.in/noc17_mg12/preview “Supply Chain Analytics”, Dr. RajatAgrawal, IIT Roorkee.

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	2							1	3	1	2
CO2	3	3	2	2	2							1	3	1	2
CO3	3	3	2	2	2							1	3	1	2
CO4	3	3	2	2	2							1	3	1	2
CO5	3	3	2	2	2							1	3	1	2
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMCA22	ORGANIZATIONAL BEHAVIOR	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	To Understand the Management Process				

Course Objectives

The course is intended to

1. Enable the students to understand the Organizational Behavior
2. Analyze various factors affecting Personality Organizational Change dynamic of groups
3. Understand various type of Group Behavior
4. Know about the purposes of performance determinants of personality
5. Know the list of characteristics of various leadership styles.

Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Students will have a better understanding of human behavior in organization.	Understand
CO2.	They will know the framework for managing individual and group performance.	Remember
CO3.	Characteristics of attitudes and components of attitudes – A brief discussion	Apply
CO4.	List the determinants of personality	Apply
CO5.	List the characteristics of various leadership styles.	Apply

Course Contents

Module – I	ORGANIZATIONAL BEHAVIOR INTRODUCTION	9
Organization Behaviour – Definition – Scope and Application in Management – Contributions of Other Disciplines to OB. Emerging Issues in Organizational Behaviour- Organizational behaviour models		
Module – II	**INDIVIDUAL PROCESSES**	**9**
Personality - types - Factors influencing personality- Theories. Emotions - Theories – Emotional Intelligence- Learning – Types of learners – The learning process – Learning theories. 80 Perceptions – Importance – Factors influencing perception- Attitudes – Nature of Attitudes Components of Attitudes Formation of Attitude Benefits of Positive Attitude Functions of Attitudes- Measurement-Motivation - Importance - Types - Theories.		
Module – III	**LEADERSHIP AND POWER**	**9**

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Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power - Power centers - Power and Politics		
Module – IV	**GROUP DYNAMICS**	**9**
Meaning – Types of Groups – Functions of Small Groups – Group Size Status – Managerial Implications - Group Behaviour - Group Norms - Cohesiveness - Group Thinking		
Module – V	**ORGANIZATIONAL CHANGE AND DEVELOPMENT**	**9**
Organizational Change: Meaning - Nature of Work Change - Need for Change - Change Process - Types of Change - Factors Influencing Change - Resistance to Change - Overcoming Resistance - Organizational Development: Meaning and Different Types of OD Interventions		
Total : 45 Periods		

Text books:

1. K. Aswathappa, "Organisational behaviour", Himalaya Publishing House Pvt. Ltd.11thEdition, 2020
2. Stephen P. Robbins, "Organizational Behavior", PHI Learning / Pearson Education, Edition 17, 2021 (Global edition)

Reference books:

1. Fred Luthans, "Organizational Behavior", McGraw Hill, 12th Edition 2021
2. Nelson, Quick, Khandelwal. "ORGB - An innovative approach to learning and teaching".Cengage, 2nd edition 2019
3. Ivancevich, Konopaske Matteson, "Organizational Behaviour & Management", Tata McGraw Hill, 7th edition, 2020

Additional References:

1. https://onlinecourses.swayam2.ac.in/cec20_mg03/preview
2. https://www.youtube.com/watch?v=4-BZN3QHFoI

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	2	2						1	3	3	2	2
CO2	3	2	3	2	2						1	3	3	2	2
CO3	3	2	3	2	2						1	3	3	2	2
CO4	3	2	3	2	2						1	3	3	2	2
CO5	3	2	3	2	2						1	3	3	2	2
	3	High				2	Medium				1	Low			

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA23	**MANAGEMENT INFORMATION SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To know about the Business and decision making				

Course Objectives

The course is intended to

1. Describe the role of information technology and decision support systems in business
2. Introduce the fundamental principles of computer-based information systems analysis and design
3. Expert system structures as strategic weapons to counter the threats to business and make business more competitive.
4. Enable the students to use information to assess the impact of the Internet and Internet technology.
5. Provide the theoretical models used in database management systems to answer business Questions

Course Outcomes

On successful completion of the course the students will be able to

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Co.No	Course Outcome	Bloom's Level
CO1.	Identify and explore the importance of Information System	Understand
CO2.	Understand about the Information Technologies	Apply
CO3.	Design the Business Applications	Apply
CO4.	Developing Business/IT Strategies	Apply
CO5.	Implementation of Management Challenge issues	Apply

Course Contents

Module – I	**BASIC CONCEPTS OF INFORMATION SYSTEM**	**9**
Role of data and information, Organization structures, Business Process, Systems Approach and introduction to Information Systems.		
Module – II	**TYPES OF INFORMATION SYSTEMS**	**9**
Resources and components of Information System, integration and automation of business functions and developing business models. Role and advantages of Transaction Processing System, Management Information System, Expert Systems and Artificial Intelligence, Executive Support Systems and Strategic Information Systems.		
Module – III	**ARCHITECTURE & DESIGN OF IS**	**9**
Architecture, development and maintenance of Information Systems, Centralized and Decentralized Information Systems, Factors of success and failure, value and risk of IS.		
Module – IV	**DECISION MAKING PROCESS**	**9**
Programmed and Non- Programmed decisions, Decision Support Systems, Models and approaches to DSS		
Module – V	**ENTERPRISE MANAGEMENT TECHNOLOGIES**	**9**
Business Process Reengineering, Total Quality Management and Enterprise Management System viz. ERP, SCM, CRM and Ecommerce.		
		Total : 45 Periods

Text books:

1. James AO'Brien, George M Marakas, Ramesh Behl, "Management Information Systems", McGraw Hill Education(India) Edition, 2020.
2. Management Information System Paperback –by C. Laudon Kenneth (Author), P. Laudon

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Jane (Author) Edition 2018

Reference book:

1. Laudon K.C, Laudon J.P, Brabston M.E, “Management Information Systems -Managing the digital firm”, Pearon Education, 2021.
2. Jeffrey A.Hoffer, Joey F.George, Joseph S. Valachich, “Modern Systems Analysisand Design”, Third Edition, Prentice Hall, 2021

Additional resources:

1. http://www.nptel.ac.in/courses/122105022/ “Management Information System”,Prof. BiswajitMahanty, IIT, Kharagpur.
2. https://archive.nptel.ac.in/courses/110/105/110105148/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	2							2	3	2	1
CO2	3	3	2	2	2							2	3	2	1
CO3	3	3	2	2	2							2	3	2	1
CO4	3	3	2	2	2							2	3	2	1
CO5	3	3	2	2	2							2	3	2	1
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA24	**AGILE METHODOLOGIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective(PE)				
Pre requisites	To understand the basic concepts of Software Engineering				

Course Objectives

The course is intended to

1. Provide students with a theoretical as well as practical understanding of agile software
2. development practices and how small teams can apply them to create high-quality software.
3. Provide a good understanding of software design and a set of software technologies and APIs.
4. A detailed examination and demonstration of Agile development and testing techniques.
5. Understand Agile development and testing

Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Realize the importance of interacting with business stakeholders in determining the requirements for a software system	Understand
CO2.	Perform iterative software development processes: how to plan them, how to execute them.	Apply
CO3.	Point out the impact of social aspects on software development success.	Apply
CO4.	Develop techniques and tools for improving team collaboration and software quality.	Apply

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CO5.	Show how agile approaches can be scaled up to the enterprise level	Apply

Course Contents

Module – I	**AGILE FUNDAMENTAL**	**9**
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values		
Module – II	**AGILE PROCESSES**	**9**
Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices		
Module – III	**AGILITY AND KNOWLEDGE MANAGEMENT**	**9**
Agile Information Systems – Agile Decision Making -Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM)		
Module – IV	**AGILITY AND REQUIREMENTS ENGINEERING**	**9**
Impact of Agile Processes in RE-Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment,– Agile Requirements Modeling and Generation		
Module – V	**AGILITY AND QUALITY ASSURANCE**	**9**
Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Agile Approach in Global Software Development - Agile Scrum - Scrum Master – Scaling Projects using Scrum		
		Total : 45 Periods

Text books:

1. David J. Anderson and Eli Schragenheim,, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Illustrated Edition, Prentice Hall PTR, 2019
2. Orit Hazza and Yaepl Dubinsky, "Agile Software Engineering,: Undergraduate Topics in Computer Science, Springer Verlag, First Edition, 2020.

