School of Computer Science Engineering and Information Systems

Master of Computer Applications

(M.C.A)

Curriculum

(*2023-2024 onwards*)

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VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking,for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve criticalproblems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries &universities for productivity and economic development.

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

- To be a centre of excellence in education and research in Information and Technology, producing global leaders for improvement of the society

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

To provide sound fundamentals, and advances in Information Technology, Software Engineering, Digital Communications and Computer Applications by offering world class curricula.

- To create ethically strong leaders and trend setters for next generation IT.

- To nurture the desire among faculty and students from across the globe to perform outstanding and impactful research for the benefit of humanity and, to achieve meritorious and significant growth.

Master of Computer Applications

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be practitioners and leaders in their chosen field andfunction in their profession with social awareness and responsibility.

2. Graduates will interact with their peers in other disciplines in their work place and society and contribute to the economic growth of the country.

3. Graduates will be successful in pursuing higher studies in their chosen fieldwith career path in teaching or research.

PROGRAMME EDUCATIONAL OBJECTIVES (POs)

PO_1:   Having an ability to apply mathematics and science in computer applications.

PO_2:   Having a clear understanding of the subject related concepts and of contemporary issues.

PO_3:   Having an ability to design a component or a product by applying all the relevant standards and with realistic constraints.

PO_4:   Having an ability to design and conduct experiments, as well as to analyze and interpret data.

PO_5:   Having the skills and the ability to use IT tools and techniques to implement software practices.

PO_6:   Having problem solving ability- solving social issues and problems.

PO_7:   Having adaptive thinking and adaptability in relation to sustainable development.

PO_8:   Having a clear understanding of professional and ethical responsibility.

PO_9:   Having a good working knowledge of communicating in English.

PO_10: Having interest in lifelong learning.

Master of Computer Applications

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of M.C.A. (Master of Computer Applications) programme, graduates will be able to

- PSO1: To exhibit practical competencies in a broad range of programminglanguages and software platforms.

- PSO2: To provide intensive software solutions for real-world applicationswith the aid of modern computational tools and techniques.

- PSO3: To instill skill set towards life-long learning by creating research ambience and higher educational opportunities.

<table>
<tr><td colspan="3" align="center">CREDIT INFO</td></tr>
<tr><th>S.no</th><th>Catagory</th><th>Credit</th></tr>
<tr><td>1</td><td>Discipline Core</td><td>28</td></tr>
<tr><td>2</td><td>Discipline Elective</td><td>13</td></tr>
<tr><td>3</td><td>Projects and Internship</td><td>31</td></tr>
<tr><td>4</td><td>Open Elective</td><td>3</td></tr>
<tr><td>5</td><td>Skill Enhancement</td><td>5</td></tr>
<tr><td colspan="2" align="center">Total Credits</td><td>80</td></tr>
</table>

Discipline Core

sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	PMAT501L	Probability and Statistics	Theory Only	1.0	3	0	0	0	3.0
2	PMCA501L	Data structures and Algorithms	Theory Only	1.0	3	0	0	0	3.0
3	PMCA501P	Data structures and Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
4	PMCA502L	Java Programming	Theory Only	1.0	3	0	0	0	3.0
5	PMCA502P	Java Programming Lab	Lab Only	1.0	0	0	2	0	1.0
6	PMCA503L	Database Systems	Theory Only	1.0	3	0	0	0	3.0
7	PMCA503P	Database Systems Lab	Lab Only	1.0	0	0	2	0	1.0
8	PMCA504L	Software Engineering	Theory Only	1.0	3	0	0	0	3.0
9	PMCA505L	Data Communication and Networking	Theory Only	1.0	3	0	0	0	3.0
10	PMCA506L	Cloud Computing	Theory Only	1.0	3	0	0	0	3.0
11	PMCA507L	Machine Learning	Theory Only	1.0	3	0	0	0	3.0
12	PMCA507P	Machine Learning Lab	Lab Only	1.0	0	0	2	0	1.0

Discipline Elective

sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	PMCA601L	Full Stack Web Development	Theory Only	1.0	3	0	0	0	3.0
2	PMCA601P	Full Stack Web Development Lab	Lab Only	1.0	0	0	2	0	1.0
3	PMCA602L	Python Programming	Theory Only	1.0	2	0	0	0	2.0
4	PMCA602P	Python Programming Lab	Lab Only	1.0	0	0	2	0	1.0
5	PMCA603L	Mobile Application Design and Development	Theory Only	1.0	2	0	0	0	2.0
6	PMCA603P	Mobile Application Design and Development Lab	Lab Only	1.0	0	0	2	0	1.0
7	PMCA604L	Soft Computing	Theory Only	1.0	3	0	0	0	3.0
8	PMCA605L	Cyber Security	Theory Only	1.0	3	0	0	0	3.0
9	PMCA606L	Internet of Things	Theory Only	1.0	3	0	0	0	3.0
10	PMCA607L	Big Data Analytics	Theory Only	1.0	3	0	0	0	3.0
11	PMCA608L	Deep Learning Techniques	Theory Only	1.0	3	0	0	0	3.0
12	PMCA609L	Social Network Analysis	Theory Only	1.0	3	0	0	0	3.0
13	PMCA610L	Blockchain Technologies	Theory Only	1.0	3	0	0	0	3.0

		Discipline Elective								
14	PMCA611L	Artificial Intelligence	Theory Only	1.0	3	0	0	0	3.0
15	PMCA612L	Domain Specific Predictive Analytics	Theory Only	1.0	3	0	0	0	3.0
16	PMCA613L	Digital Forensics	Theory Only	1.0	3	0	0	0	3.0
17	PMCA614L	Software Testing	Theory Only	1.0	2	0	0	0	2.0
18	PMCA614P	Software Testing Lab	Lab Only	1.0	0	0	2	0	1.0
19	PMCA615L	Software Project Management	Theory Only	1.0	3	0	0	0	3.0
20	PMCA616L	Storage Systems and Management	Theory Only	1.0	3	0	0	0	3.0
21	PMCA617L	Data Visualization	Theory Only	1.0	2	0	0	0	2.0
22	PMCA617P	Data Visualization Lab	Lab Only	1.0	0	0	2	0	1.0
23	PMCA618L	Industry 4.0	Theory Only	1.0	3	0	0	0	3.0
24	PMCA619L	Game programming	Theory Only	1.0	3	0	0	0	3.0
25	PMCA619P	Game programming Lab	Lab Only	1.0	0	0	2	0	1.0
26	PMCA620L	Programming in C#	Theory Only	1.0	3	0	0	0	3.0
27	PMCA620P	Programming in C# Lab	Lab Only	1.0	0	0	2	0	1.0
28	PMCA621L	Data Science	Theory Only	1.0	2	0	0	0	2.0
29	PMCA621P	Data Science Lab	Lab Only	1.0	0	0	2	0	1.0
30	PMCA622L	Optimization Techniques	Theory Only	1.0	3	0	0	0	3.0
31	PMCA623L	Business Data Analytics	Theory Only	1.0	3	0	0	0	3.0

		Projects and Internship							
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	PMCA696J	Study Oriented Project	Project	1.0	0	0	0	0	2.0
2	PMCA697J	Design Project	Project	1.0	0	0	0	0	2.0
3	PMCA698J	Internship I/ Dissertation I	Project	1.0	0	0	0	0	12.0
4	PMCA699J	Internship II/ Dissertation II	Project	1.0	0	0	0	0	15.0

		Open Elective							
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	PSTS601L	Advanced Competitive Coding	Soft Skill	1.0	3	0	0	0	3.0

		Skill Enhancement							
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credit
1	PENG501P	Technical Report Writing	Lab Only	1.0	0	0	4	0	2.0
2	PSTS501P	Qualitative Skills Practice	Soft Skill	1.0	0	0	3	0	1.5
3	PSTS502P	Quantitative Skills Practice	Lab Only	1.0	0	0	3	0	1.5

Discipline Core

(2023-2024)

Master of Computer Applications

Course Code	Course Title	L	T	P	C
PMAT501L	Probability and Statistics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand and apply relevance of Probability and Statistical Theory to various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To compare and conclude on testing methods making inference to predict modelling techniques for decision making.

Course Outcomes:

1. Identifying the basic probability concepts using real time problems.
2. Understanding the facts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Analyse estimation and relate the testing methods to make inference and modelling techniques for decision making.

Module:1	Probability	6 hours

Probability – The axioms of probability – Conditional probability – Multiplication rule- Theorem of total probability- Bayes theorem – Independence of events.