Reference books:

1. Craig Larman, "Agile and Iterative Development: A Manager's Guide", Pearson Education, Second Impression, 2020
2. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Elsevier, Butterworth-Heinemann, First Edition, 2020.
3. Ken Schwaber, "Agile Project Management with Scrum", Illustrated, Revised Edition Microsoft Press, 2021

Additional resources:

1. **https://www.youtube.com/watch?v=x90kIAFGYKE**
2. https://www.youtube.com/watch?v=x90kIAFGYKE

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	2							2	3	2	1
CO2	3	3	2	2	2							2	3	2	1
CO3	3	3	2	2	2							2	3	2	1
CO4	3	3	2	2	2							2	3	2	1
CO5	3	3	2	2	2							2	3	2	1
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMCA25	ENTERPRISE RESOURCE PLANNING	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective(PE)				
Pre requisites	Fundamentals of Business Modules				

Course Objectives

The course is intended to

1. Impart the knowledge on of the fundamental concepts of ERP systems.
2. Expose the architecture and working of different modules in ERP.
3. Familiarize the activities of ERP Project Management cycle
4. Understand modules of SAP concepts
5. Understand of the ERP futures

Course Outcomes

On successful completion of the course the students will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Understand the main concepts of ERP.	Understand
CO2.	Outline the components ERP Implementation.	Apply
CO3.	Design of Business modules	Apply
CO4.	Practices used to SAP	Apply
CO5.	Able to identify Turbo Charges the ERP System	Analyze

Course Contents

Module – I	**INTRODUCTION TO ERP**	**9**
Overview – Benefits of ERP – ERP and Related Technologies – Business Process Reengineering – Data Warehousing – Data Mining – On-line Analytical Processing -Supply Chain Management.		
Module – II	**ERP IMPLEMENTATION**	**9**
Implementation Life Cycle – Implementation Methodology – Hidden Costs – Organizing Implementation - Vendors, Consultants and Users - Contracts - Project Management and Monitoring. .		
Module – III	**BUSINESS MODULES**	**9**

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Business Modules in an ERP Package - Finance - Manufacturing - Human Resource - Plant Maintenance - Materials Management - Quality Management - Sales and Distribution.

Module – IV	**ERP MARKET**	**9**
ERP Market Place – SAP AG – PeopleSoft – Baan Company – JD Edwards World Solutions Company - Oracle Corporation - QAD - System Software Associates.		
Module – V	**ERP – PRESENT AND FUTURE**	**9**
Turbo Charge the ERP System – EIA – ERP and E-Commerce – ERP and Internet – Future Directions in ERP.		
	Total : 45 Periods	

Text Books;

1. Enterprise resource planning: concepts and practice Garg, vinod kumar venkitakrishnan, N. K. Second Edition 2020
2. Enterprise Resource Planning, Alexis Leon, Tata McGraw-Hill, 2021

Reference Books

1. Enterprise Resource Planning, Veena Bansal Publisher(s): Pearson India,Second Edition June 2020
2. Enterprise Resource Planning Daniel E. O'Leary, Cambridge University Press, Second Edition June 2019

Additional resources:

1. https://nptel.ac.in/courses/110105148
2. https://nptel.ac.in/courses/110109122

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2								2	3	2	1
CO2	3	3	2	2								2	3	2	1
CO3	3	3	2	2								2	3	2	1
CO4	3	3	2	2								2	3	2	1

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CO5	3	3	2	2								2	3	2	1
	3	High				2	Medium				1	Low			

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA26	**SOCIAL NETWORK AND BUSINESS SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective(PE)				
Pre requisites	To learn about Social Networking in Business System				

Course Objectives

The course is intended to

1. Gain knowledge about social networks, its structure and their data sources.
2. Study about the knowledge representation technologies for social network analysis.
3. Analyze the data left behind in social networks.
4. Gain knowledge about the community maintained social media resources.
5. Learn about the visualization of social networks.

Course Outcomes

At the end of this course, learners will be able to

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Co.No	Course Outcome	Bloom's Level
CO1.	Explain the basic principles behind network analysis algorithms.	Understand
CO2.	Model and represent knowledge for social semantic Web.	Apply
CO3.	Use extraction and mining tools for analyzing Social networks.	Apply
CO4.	Discuss about community maintained social media resources.	Apply
CO5.	Develop personalized visualization for social networks	Analyze

Course Contents

Module – I	**INTRODUCTION TO SEMANTIC WEB**	**9**
The development of Semantic Web – Emergence of the Social Web – The Development of Social Network Analysis - Basic Graph Theoretical Concepts of Social Network Analysis - Electronic Sources for Network Analysis - Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks.		
Module – II	**KNOWLEDGE REPRESENTATION ON THE SEMANTIC WEB**	**9**
Ontology-based knowledge Representation – Ontology languages for the Semantic Web: RDF and OWL-Modeling Social Network Data - Network Data Representation, Ontological Representation of Social Individuals and Relationships -Aggregating and Reasoning with Social Network Data. .		
Module – III	**SOCIAL NETWORK MINING**	**9**
Detecting Communities in Social Network - Evaluating Communities -Methods for Community Detection - Applications of Community Mining Algorithms - Tools for detecting Communities - Application: Mining Facebook - Exploring Facebook's social Graph API - Analyzing social graph connections		
Module – IV	**COMMUNITY MAINTAINED SOCIAL MEDIA RESOURCES**	**9**
Community Maintained Resources - Supporting technologies for community maintained resources- User motivations-Location based social interaction – location technology- mobile location sharing - Social Information Sharing and social filtering - Automated recommender System		
Module – V	**VISUALIZATION OF SOCIAL NETWORKS**	**9**
Visualization of Social Networks - Node-Edge Diagrams – Random Layout – Force-Directed Layout – Tree Layout – Matrix Representations -Matrix and Node-Link Diagrams – Hybrid Representations - Visualizing Online Social Networks.		
Total : 45 Periods		

Text books:

1. Matthew A. Russell,"Mining the Social Web: Data Mining Facebook, Twitter,LinkedIn, Google+, Githuband more", O'REILLY, Third Edition, 2018.
2. CharuAggarwal, "Social Network Data Analytics," Springer, First Edition, 2020
3. Jennifer Golbeck, "Analyzing the social web", Waltham, MA: Morgan Kaufmann (Elsevier), First Edition, 2021.