Module:2	Random Variables	6 hours

Discrete and continuous random variables – probability mass, probability density and cumulative distribution functions - Joint distributions – Marginal and conditional distributions – Product moments – Covariance.

Module:3	Correlation and Regression	6 hours

Mathematical expectation - Moments – Moment generating functions – Characteristic function - Correlation and linear regression – Partial correlation- Multiple correlation - Multiple linear regression.

Module:4	Distributions	6 hours

Discrete distributions - Binomial, Poisson, Geometric – Continuous distributions – Uniform - Exponential – Gamma – Weibull – Beta -Normal distributions.

Module:5	Testing of Hypothesis – Large samples	7 hours

Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on Normal distribution for single mean - Difference of means – single proportion - difference of proportion – Difference of standard deviations.

Module:6	Testing of Hypothesis – Small samples	6 hours

Tests based on t, F distributions for mean, variance and proportion – Chi-square test - Contingency table – Goodness of fit.

Module:7	Non parametric Test	6 hours

Sign test-Rank sum test-Run test- Kruskal Wallis test-Mann Whitney U test-The Kolmogorov Smirnov and Anderson-Darling Tests.

Module:8	Contemporary Issues	2 hours

Industry Expert Lecture – Reliability Concepts			
		Total Lecture hours:	**45 hours**

Text Book(s)

1.	Richard A Johnson, Probability and Statistics for engineers, 2018, 9th edition, Pearson Education Ltd, Malaysia.

Reference Books

1.	Ronald E Walpole, Raymond H Myers, Sharaon L Myers and Keying Ye, Probability Statistics for Engineers and Scientists, 2011, 9th Edition, Prentice Hall, Delhi.
2.	Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 2016, 6th Edition, John Wiley & Sons.
3.	Robert V. Hogg, J.W. McKean, and Allen T. Craig, Introduction to Mathematical Statistics, 2012, 7th Edition, Pearson Education, Asia.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT.			
Recommended by Board of Studies	06-06-2023		
Approved by Academic Council	No. 70	Date	30-06-2023

Course Code	Course Title	L	T	P	C
PMCA501L	Data Structures and Algorithms	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To provide basic techniques of algorithm analysis and exhibit the capacity to implement various linked data structures.
2. To become familiar with several sorting algorithms and demonstrate the applications of graph algorithms.
3. To practice the various algorithm design techniques.

Course Outcomes:

1. Analyze and apply the time and space complexities of various algorithms
2. Choose appropriate data structure for the specified problem
3. Handle operations like searching, insertion, deletion and traversing mechanisms on various data structures
4. Comprehend and apply linear and non-linear data structures to design algorithms
5. Solve problems using different algorithm design techniques

Module:1	Foundations on Algorithmic Analysis	7 hours

The Role of Algorithms in Computing - Analyzing and Designing Algorithms - Characterizing Running Time - Asymptotic Notations - Formal Definition, Standard Notations and Common Functions - Solving Recurrence - Substitution Method - Recurrence Tree Method - Master Method

Module:2	Elementary Data Structure - Stack, Queue and List	5 hours

Stack and its Applications - Expression Conversion - Expression Evaluation - Balancing Parenthesis in Expression - Processing Functions Calls - Simple Queue - Circular, Priority Queue and its Applications - Singly Linked List - Circular Linked List - Doubly Linked List - Doubly Circular Linked List Operations and its Applications - Polynomial Representation and its Operations

Module:3	Sorting and Order Statistics	6 hours

Sorting - Insertion Sort, Shell Sort, Merge Sort, Radix Sort, Heap Sort - Searching - Linear Search, Binary Search - Time Complexity Analysis of Sorting and Searching Algorithms - Hashing - Hash Functions, Closed Addressing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing

Module:4	Advanced Data Structure - Tree	6 hours

Preliminaries - Binary Trees - Expression Tree - Binary Search Tree - AVL Tree - Splay Tree - B -Tree

Module:5	Graph Algorithms	6 hours

Representation of Graphs - Graph Traversals - Depth First Search - Breadth First Search - Minimum Spanning Trees - The Algorithms of Kruskal and Prim - Single Source Shortest Path - Bellman-Ford Algorithm - Dijkstra's Algorithm

Module:6	Advanced Design Analysis Techniques - Greedy and Divide & Conquer	6 hours

Greedy Algorithms - Huffman Code - Bin Packing - Divide and Conquer - Quicksort - Strassen's Matrix Multiplication		
Module:7	**Advanced Design Analysis Techniques - Backtracking and Dynamic Programming**	**7 hours**
Backtracking - N-Queens Problem, Longest Common Subsequence, Dynamic Programming - Knapsack Problem - Ordering Matrix Multiplication - All Pairs Shortest Path Problem - Floyd-Warshall Algorithm		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2022, 4th Edition, MIT Press, USA.

Reference Books	
1.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2019, 4th Edition, Pearson Education, Delhi.
2.	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data structures and Algorithms in Python", 2013, John Wiley and Sons, Inc., United States of America.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA501P	Data Structures and Algorithms Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To become more familiar with basic understanding of the algorithmic techniques and also to master the implementation of different data structures.
2. To learn and implement several sorting and graph algorithms.

Course Outcomes:

1. Categorize appropriate data structures as per the given problem definition
2. Solve problems using linear and non-linear data structures
3. Demonstrate operations like searching, insertion, deletion and traversing mechanism on various data structures

Indicative Experiments	Hours
1. **Linear Data Structures - Stacks, Queues and Linked Lists** Implement stack functions using arrays Implement multiple stacks Implementation of multiple queue Implement queue functions using arrays Implementation of circular queue Reversing a queue Reverse a singly linked list Merge two linked list Remove duplicate nodes from sorted linked list Program to find size of doubly linked list Rotate circular linked list by n nodes Find nth node from the end of circular linked list	9 hours
2. **Non Linear Data Structures - Trees and Graphs** Merge two binary trees Determine whether the given two binary trees are identical or not Implement backtracking using depth first search Detecting a cycle in the graph Determine the height of a binary search tree Identify if the given binary search tree is valid or not.	9 hours
3. **Greedy Approach** Implement kruskal's algorithm Implement prim's algorithm	4 hours
4. **Dynamic Programming** Implement floyd-warshall algorithm Implement knapsack problem	4 hours
5. **Divide and Conquer Approach** Quick sort Merge sort	4 hours

		Total Laboratory Hours	30 hours

Text Book(s)

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2022, 4th Edition, MIT Press, USA.

Reference Books

1.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 2019, 4th Edition, Pearson Education, Delhi.
2.	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data structures and Algorithms in Python", 2013, John Wiley and Sons, Inc., United States of America.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA502L	Java Programming	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. Comprehending basic and object oriented concepts in java & libraries of java.
2. Applying learnt concepts and developing various approaches to solve problems.
3. Designing and building real-time applications with an event-driven graphical user interface accessing files or databases.
4. Designing and building web applications.

Course Outcomes:

1. Ability to familiarize with core object oriented concepts in java
2. Apply multithreading and exception handling concepts in java to solve problems
3. Design and develop GUI applications that involve databases for real world problems using JavaFX and JDBC
4. Design, develop and deploy web applications using servlets and java server pages
5. Ability to write client server applications using networking concepts and configure spring applications with spring framework and hibernate

Module:1	OOPs Concept	8 hours

Java - Introduction, Classes and Objects - Methods - Constructors - this Keyword - Method Overloading, Inheritance - Types - Method Overriding - super Keyword - Abstract class - final Keyword, Interface, Packages - Predefined and User-defined, Stream based I/O and File I/O

Module:2	Exception Handling and Multithreading	6 hours

Exception Handling - Keywords - Built-in Exceptions - User Defined Exceptions, Multithreading - The Lifecycle of a Thread - Thread Creation using Thread Class and Runnable Interface - Synchronization - Inter-Thread Communication

Module:3	GUI and JDBC	6 hours

GUI Programming using JavaFX - Exploring Events - Controls and JavaFX Menus - Accessing Databases using JDBC Connectivity - Prepared Statement

Module:4	Servlet and Java Server Pages	6 hours

MVC Architecture- Servlets - TOMCAT Directory Structure for a Web Application - Servlet API Overview - Servlet Life Cycle - GenericServlet&HttpServlet - ServletConfig&ServletContext - JSP Directives, Simple JSP Page - JSP Tags - JSP & Java Beans - Session Management using JSP

Module:5	Struts Framework	6 hours

Introduction to MVC Architecture - Struts 2 Framework Architecture - Core Components of Struts 2 - Validations in Struts - Struts 2 Tiles - Annotations - Dependency Injection and Inversion of Control - Simple Struts 2 Application