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Reference books:

1. BorkoFurht, “Handbook of Social Network Technologies and Applications”, Springer, First Edition, 2021
2. Peter Mika, “Social Networks and the Semantic Web”, Springer, First Edition, 2019
3. Stanley Wasserman and Katherine Faust, “Social network analysis is: methods and applications”, Cambridge University Press, First Edition, 2018.

Additional resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs14/Semantic
2. https://onlinecourses.nptel.ac.in/noc24_cs14/Visualization

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	3							2	3	2	2
CO2	3	3	2	2	3							2	3	2	1
CO3	3	3	2	2	3							2	3	1	2
CO4	3	3	2	2	3							2	3	2	2
CO5	3	3	2	2	3							2	3	2	1
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0

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Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA27	ETHICAL HACKING & CYBER FORENSICS	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Networking fundamentals and Linux OS knowledge				

Course Objectives

The course is intended to

1. Understand the fundamentals and scope of ethical hacking and network penetration techniques.
2. Comprehend key concepts of data recovery, digital evidence acquisition, and authentication.
3. Apply various computer forensic technologies and assess vendor services.
4. Analyze methods for identifying and reconstructing electronic evidence and event trails.
5. Evaluate modern digital threats and the strategies employed by different threat actors.

Course Outcomes

On successful completion of the course the students will be able to

CO No	Course Outcomes	Bloom's Level
CO1	Understand the basics and significance of ethical hacking practices.	Understanding
CO2	Identify and classify various computer forensics tools and technologies.	Applying
CO3	Apply data recovery and evidence handling techniques effectively.	Applying
CO4	Analyze and reconstruct events from electronic evidence and data sources.	Analyzing
CO5	Evaluate digital threats and assess response strategies from multiple domains.	Evaluating

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Course Contents

Module- I	**INTRODUCTION TO ETHICAL HACKING**	**9**
Foundation for ethical hacking, ethical hacking in motion, hacking network hosts, hacking operating systems, hacking applications.		
Module -II	**CYBER THREATS AND ATTACKS**	**9**
AI-Powered Cyber attacks - Deep fake Scams - Highly Evasive Adaptive Threats (HEAT)- Remote Purchase Fraud - Teenage Hackers and Social Engineering - Supply Chain Attacks - Cloud-Based Threats - 5G Network Vulnerabilities - Insider Threats.		
Module -III	**NETWORK SECURITY**	**9**
Firewalls - Intrusion Detection and Prevention Systems (IDPS) - Virtual Private Networks (VPNs) - Network Access Control (NAC) - Secure Network Architecture - Wireless Network Security - Port Security - Security Information and Event Management (SIEM) - Network Encryption Protocols.		
Module- IV	**ACCESS CONTROL AND AUTHENTICATION**	**9**
Password less Authentication - Biometric Authentication - AI-Powered Access Control - Mobile Access Solutions - Cloud-Based Access Control - Integration with IoT Devices - Zero Trust Architecture (ZTA) - Multimodal Authentication - Unified Security Platforms.		
Module- V	**ELECTRONIC EVIDENCE AND THREAT ANALYSIS**	**9**
Discovery of electronic evidence-Identification of data- Reconstructing past events- Electronic traces and networks. Fighting against macro threats- Information warfare arsena - Tactics of the military- Tactics of terrorists and rogues- Tactics of private companies.		
		Total : 45 Periods

TEXT BOOKS:

1. EC-Council, Ethical Hacking and Countermeasures: Attack Phases, Cengage Learning, 2nd Edition, 2021
2. Chuck Easttom, Computer Security Fundamentals, Pearson, 4th Edition, 2023
3. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage, 6th Edition, 2023

REFERENCE BOOKS:

1. James Graham, Richard Howard, Ryan Olson – Cybersecurity Essentials, 3rd Edition, 2021, CRC Press
2. Marjie T. Britz – Computer Forensics and Cyber Crime: An Introduction, 4th Edition, 2022, Pearson
3. Kevin Mandia, Chris Prosise – Incident Response & Computer Forensics, 4th Edition, 2023, McGraw Hill.
4. Yuri Diogenes, Dr. Erdal Ozkaya, Cybersecurity Attack and Defense Strategies (4th Edition), Feb 2025

ADDITIONAL REFERENCES:

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1. https://www.cybrary.it - Cybersecurity and forensics training platform
2. https://www.sans.org - SANS Institute: Digital Forensics & Incident Response resources

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)														
COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	2	1	1						2	2	1
CO2	2	2	2	2	2	1						2	2	2
CO3	2	1	2	2	2	1						2	2	1
CO4	2	2	2	2	2	1						2	2	2
CO5	2	1	1	1	1	1						2	2	1
	3-High				2-Medium				1-Low					

Formative Assessment			
Blooms Taxonomy	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations (IAE)			Final Examinations (FE)
	IAE - I (5)	IAE - II (10)	IAE - III (10)	60
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	30
Analyze	10	10	10	10
Evaluate	10	10	10	10
Create	0	0	0	0

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PROFESSIONALELECTIVE–IIISEMESTER–III

23PMCA41	**Service Oriented Architecture**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	Fundamental of Web Services				

Course Objectives

The course is intended to

1. Know the basic principles of service oriented architecture, its components and techniques
2. Understand the architecture of web services
3. Design and develop web services using protocol
4. Acquire the fundamental knowledge of cloud computing
5. Understand knowledge of cloud computing architecture

Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Able to know the structure of XML and to design and store data in XML	Understand
CO2.	Able to apply SOAP, HTTP and UDDI services in the web applications	Apply
CO3.	Able to apply SOA architecture and the underlying design principles for the web projects	Apply
CO4.	Able to understand the role of SOA in J2EE and .NET	Understand
CO5.	Able to know the cloud computing architecture and the types of clouds	Apply

Course Contents

Module – I	**SOA BASICS**	**9**
Roots of SOA – Characteristics of SOA - Comparing SOA to client-server and distributed Internet architectures – Anatomy of SOA- How components in an SOA interrelate - Principles of service orientation – Service Layers.		
Module – II	**XML AND WEB SERVICES**	**9**
XML structure - Elements - Creating Well-formed XML - Name Spaces - Schema Elements, Types, Attributes – XSL Transformations – Parser – Web Services Overview – Architecture..		
Module – III	**WSDL, SOAP and UDDI**	**9**

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WSDL - Overview Of SOAP – HTTP – XML-RPC – SOAP: Protocol – Message Structure – Intermediaries – Actors – Design Patterns And Faults – SOAP With Attachments – UDDI.		
Module – IV	**SOA IN J2EE AND .NET**	**9**
SOA platform basics – SOA support in J2EE – Java API for XML-based web services (JAX-WS) - Java architecture for XML binding (JAXB) - Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC) - JAXP-JAX-RS SOA support in .NET - ASP.NET web services.		
Module – V	**CLOUD COMPUTING**	**9**
Vision of Cloud computing - Cloud Definition - Characteristics and Benefits - Virtualization - Cloud computing Architecture - Cloud Reference Model, Types of Clouds - Cloud Platforms in Industry.		
		Total : 45 Periods

Text books:

1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2020.
2. Heather Williamson, "XML, The Complete Reference", McGraw Hill Education, 2019.
3. Frank. P. Coyle, "XML, Web Services And The Data Revolution", Pearson Education,2020.
4. Richard Monson-Haefel, "J2EETM Web Services", Pearson Education,2007.
5. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", McGraw Hill Education, 2019.