Module:6	Spring Framework and Hibernate	6 hours

Architecting Your Application with Spring, Hibernate and Patterns - Spring Basics - Basic Application Setup - Persistence with Hibernate - Domain Model Fundamentals - Transaction Management - Effective Testing		
Module:7	**Networking and RMI**	**5 hours**
Introduction to Network - IP Address - Domain Names - Ports - Client/Server Model - Inet Address Class - URI - Sockets for Client and Servers - UDP Datagram and Sockets , RMI - Implementation - Loading Classes at Run Time - RMI and Registry Package		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture Hours:	**45 hours**

Text Book(s)

1.	Herbert Schildt, "Java: The Complete Reference", 2021, 12th Edition, McGraw Hill Education.
2.	Jim Keogh, "J2EE: The Complete Reference", 2017, McGraw Hill Education.

Reference Books

1.	Paul J. Deitel, Harvey Deitel, "Java SE8 for Programmers", 2014, 3rd Edition, Deitel Developer Series.
2.	Marty Hall and Larry Brown, "Core Servlets and Java Server Pages", 2007, 2nd Edition, Pearson
3.	Shara. K and Späth. P, "Learn JavaFX 17: Building User Experience and Interfaces with Java", 2022, Apress.
4.	Fisher. P and Murphy B.D, "Spring Persistence with Hibernate", 2016, 2nd Edition, Apress.
5.	Nicholas S. Williams, "Professional Java for Web Applications", 2014, 1st Edition, Wrox Press.
6.	Elliotte Rusty. H, "Java Network Programming", 2015, 4th Edition, O'Reilly Media, Inc.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA502P	Java Programming Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To comprehend basic and object-oriented concepts in java.
2. To apply learned concepts and develop various approaches for problem-solving.
3. To design and build real-time applications with event-driven graphical user interfaces, accessing files or databases.

Course Outcomes:

1. Develop a working knowledge of java core concepts and understand how to apply them
2. Design and develop GUI applications that involve real-world problems using JavaFX and JDBC
3. Implement web applications using servlets, java server pages, struts, spring framework and hibernate
4. Use networking concepts to create client server applications.

Indicative Experiments		Hours
1.	Basic programs	2 hours
2	Implementation of package, interface and abstract class	4 hours
3.	Test any five of standard exception and user defined custom exceptions in java	2 hours
4.	Threads creation and design applications by extending the thread class / Implementing the runnable interface. Application of multithreading in java	2 hours
5.	Design GUI based java application using JavaFX controls and JDBC.	4 hours
6.	Implementation of servlet programs - session management	4 hours
7.	Designing web applications using JSP tags.	2 hours
8.	Simple application using struts	4 hours
9.	Simple applications using spring and hibernate	4 hours
10.	Design and implement networking applications.	2 hours
Total Laboratory Hours		**30 hours**

Text Book(s)

1 2	Herbert Schildt, "Java: The Complete Reference", 2021, 12th Edition, McGraw Hill Education. Jim Keogh, "J2EE: The Complete Reference", 2017, McGraw Hill Education.

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA503L	Database Systems	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand, analyze and design databases.
2. To emphasize on the understanding of data models, architecture and administration.
3. To appreciate the internal functioning of database management systems.

Course Outcomes:

1. Identify the basic concepts of database and various data models used in DB design
2. Design conceptual models to represent simple database application scenarios
3. Convert high-level conceptual model to relational data model and to improve a database design by normalization
4. Populate and query a database using SQL and PL/SQL. Also apply Query processing and indexing techniques to optimize the database system performance
5. Apply and relate the concept of transaction, concurrency control and recovery on data

Module:1	Fundamentals of DBMS	6 hours

Introduction to Databases - Database Environment - Database Architectures - Data Models, Entity - Relationship Modeling, Enhanced Entity-Relationship Modeling

Module:2	Relational Model	6 hours

The Relational Model - Terminology, Integrity Constraints, Logical Database Design, ER and EER to Relational Mapping, Relational Algebra - Binary, Unary Operators, Aggregate and GROUP BY

Module:3	Design using Normalization Theory	6 hours

Data Redundancy and Update Anomalies, Functional Dependencies, Process of Normalization - 1NF - 2NF - 3NF - Functional Dependencies - Inference Rules, Minimal sets of Functional Dependencies - BCNF - 4NF - 5NF, Lossless-Join algorithms of Normal Forms