References book:

1. Sandeep chatterjee, James Webber, "Developing Enterprise Web Services.
2. An Architect's Guide", Pearson Education, 2020.
3. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2019.
4. Dan woods and Thomas Mattern, "Enterprise SOA designing IT for Business Innovation", O'REILLY, First Edition, 2019.

Additional resources:

1. https://www.slideshare.net/Zubin67/lecture-notes-for-soa "Service oriented Computing and Service Oriented Architecture", W.T. Tsai, Arizona State University
2. https://onlinecourses.nptel.ac.in/noc24_cs14/Service

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	3							2	3	2	2
CO2	3	3	2	2	3							2	2	2	1
CO3	3	3	3	2	3							2	3	3	2
CO4	3	3	2	2	3							2	3	2	2
CO5	3	3	3	2	3							2	3	3	1
	3	High				2	Medium				1	Low			

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA42	**BIG DATA ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	Provides basic knowledge about Big data, its framework and its storage technologies				

Course Objectives

The course is intended to

1. Explore the fundamental concepts of big data analytics
2. Learn to analyze the big data using intelligent techniques.
3. Understand the various search methods and visualization techniques.
4. Learn to use various techniques for mining data stream.
5. Understand the applications using Map Reduce Concepts

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Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Work with big data platform and Understand the fundamentals of various big data analysis techniques	Understand
CO2.	Analyze the big data analytic techniques for useful business applications.	Apply
CO3.	Design efficient algorithms for mining the data from large volumes.	Apply
CO4.	Analyze the HADOOP and Map Reduce technologies associated with big data analytics	Understand
CO5.	Explore the applications of Big Data	Apply

Course contents

Module – I	**INTRODUCTION TO BIG DATA**	**9**
Analytics -Nuances of big data -Value -Issues -Case for Big data -Big data options Team challenge – Big data sources -Acquisition -Nuts and Bolts of Big data. Features of Big Data -Security, Compliance, auditing and protection-Evolution of Big data -Best Practices for Big data Analytics -Big data characteristics -Volume, Veracity, Velocity, Variety -Data Appliance and Integration tools -Green plum – Informatica.		
Module – II	**HADOOP**	**9**
Introduction – Distributed Computing Challenges – Hadoop Overview – Hadoop Distribution - HDFS - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Hadoop Ecosystem		
Module – III	**BIG DATA TECHNOLOGY LANDSCAPE AND MONGODB**	**9**
NoSQL: Types of NoSQL - SQL versus NoSQL - MongoDB - Terms used in RDBMS and MongoDB – Data types – MongoDB Query Language - Introduction to MapReduce Programming		
Module – IV	**HIVE & PIG**	**9**
Hive – Hive Architecture – Data Types - File Format – Hive Query Language – Pig: Anatomy – Pig Latin Overview - Data Types – Running Pig – Execution Modes of Pig – HDFS commands - Relational Operators - Eval function - Complex Data types - Piggy Bank - User-Defined Functions - Parameter substitution.		
Module – V	**CASSANDRA**	**9**
Introduction - Features - Data Types - CQLSH - CRUD - Collections - Using a Counter - Time to Live - Alter Commands - Import and Export - Querying System Tables..		
		Total : 45 Periods

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Text books:

1. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2020.
2. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2019
3. Tom White, Hadoop: The Definitive Guide, O'Reilly, 2019

References book:-

1. Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2020.
2. Kafka: The Definitive Guide- Real-Time Data and Stream Processing at Scale, by Gwen Shapira, Neha Narkhede ,Todd Palino,"O'Reilly,2020

Additional Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview.
2. https://nptel.ac.in/courses/106104189

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2								2	3	2	2
CO2	3	3	2	2								2	2	2	1
CO3	3	3	3	2								2	3	3	2
CO4	3	3	2	2								2	3	2	2
CO5	3	3	3	2								2	3	3	1
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA43	**DATABASE TUNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To understand database tuning with query optimization				

Course Objectives

The course is intended to

1. Impart the knowledge on the significance of database tuning.
2. Provide familiarity with query optimization for tuning databases.
3. Gain the knowledge about the tuning based E-commerce applications.
4. Explore the knowledge about trouble shooting
5. Understand the knowledge about implementation of case studies

Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Identify and explore the importance of Database tuning	Understand
CO2.	Design the architecture for an Data structure	Apply
CO3.	Design the optimizing indexes	Apply
CO4.	Design the Trouble Shooting methods for Database tuning.	Apply
CO5.	Implementation of Tuning E-Commerce Applications	Analyze

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Course contents

Module – I	**RELATIONAL DATABASES**	**9**
Review of Relational Databases -Relational Algebra -Locking and Concurrency Control -Correctness Consideration -Lock Tuning -Logging and the Recovery Subsystem – Principles of Recovery -Tuning the Recovery Subsystem -Operating Systems Considerations – Hardware Tuning.		
Module – II	**OPTIMIZING INDEXES**	**9**
Types of Queries-Data Structures -B-tree -B+ Tree -Hash Structures -Bit Map Indexes -Clustering Indexes -Non Clustering Indexes -Composite Indexes -Hot Tables – Comparison of Indexing and Hashing		
Module – III	**QUERY OPTIMIZATION**	**9**
Tuning Relational Systems -Normalization -Tuning Normalization -Clustering Two Tables -Aggregate Maintenance -Record Layout -Query Tuning -Triggers -Client Server Mechanisms - Objects - Application Tools and Performance -Tuning the Application Interface - Bulk Loading Data -Accessing Multiple Databases.		
Module – IV	**TROUBLESHOOTING**	**9**
Analytics -Nuances of big data -Value -Issues -Case for Big data -Big data options Team challenge – Big data sources -Acquisition -Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing and protection-Evolution of Big data -Best Practices for Big data Analytics -Big data characteristics -Volume, Veracity, Velocity, Variety -Data Appliance and Integration tools -Green plum - Informatica.		
Module – V	**CASE STUDIES**	**9**
Tuning E-Commerce Applications -E-Commerce Architecture -Tuning E-Commerce Architecture - Transaction Chopping -Time Series Databases -Understanding Access Plans - Configuration Parameters -Oracle -SQL Server -DB2UDB -Distributed Database - Implementation.		
		Total : 45 Periods

Text books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, McGraw Hill, 6th Edition, 2019. (Unit 1).
2. Dennis Shasha and Philippe Bonnet, “Database Tuning, Principles, Experiments, and Troubleshooting Techniques”, Morgan Kaufmann, An Imprint of Elsevier, 2021.

Reference books:

1. Mittra, Sitansu S, “Database Performance Tuning and Optimization Using Oracle” Springer, 2020.
2. Bill Padfield, Darl Kuhn, Sam R. Alapati, “Oracle Database 12c Performance Tuning Recipes: A Problem-Solution Approach”, APress, December 2021.
3. M.TamerOzsu, Patrick Valduriez and S.Sridhar, “Principles of Distributed Database Systems”, Pearson Education, 2019.

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Additional resources:

1. http://www.nptelvideos.in/2012/11/database-management-system.html,"Database Management Systems", Prof.D.Janakiram, Department of Computer Science and Engineering, IIT Madras/ Dr. S. Srinath, IIIT Bangalore.