Module:4	SQL and PL/SQL	7 hours

SQL - Data Definition, Views, Data Manipulation and Transaction Control Languages, Advanced SQL - Declarations, Control Statements, Exception, Cursor, Subprograms, Triggers and ADT

Module:5	Query processing and Physical database design	6 hours

Query processing - Query Decomposition, Heuristical Approach to Query Optimization, Indexing - Sparse and Dense, BTree Vs Hash, Tuning Physical Design - Index and Query Rewriting

Module:6	Transaction Management	6 hours

Properties of Transaction, Concurrency Control - The Need for Concurrency Control, Serializability and Recoverability, Locking and Timestamp Methods, Multiversion Techniques, Recovery - Need, Techniques		
Module:7	**Advanced Database Models**	**6 hours**
Temporal Database Concepts - Spatial Database Concepts - Distributed Database Concepts - NoSQL Databases - Introduction to MongoDB - Datamodels, CRUD Operations and Sharding.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 2016, 7th Edition, Pearson Education, Delhi.
2.	Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation, and Management", 2015, 6th Edition, Pearson Education, USA.

Reference Books	
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", 2020, 7th Edition, McGraw Hill, Delhi.
2.	Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 2007, 3rd Edition, McGraw Hill, Delhi.
3.	Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage", 2019, 3rd Edition, O'Reilly.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA503P	Database Systems Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand, analyze and design databases.
2. To work on existing database systems, and create new relational databases and analyze the design.

Course Outcomes:

1. Use of SQL interface of a RDBMS package to create, secure, populate and query DB.
2. Use procedural language to develop comprehensive solutions for all types of applications.
3. Develop a Front-end application to perform transactions on SQL and No SQL database.

Indicative Experiments		Hours
1.	**Database Creation** Viewing all Databases - Creating a Database - Viewing all Tables in a Database - Creating Tables - Dropping / Truncating/Renaming Tables, Creating Views, Set the New Constraints to the Table - Drop the Constraints/Modify Constraints, etc.	6 Hours
2	**Database Manipulation** Inserting / Updating / Deleting Records in a Table - Using Transaction Control Commands - Commit, Rollback and Save point	2 Hours
3.	**SET Operators and Built-in Functions** Union, Intersection, Minus, and Queries involving Date Functions - String Functions and Math Functions	2 Hours
4.	**Complex Queries (Nested and Join Queries)** Join Queries-Inner Join, Outer Join - Subqueries-With IN clause - With EXISTS clause	4 Hours
5.	**PL/SQL Programs** Variables, Constants, Loops, Conditional Statements, Cursor, Procedure, and Functions	8 Hours
6.	**No SQL Databases** Mongo DB- Create, CRUD operation.	2 Hours
7.	Design and develop business applications using SQL, PL/SQL and No SQL.	6 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1	Bob Bryla, Kevin Loney, "Oracle Database 12c The Complete Reference", 2013, Illustrated Edition, McGraw-Hill Education, (Oracle Press).
2	Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming", 2014, 6th Edition, O'Reilly Media, Inc.
3	Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage", 2019, 3rd Edition, O'Reilly.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA504L	Software Engineering	3	0	0	3
Pre-requisite	NIL	Syllabus version
		1.0

Course Objectives:

1. To teach the concepts of process, product and project.
2. To elucidate the knowledge of requirement analysis.
3. To provide the knowledge of software design and testing.

Course Outcomes:

1. Demonstrate the basics of software engineering process, ethics and development
2. Understand the concept of various process models, activities and improvement
3. Analyze the various aspects of software requirement engineering and system models
4. Understand and analyze the decisions about the UML design process
5. Implement a computer-based system to meet the desired needs of the customer with proper understanding of the critical systems development and software testing

Module:1	Introduction to Software Engineering	5 hours

Nature of Software, Software Engineering - Need, Importance and its Characteristics - Software Process - Generic Process Model - Prescriptive Process Model Specialized, Unified Process, Classical Evolutionary models, Personal and Team Process Model - Software Project Metrics

Module:2	Agile Development	5 hours

Agile Process - Agility Principles - Adaptive Software Development - Extreme Programming Scrum - Dynamic Systems Development Method - Crystal - Feature Driven Development - Lean Software Development - Agile Modelling - Agile Unified Process