2. https://www.youtube.com/watch?v=v8Ach7-ugDY,"Query Optimization Database Management Systems", Prof.S.Sudarshan, Department of Computer Science and Engineering, IIT, Bombay

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3										3	2	2
CO2	3	3	2										2	2	1
CO3	3	3	3										3	3	2
CO4	3	3	2										3	2	2
CO5	3	3	3										3	3	1
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA44	**SOFTWARE RELIABILITY ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To understand the challenges and optimization of reliability engineering				

Course Objectives

The course is intended to

1. Familiarize the concepts of reliability
2. Expose the issues in system and models
3. Expose about design for reliability
4. Expose the concept of design for maintainability
5. Provide the challenges and optimization of system reliability

Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Construct the reliability engineering	Understand
CO2.	Gain Knowledge about system models concepts	Apply
CO3.	Understand about principles of reliability	Understand
CO4.	Able to design computer based maintainability	Apply
CO5.	Gain Knowledge about optimization of system reliability	Analyze

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Course Contents

Module – I	**CONCEPTS OF RELIABILITY**	**9**
Definition of reliability – reliability Vs quality-reliability function-MTTF – hazard rate function- bathtub curve – derivation of the reliability function-constant failure rate model – time dependent failure models. Weibull distribution – normal distribution – the lognormal distribution. Serial configuration – parallel configuration.		
Module – II	**SYSTEM AND MODELS**	**9**
Combined series parallel systems – system structure function, minimal cuts and minimal paths – Markov analysis – load sharing systems, standby system, degraded systems, three state devices – covariate models, static models, dynamic models, physics of failure models.		
Module – III	**DESIGN FOR RELIABILITY**	**9**
Reliability design process – system effectiveness – economic analysis and life cycle cost – reliability allocation – optimal, Arinc, Agree, – Design methods – parts and material selection, derating, stress- strength analysis – failure analysis – identification of failure mode – determination of causes –assessment of effects – classification of seventy – computation of critically index – corrective action – system safety and FTA. Analysis of downtime – the repair time distribution – stochastic point processes – system repair time		
Module – IV	**DESIGN FOR MAINTAINABILITY**	**9**
Reliability under preventive maintenance – state dependent systems with repair – MTTR-mean system downtime – MTR – MH/OH – cost model – fault isolation and self diagnostics – repair Vs replacement – replacement model –proactive,preventive,predictive maintenance – maintenance and spares provisioning –maintainability prediction and demonstration – concepts and definition of availability.		
Module – V	**OPTIMIZATION OF SYSTEM RELIABILITY**	**9**
Optimization techniques for system reliability with redundancy – heuristic methods applied to optimal system reliability- redundancy allocation by dynamic programming – reliability optimization by non linear programming.		
		Total : 45 Periods

Text books:

1. Charles E. Ebling, “An introduction to Reliability and Maintainability Engg”, Tata McGraw-Hill, 2020.
2. Patrick D T o’connor, “Practical Reliability Engineering”, John-Wiley and Sons inc, 2021.

Reference books:

1. David J Smith, “Reliability, Maintainability and Risk: Practical Methods for Engineers”, Butterworth, 2020.
2. Way kuo, Rajendra Prasad V, Frank A and Tillman, ching- lai Hwang “Optimal Reliability Design and Applciations”, Cambridge University Press P ltd., 2019.
3. Oleg Vinogradov, “Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 2021.

Additional resources:

1. https://www.youtube.com/watch?v=TNJ5eXpege0
2. https://www.youtube.com/watch?v=2jXCn7q2wEI

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2									3	2	2
CO2	3	3	2	2									2	2	1
CO3	3	3	3	3									3	3	2
CO4	3	3	2	2									3	2	2
CO5	3	3	3	3									3	3	1
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

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23PMCA45	**C# and ASP .NET PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To understand the basic knowledge of C or C++ or any programming language or programming fundamentals.				

Course Objectives

The course is intended to

1. Understand the foundations of CLR execution.
2. Learn the technologies of the .NET framework.
3. Know the object oriented aspects of C#.
4. Be aware of application development in .NET.
5. Learn web based applications on .NET (ASP.NET).

Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	List the major elements of the .NET frame work	Understand
CO2.	Explain how C# fits into the .NET platform.	Apply
CO3.	Analyze the basic structure of a C# application	Analyze
CO4.	Debug, compile, and run a simple application.	Apply
CO5.	Develop programs using C# on Web based applications .NET	Analyze

Course contents

Module – I	**INTRODUCTION TO C#**	**9**
Concepts of C#, overview of C#, Literals, Variables, Data Types, Operators, checked and unchecked operators, Expressions, Branching, Looping, Methods, implicit and explicit casting, Constant, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing.		
Module – II	**OBJECT ORIENTED ASPECTS OF C#**	**9**

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Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism, sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.		
Module – III	**APPLICATION DEVELOPMENT ON .NET**	**9**
Building windows application, Creating our own window forms with events and controls, menu creation, inheriting window forms, SDI and MDI application, Dialog Box(Modal and Modeless), accessing data with ADO.NET, DataSet, typed dataset, Data Adapter, updating database using stored procedures, SQL Server with ADO.NET, handling exceptions, validating controls, windows application configuration		
Module – IV	**WEB BASED APPLICATION DEVELOPMENT ON .NET**	**9**
Programming web application with web forms, ASP.NET introduction, working with XML and .NET, Creating Virtual Directory and Web Application, session management techniques, web.config, web services, passing datasets, returning datasets from web services, handling transaction, handling exceptions, returning exceptions from SQL Server.		
Module – V	**CLR AND .NET FRAMEWORK**	**9**
Assemblies, Versoning, Attributes, reflection, viewing meta data, type discovery, reflection on type, marshalling, remoting, security in .NET		
Total : 45 Periods		

Text books:

1. Herbert Schildt, “The Complete Reference: C# 4.0”, Tata Mc Graw Hill, 2021.
2. Christian Nagel et al. “Professional C# 2019 with .NET 4.5”, Wiley India, 2020.

References:

1. Andrew Troelsen , “Pro C# 2020 and the .NET 4 Platform, Fifth edition, A Press, 2019.
2. Ian Griffiths, Matthew Adams, Jesse Liberty, “Programming C# 4.0”, Sixth Edition, O‟Reilly, 2020.

Additional resources:

1. https://www.nptel.com/watch?v=TN764682
2. https://www.nptel.com/watch?v=2jXC3544I

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	2								3	2	2
CO2	3	3	2	2	2								2	2	1
CO3	3	3	3	3	1								3	3	2
CO4	3	3	2	2	2								3	2	2
CO5	3	3	3	3	1								3	3	1
	3	High				2	Medium				1	Low			

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA46	**NATURAL LANGUAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To understand the concept of Natural Language Processing				

Course Objectives

The course is intended to

1. Learn the fundamentals of natural language processing
2. Understand word level and syntactic analysis.
3. Understand the role of semantics of sentences and pragmatics
4. Get knowledge about the machine translation.
5. about NLG machine transaction

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Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Tag a given text with basic Language features	Understand
CO2.	Design an innovative application using NLP components	Apply
CO3.	Implement a rule based system to tackle morphology/syntax of a language	Apply
CO4.	Design a tag set to be used for statistical processing for real-time applications	Apply
CO5.	Apply NLG and machine transaction	Apply