Module:3	Requirements Engineering	7 hours

Requirements Engineering, Establishing the Groundwork, Requirements Gathering, Developing Use Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements - Requirements Monitoring, Validating Requirements

Module:4	Object Oriented Design	7 hours

Design Concepts - Architectural Design - Object Oriented Design using UML - Interactions - Use Cases - Use Case Diagrams - Interaction Diagrams - Activity Diagrams - State Machines - Processes and Threads - Time and Space - State Chart Diagrams - Components - Deployment Diagram

Module:5	Software Quality Assurance and Management	7 hours

Software Quality - Quality Factors- The Software Quality Dilemma - Achieving Software Quality, Reviews - Criteria for Types of Reviews - Informal Reviews - Formal Technical Reviews, Software Quality Assurance - Elements of Software Quality Assurance - SQA Processes and Product Characteristics - SQA Tasks, Goals, and Metrics - Formal Approaches to SQA - Statistical Software Quality Assurance - Software Reliability - The ISO 9000 Quality Standards - The SQA Plan

Module:6	Software Testing and Evolution	6 hours

Strategic Approach to Software Testing, Planning and Recordkeeping, Test-Case Design, White Box Testing, Black-Box Testing, Object-Oriented Testing, Integration Testing, Artificial Intelligence and Regression Testing, Integration Testing in the OO Context, Validation Testing, Testing Patterns

Module:7	DevOpS	6 hours

DevOps - Motivation - Cloud as a Platform - Operations - Deployment Pipeline – Overall Architecture - Building and Testing – Deployment – Crosscutting Concerns- Monitoring- Security and Security Audits-Other Ileitis- Business Considerations- Case study - Migrating to Microservices

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R & D Organizations

		Total Lecture Hours:	45 hours

Text Book(s)	
1.	Roger S Pressman and Bruce Maxim, "Software Engineering - A Practitioner's Approach", 2019, 9th Edition, McGraw Hill Higher Education.

Reference Books	
1.	Ian Sommerville, "Software Engineering", 2017, 10th Edition, Addison-Wesley.
2.	Grady Booch, James Rumbaugh and Ivar Jacobson, "The Unified Modeling Languages User Guide", 2019, Addison Wesley.
3.	Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspectivell", 2017, Pearson Education.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA505L	Data Communication and Networking	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To familiarize the students with computer network communication architectures, basic terminologies, protocols, and applications.
2. To help students acquire knowledge in network design and management.
3. To understand the architecture and protocols of various web applications.

Course Outcomes:

1. Understand the basic concepts of data communication, protocols, and standards
2. Comprehend various switching techniques and analyze the performance of the network
3. Analyze various error detection and correction techniques and flow control mechanisms
4. Understand IP addressing techniques and various routing protocols
5. Identify suitable Transport layer protocol and Application layer protocol for real-time applications

Module:1	Introduction	5 hours

Basics - Data Communications - Type of Connection - Physical Topology - Categories of Networks - Protocols and Standards - Layered Tasks - OSI Model - TCP/IP Protocol Suite - TCP/IP Addressing

Module:2	Physical Layer and Media	7 hours

Data and Signals - Analog and Digital Signals - Transmission Impairment - Data Rate Limits - Performance Metrics - Bandwidth Utilization - Multiplexing and Spectrum Spreading - Transmission media types

Module:3	Switching Techniques	3 hours

Switching - Circuit Switched Networks - Datagram Networks - Virtual Circuit Networks - Structure of a Switch

Module:4	Data Link Layer	7 hours

Introduction - Error Detection - Cyclic Redundancy Check - Checksum - Error Correction - Hamming Code - Data Link Control - Framing - Flow and Error Control - Protocols - Noisy and Noiseless Channels - Multiple Access - Random Access - Controlled Access - Channelization

Module:5	Network Layer	10 hours

Addressing - IPv4 Addresses - Classful Addressing Classless Addressing - Subnetting -Network Address Translation (NAT) - IPv6 Addresses - Advantages - Transition from IPv4 to IPv6 - Delivery - Forwarding - Routing - Unicast Routing Protocols - Multicast Routing Protocols