Course contents

Module – I	**TEXT PROCESSING BASICS**	**9**
Overview: NLP-Language - Text Processing – Spelling Correction – Weight Edit Distance- other Variations – Noisy Channel Model for spelling correction -N-Gram Language Models - Evaluation of Language models- Basic Smoothing.		
Module – II	**LANGUAGE MODELLING AND SMOOTHING**	**9**
Language modeling - smoothing models - Computational Morphology - Finite state Methods for morphology - Introduction to POS tagging - Hidden Markov model for POS tagging - Models for sequential parsing - MaxEnt- CRF.		
Module – III	**SYTAX, PARSING, SEMANTICS**	**9**
Syntax – Parsing – CKY-PCFGs – Inside and outside probabilities - Dependency grammar and parsing - Transition based Parsing - Formulation - Learning. MST Based Parsing - Distributional model for semantics - Word Embeddings - Lexical Semantics-word Net - Word Sense Disambiguation - Novel word sense detection.		
Module – IV	**TOPIC MODELS AND INFORMATION EXTRACTION**	**9**
Programming web application with web forms, ASP.NET introduction, working with XML and .NET, Creating Virtual Directory and Web Application, session management techniques, web.config, web services, passing datasets, returning datasets from web services, handling transaction, handling exceptions, returning exceptions from SQL Server.		
Module – V	**TEXT SUMMARIZATION & TEXT CLASSIFICATION**	**9**
Optimization Based models for summarization – Evaluation- Text classification – sentiment Analysis - Affective lexicon -Learning affective lexicons - computing with affective lexicons		
		Total : 45 Periods

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TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin¯Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech,3rd Edition,Pearson Publication, 2019.

2. Steven Bird, Ewan Klein and Edward Loper, ¯Natural Language Processing with Python, First Edition, OReilly Media, 2020.

REFERENCES BOOKS:

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, 1st Edition, Atlantic Publisher, 2019.

2. Richard M Reese, Natural Language Processing with Java, 2rd Edition, OReilly Media, 2020.

3. NitinIndurkhya and Fred J. Damerau, ¯Handbook of Natural Language Processing,2rd Edition, Chapman and Hall/CRC Press, 2021

Additional resources:

1. http://nptel.ac.in/courses/106106129/28

2. http://nptel.ac.in/courses/110106064/“

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	2								3	2	2
CO2	3	3	2	2	2								2	2	1
CO3	3	3	3	3	1								3	3	2
CO4	3	3	2	2	2								3	2	2
CO5	3	3	3	3	1								3	3	1
	3	High				2	Medium				1	Low			

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA47	**CYBER SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Nature of Course	Professional Elective (PE)				
Pre requisites	To understand the basic network concepts				

Course Objectives

The course is intended to

1. Learn the principles of cyber security and to identify threats and risks.
2. Learn how to secure physical assets and develop system security controls.
3. Understand how to apply security for Business applications and Network Communications.
4. Learn the technical means to achieve security.
5. Learn to monitor and audit security measures..

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Course Outcomes

At the end of this course, learners will be able to

Co.No	Course Outcome	Bloom's Level
CO1.	Develop a set of risk and security requirements to ensure that there are no gaps in an organization's security practices.	Understand
CO2.	Achieve management, operational and technical means for effective cyber security.	Apply
CO3.	Audit and monitor the performance of cyber security controls.	Apply
CO4.	Spot gaps in the system and devise improvements.	Apply
CO5.	Identify and report vulnerabilities in the system	Analyze

Module – I	**PLANNING FOR CYBER SECURITY**	**9**
Best Practices-Standards and a plan of Action-Security Governance Principles, components and Approach-Information Risk Management-Asset Identification-Threat Identification-Vulnerability Identification-Risk Assessment Approaches-Likelihood and Impact Assessment-Risk Determination, Evaluation and Treatment-Security Management Function- Security Policy-Acceptable Use Policy Security Management Best Practices - Security Models: Bell La Padula model, Biba Integrity Model - Chinese Wall model		
Module – II	**SECURITY CONTROLS**	**9**
People Management-Human Resource Security-Security Awareness and Education-Information Management- Information Classification and handling-Privacy-Documents and Record Management Physical Asset Management-Office Equipment-Industrial Control Systems-Mobile Device Security System Development-Incorporating Security into SDLC - Disaster management and Incident response planning.		
Module – III	**CYBER SECURITY FOR BUSINESS APPLICATIONS AND NETWORKS**	**9**
Business Application Management-Corporate Business Application Security-End user Developed Applications-System Access- Authentication Mechanisms-Access Control-System Management Virtual Servers-Network Storage Systems-Network Management Concepts- Firewall-IP Security Electronic Communications - Case study on OWASP vulnerabilities using OWASP ZAP tool.		
Module – IV	**TECHNICAL SECURITY**	**9**
Supply Chain Management-Cloud Security-Security Architecture-Malware Protection-Intrusion Detection-Digital Rights Management-Cryptographic Techniques-Threat and Incident Management Vulnerability Management-Security Event Management-Forensic Investigations-Local Environment Management-Business Continuity..		
Module – V	**SECURITY ASSESSMENT**	**9**
Security Monitoring and Improvement-Security Audit-Security Performance-Information Risk Reporting-Information Security Compliance Monitoring-Security Monitoring and Improvement Best Practices		

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Total : 45 Periods

Text Books

1. William Stallings, “Effective Cyber Security - A guide to using Best Practices and Standards”, Addison-Wesley Professional, First Edition, 2019.
2. Adam Shostack, “Threat Modelling - Designing for Security”, Wiley Publications, First Edition,2020.
3. Gregory J. Touhill and C. Joseph Touhill, “Cyber Security for Executives - A Practical Guide”,Wiley Publications, First Edition, 2021.

Reference Books

1. Raef Meeuwisse, “Cyber Security for Beginners”, Second Edition, Cyber Simplicity Ltd, 2018.
2. Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy”, 2nd Edition, Syngress, 2019.
3. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, “Security in Computing”, Fifth Edition, Prentice Hall, 2021.

Additional References

1. https://nptel.ac.in/courses/106105479/
2. https://nptel.ac.in/courses/106105578/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	1								3	2	2
CO2	3	3	2	2	2								2	2	1
CO3	3	3	3	3	1								3	3	2
CO4	3	3	2	2	2								3	2	1
CO5	3	3	3	3	1								3	3	2
	3	High				2	Medium				1	Low			

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	
Understand	Tutorial class / Assignment	5	
Apply			

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	Attendance	5	15

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**E – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	20	20	20	40
Analyze	20	20	20	50
Evaluate	0	0	0	0
Create	0	0	0	0

23PMCA48	COMPUTER GRAPHICS AND 3D MODELING FOR XR	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective (PE)				
Pre requisites	Basic Programming Knowledge and Logic Skills				

Course Objectives
The course is intended to

1. Understand the fundamentals of computer graphics and 3D modeling concepts.
2. Explore rendering and animation techniques for immersive XR environments.
3. Learn methods to create 3D models optimized for XR applications.
4. Apply transformations and projections for interactive 3D scenes.
5. Develop skills to integrate 3D graphics into XR platforms like VR and AR.

Course Outcomes
On successful completion of the course the students will be able to

CO No	Course Outcomes	Bloom's Level
CO1	Explain core concepts of computer graphics and 3D modeling	Understanding
CO2	Demonstrate knowledge of rendering and animation techniques for XR	Applying
CO3	Create optimized 3D models suitable for XR applications	Creating
CO4	Apply geometric transformations and projections to 3D scenes	Applying
CO5	Develop basic XR experiences integrating 3D models and graphics.	Creating

.

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Course Contents

Module – I	**INTRODUCTION**	**9**
Fundamentals of computer graphics-Graphics pipeline-Coordinate systems-Overview of extended reality (XR), virtual reality (VR), augmented reality (AR), mixed reality (MR)-Applications and significance.		
Module – II	**3D MODELING FUNDAMENTALS**	**9**
Geometric primitives- Mesh structures-Polygonal modelling-NURBS-Subdivision surfaces-Texture mapping-Material properties.		
Module – III	**RENDERING AND ANIMATION FOR XR**	**9**
Rendering techniques (rasterization, ray tracing)- lighting models-shading model-animation basics- skeletal rigging-keyframe animation.		
Module – IV	**TRANSFORMATIONS AND PROJECTIONS**	**9**
Translation-scaling- rotation in 3D- view transformations-camera models-orthographic projection- perspective projection.		
Module – V	**XR INTEGRATION AND APPLICATIONS**	**9**
XR hardware overview-XR software platforms-importing 3D models into Unity and Unreal Engine-performance optimization-interaction design basics for XR.		
		Total : 45 Periods

TEXT BOOKS

1. Tom Taulli, Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business, Springer, 1st Edition, 2023.

2. David Foster, Generative Deep Learning: Unlocking the Creative Power of AI and Python, O'Reilly Media, 2nd Edition, 2023.

3. Mark Liu, Learn Generative AI with PyTorch, Manning Publications, 1st Edition, 2024.

4. Chris Fregly, Antje Barth, and Shelbee Eigenbrode, Generative AI on AWS, O'Reilly Media, 1st Edition, 2023.

5. James Phoenix and Mike Taylor, Prompt Engineering for Generative AI: Future-Proof Inputs for AI Systems, Apress, 1st Edition, 2025.

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1. Steven M. LaValle, Virtual Reality, Cambridge University Press, 1st Edition, 2023.
2. Jianbo Su and Xiuquan Qiao (Eds.), Advances in Haptics and Virtual Reality: Proceedings of ICHVR 2023, Springer, 1st Edition, 2024.
3. Editors, AI Technologies and Virtual Reality: Proceedings of AIVR 2023, Springer Singapore, 1st Edition, 2024.
4. Cyane Tornatzky and Kelley, An Artistic Approach to Virtual Reality, Routledge, 1st Edition, 2023.
5. Jessica Stone (Ed.), Mental Health Virtual Reality: The Power of Immersive Worlds, John Wiley & Sons, 1st Edition, 2025.

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1. https://semanticscholar.org
2. https://elicit.com/tools/ai-for-research
3. https://numerous.ai/blog/free-ai-tools-for-research
4. https://guides.library.georgetown.edu/ai/tools
5. https://library.hkust.edu.hk/sc/ai-tools-with-genuine-sources

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

COs	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	1	1						2	2	1
CO2	3	3	3	3	1	2						2	3	2
CO3	2	3	3	3	1	3						3	3	2
CO4	3	2	3	2	1	1						3	2	1
CO5	3	3	2	3	1	3						3	3	2
	3-High				2-Medium				1- Low					

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Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	10	10	10
Apply	15	15	15	25
Analyze	0	0	0	10
Evaluate	0	0	0	0
Create	5	10	10	15

23PMCA49	Quantum Computing	L	T	P	C
		2	0	2	3
Nature of Course	Professional Elective				
Pre requisites	Basic Linear Algebra and Python Programming				

Course Objectives

The course is intended

1. To learn the basics of quantum mechanics, qubits, quantum states, and quantum circuits.
2. To apply basic quantum gates and algorithms using simple models and Python.
3. To study quantum information, noise, and errors in quantum systems.
4. To evaluate quantum error correction methods and fault-tolerant computation.

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5. To create basic quantum information models and simple cryptography using Python.

Course Outcomes

On successful completion of course the students can learn

CO.No	Course Outcome	Bloom's Level
1	**To Identify** the fundamentals of quantum mechanics, qubits, quantum states, and the quantum circuit model.	Understand
2	**To Use and implement** basic quantum gates and quantum algorithms with mathematical models and Python simulations.	Apply
3	To Examine and interpret quantum information, noise models, and the effects of errors on quantum systems	Apply
4	To assess quantum error correction techniques and fault-tolerant quantum computation using analytical methods and Python tools.	Apply
5	To Design and develop simple quantum information models and cryptographic concepts using entropy measures and Python-based analysis.	Apply

Course Contents

Module – I	QUANTUM MECHANICS AND QUANTUM COMPUTATION	**9**
Basics of quantum mechanics – postulates of quantum mechanics – qubits and quantum states – density operator – superposition – entanglement – EPR paradox – Bell inequality – measurement in quantum systems – quantum circuits – single-qubit operations – controlled quantum operations – universal quantum gates – quantum circuit model – simulation of quantum systems using Python.		
Module – II	QUANTUM COMPUTERS AND ALGORITHMS	**9**
Principles of quantum computation – conditions for quantum computation – harmonic oscillator quantum computer – optical photon quantum computer – optical cavity quantum electrodynamics – ion trap quantum computer – nuclear magnetic resonance quantum computer – other quantum computing implementation schemes – quantum Fourier transform – applications of quantum Fourier transform – quantum search algorithms – implementation of quantum algorithms using Python		
Module – III	QUANTUM INFORMATION AND NOISE	**9**
Quantum information – classical noise – Markov processes – quantum noise – quantum operations – examples of quantum noise – applications of quantum operations – limitations of quantum operations – analysis of noise effects using Python.		
Module – IV	QUANTUM ERROR CORRECTION	**9**

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Introduction to quantum errors – need for quantum error correction – Shor error correction code – theory of quantum error correction – construction of quantum codes – stabilizer codes – fault-tolerant quantum computation – evaluation of error correction techniques using Python.		
Module – V	**ENTROPY AND QUANTUM INFORMATION THEORY**	**9**
Entropy concept – Shannon entropy – properties of entropy – Von Neumann Entropy – strong subadditivity – distinguishing quantum states – accessible information – data compression – classical information over noisy quantum channels – quantum information over noisy quantum channels – entanglement as a physical resource – quantum cryptography – entropy and information analysis using Python		
		Total : 45 Periods

Textbooks

1. Kuldeep Singh Kaswan, Jagjit Singh Dhatterwal, Anupam Baliyan, Shalli Rani, **Quantum Computing: A New Era of Computing**, Wiley India, 2023.

2. Shrikant Tiwari, Amit Kumar Tyagi, S.V. Nagaraj, **Quantum Computing: The Future of Information Processing**, Routledge / Taylor & Francis, 2025.

Reference Books

1. **Fernando L. Pelayo, Mauro Mezzini (Eds.)**, *Quantum Computing Algorithms and Computational Complexity,* MDPI Books, 2023.
2. S. B. Goyal, Vidyapati Kumar, Sardar M. N. Islam, Deepika Ghai, Quantum Computing, Cyber Security and Cryptography: Issues, Technologies, Algorithms, Programming and Strategies, Springer Nature Singapore, 2025.
3. Marius Iulian Mihailescu, Stefania Loredana Nita, Valentina Marascu, Valentin Barna, Applied Quantum Computing and Cryptography: Challenges, Opportunities, and Performance Analysis for Algorithms, Springer Cham, 2025.

Additional References

1. https://quantum-computing.ibm.com/docs/
2. https://qiskit.org/documentation/
3. https://link.springer.com/book/10.1007/978-3-031-37966-6
4. https://link.springer.com/book/10.1007/978-3-031-59318-5

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LAB EXCERCISES

MODULE 1	QUANTUM MECHANICS AND QUANTUM COMPUTATION
	1. Single Qubit Gate Simulation – Quantum Composer 2. Two Qubit Gate Simulation – Quantum Composer 3. Composing Simple Quantum Circuits with Q-Gates and Measuring Output into Classical Bits
MODULE II	QUANTUM COMPUTERS AND ALGORITHMS
	4.IBM Qiskit Platform Introduction 5 Implementation of Shor's Algorithm 6. Implementation of Grover's Algorithm 7. Implementation of Deutsch's Algorithm 8. Implementation of Deutsch-Jozsa Algorithm
MODULE III	QUANTUM INFORMATION AND NOISE
	9.Analysis of noise effects on simple quantum circuits using Python
MODULE IV	QUANTUM ERROR CORRECTION
	10.Implementation of Shor Error Correction Code using Python
MODULE V	ENTROPY AND QUANTUM INFORMATION THEORY
	11.Entropy and information analysis of quantum states using Python

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	0	0	2								3	2	0
CO 2	3	2	2	1	3								3	3	0
CO 3	3	3	1	2	2								2	3	0
CO 4	3	2	3	2	3								3	3	2
CO 5	2	2	3	3	3								3	3	3
	3-High				**2-Medium**				**1-Low**						

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	0	0	10
Apply	20	35	35	90
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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23PMCA49	Quantum Computing	L	T	P	C
		2	0	2	3
Nature of Course	Professional Elective				
Pre requisites	Basic Linear Algebra and Python Programming				

Course Objectives

The course is intended

6. To learn the basics of quantum mechanics, qubits, quantum states, and quantum circuits.
7. To apply basic quantum gates and algorithms using simple models and Python.
8. To study quantum information, noise, and errors in quantum systems.
9. To evaluate quantum error correction methods and fault-tolerant computation.
10. To create basic quantum information models and simple cryptography using Python.

Course Outcomes

On successful completion of course the students can learn

CO.No	Course Outcome	Bloom's Level
1	**To Identify** the fundamentals of quantum mechanics, qubits, quantum states, and the quantum circuit model.	Understand
2	**To Use and implement** basic quantum gates and quantum algorithms with mathematical models and Python simulations.	Apply
3	To Examine and interpret quantum information, noise models, and the effects of errors on quantum systems	Apply
4	To assess quantum error correction techniques and fault-tolerant quantum computation using analytical methods and Python tools.	Apply
5	To Design and develop simple quantum information models and cryptographic concepts using entropy measures and Python-based analysis.	Apply

Course Contents

Module – I	QUANTUM MECHANICS AND QUANTUM COMPUTATION	**9**
Basics of quantum mechanics – postulates of quantum mechanics – qubits and quantum states – density operator – superposition – entanglement – EPR paradox – Bell inequality – measurement in quantum systems – quantum circuits – single-qubit operations – controlled quantum operations – universal quantum gates – quantum circuit model – simulation of quantum systems using Python.		

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Module – II	QUANTUM COMPUTERS AND ALGORITHMS	**9**
Principles of quantum computation – conditions for quantum computation – harmonic oscillator quantum computer – optical photon quantum computer – optical cavity quantum electrodynamics – ion trap quantum computer – nuclear magnetic resonance quantum computer – other quantum computing implementation schemes – quantum Fourier transform – applications of quantum Fourier transform – quantum search algorithms – implementation of quantum algorithms using Python		
Module – III	QUANTUM INFORMATION AND NOISE	**9**
Quantum information – classical noise – Markov processes – quantum noise – quantum operations – examples of quantum noise – applications of quantum operations – limitations of quantum operations – analysis of noise effects using Python.		
Module – IV	QUANTUM ERROR CORRECTION	**9**
Introduction to quantum errors – need for quantum error correction – Shor error correction code – theory of quantum error correction – construction of quantum codes – stabilizer codes – fault-tolerant quantum computation – evaluation of error correction techniques using Python.		
Module – V	ENTROPY AND QUANTUM INFORMATION THEORY	**9**
Entropy concept – Shannon entropy – properties of entropy – Von Neumann Entropy – strong subadditivity – distinguishing quantum states – accessible information – data compression – classical information over noisy quantum channels – quantum information over noisy quantum channels – entanglement as a physical resource – quantum cryptography – entropy and information analysis using Python		
		Total : 45 Periods

Textbooks

3. Kuldeep Singh Kaswan, Jagjit Singh Dhatterwal, Anupam Baliyan, Shalli Rani, **Quantum Computing: A New Era of Computing**, Wiley India, 2023.

4. Shrikant Tiwari, Amit Kumar Tyagi, S.V. Nagaraj, **Quantum Computing: The Future of Information Processing**, Routledge / Taylor & Francis, 2025.

Reference Books

4. **Fernando L. Pelayo, Mauro Mezzini (Eds.)**, *Quantum Computing Algorithms and Computational Complexity,* MDPI Books, 2023.

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5. S. B. Goyal, Vidyapati Kumar, Sardar M. N. Islam, Deepika Ghai, Quantum Computing, Cyber Security and Cryptography: Issues, Technologies, Algorithms, Programming and Strategies, Springer Nature Singapore, 2025.
6. Marius Iulian Mihailescu, Stefania Loredana Nita, Valentina Marascu, Valentin Barna, Applied Quantum Computing and Cryptography: Challenges, Opportunities, and Performance Analysis for Algorithms, Springer Cham, 2025.

Additional References

5. https://quantum-computing.ibm.com/docs/
6. https://qiskit.org/documentation/
7. https://link.springer.com/book/10.1007/978-3-031-37966-6
8. https://link.springer.com/book/10.1007/978-3-031-59318-5

LAB EXCERCISES

MODULE 1	QUANTUM MECHANICS AND QUANTUM COMPUTATION
	4. Single Qubit Gate Simulation – Quantum Composer 5. Two Qubit Gate Simulation – Quantum Composer 6. Composing Simple Quantum Circuits with Q-Gates and Measuring Output into Classical Bits
MODULE II	QUANTUM COMPUTERS AND ALGORITHMS
	4.IBM Qiskit Platform Introduction 5 Implementation of Shor's Algorithm 6. Implementation of Grover's Algorithm 7. Implementation of Deutsch's Algorithm 8. Implementation of Deutsch-Jozsa Algorithm
MODULE III	QUANTUM INFORMATION AND NOISE
	9.Analysis of noise effects on simple quantum circuits using Python
MODULE IV	QUANTUM ERROR CORRECTION

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	10.Implementation of Shor Error Correction Code using Python
MODULE V	ENTROPY AND QUANTUM INFORMATION THEORY
	11.Entropy and information analysis of quantum states using Python

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	0	0	2								3	2	0
CO 2	3	2	2	1	3								3	3	0
CO 3	3	3	1	2	2								2	3	0
CO 4	3	2	3	2	3								3	3	2
CO 5	2	2	3	3	3								3	3	3
	3-High				**2-Medium**				**1-Low**						

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Summative Assessment				
Bloom's Category	**Internal Assessment Examinations (IAE)**			**Final Examinations (FE)**
	IAE – I (5)	**IAE – II (10)**	**IAE – III (10)**	**60**
Remember	0	0	0	0
Understand	10	0	0	10
Apply	20	35	35	90
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Formative Assessment			
Blooms Taxonomy	**Assessment Component**	**Marks**	**Total marks**
Remember	Quiz	5	15
Understand	Tutorial class / Assignment	5	
Apply			
	Attendance	5	

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