Module:6	Transport Layer	6 hours

Process-to-Process Delivery - User Datagram Protocol - Transmission Control Protocol - Stream Control Transmission Protocol - Congestion Control - Open-Loop and Closed-Loop Congestion Control - Quality of Service - Techniques to Improve QoS		
Module:7	**Application Layer**	**5 hours**
Domain Name System - Remote Logging - Electronic Mail - File Transfer - Network Management - Simple Network Management Protocol (SNMP), Common Management Information Protocol (CMIP), Network Configuration Protocol (NETCONF)		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

1.	James F. Kurose and Keith W.Ross, "Computer Networking: A Top-Down Approach", 2022, 8th Edition, Pearson, India.
2.	William Stallings, "Data and Computer Communication", 2017, 10th Edition, Pearson, India.
3.	Andrew S. Tanenbaum, Nick Feamster and David J. Wetherall, "Computer Networks", 2022, 6th Edition, Pearson, India.
4.	Behrouz A. Forouzan, "Data Communications and Networking with TCP/IP Protocol Suite", 2022, 6th Edition, McGraw- Hill, India.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT, and Seminar			
Recommended by the Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA506L	Cloud Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To learn recent cloud computing paradigms and cloud infrastructures.
2. To emphasize on the understanding of virtualization and automation in a cloud environment.
3. To appreciate concepts of programming paradigms, security and storage in a cloud environment.

Course Outcomes:

1. Understand the recent cloud computing paradigms
2. Identify and relate the building blocks of cloud infrastructure
3. Understand to apply virtualization concepts and automation concepts in the cloud
4. Analyze appropriate programming approaches and tools to setup clouds
5. Explore possible ways for providing secured cloud services

Module:1	Cloud Computing Paradigms	6 hours

Evolution of Service Oriented Architecture -Web Services - Multiple Cores to Multiple Machines - Clusters to Websites and Load Balancing - Racks of Server Computers - Data Center - Multi Tenant Clouds- Concepts of Edge and Fog Computing

Module:2	Cloud Infrastructure	5 hours

Elastic Computing - Business Models for Cloud Providers - IaaS - PaaS - SaaS - Types - Private and Public Clouds- Opensource Cloud - Advantages - Hybrid Cloud - Multi Cloud- Hyperscalers - Racks, Aisles and Pods - Lights-out Data Centers - Fat Tree Designs - Scaling - Leaf - Spine Architecture - Storage in Data Center - Unified Data Center Networks.

Module:3	Virtual Machines	6 hours

Virtualization - Conceptual Organization of VM Systems - Virtual I/O Devices - Digital Objects- VM Migration - Virtual Networks, - Scaling VLANs to Data Center with VXLAN - NAT - Managing Virtualization and Mobility - Software Defined Networking

Module:4	Cloud Programming Paradigms	6 hours

MapReduce Programming Paradigm - HDFS And MapReduce - Microservices Communication Protocols Used For Microservices - Microservices Technologies, Serverless Computing Approach - Stateless Servers and Containers - Architecture of Serverless Infrastructure - DevOps Approach - Continuous Integration - Continuous Delivery.

Module:5	Orchestration	7 hours

Docker Containers - Docker Terminology and Development Tools - Docker Software Components- Kubernetes - Limits, Cluster Model, Pods - Pod Creation, Templates and Binding Times - Init Containers - Nodes and Control Plane - Control Plane Software Components- Worker Node Software Components.

Module:6	Automation	7 hours

Automation in Data Center - Levels of Automation - Plethora of Automation Tools- Automation of Manual Data Center - Evolution of automation tools - Automation with Larger Scope.

Module:7	Cloud Security and Cloud Data Storage	6 hours

Cloud Specific Security Problems - Security in Traditional Infrastructure - Zero Trust Security Model - Identity Management - Privileged Access Management - AI Technologies on Security - Protecting Remote Access - Privacy in Cloud Environment - Vulnerabilities in Cloud: Back Doors, Side Channels and Other Concerns - Managing Data in the Cloud- Storage as a Service, Using Cloud Storage Services		

Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained", 2021, 1st Edition, CRC Press, Florida.
2	Ian Foster and Dennis B. Gannon, "Cloud Computing for Science and Engineering", 2017, 1st Edition, The MIT Press, Cambridge, Massachusetts.

Reference Books

1.	Naresh Kumar Sehgal, Pramod Chandra P. Bhatt, John M. Acken, "Cloud Computing with Security: Concepts and Practices", 2020, 2nd Edition, Springer Nature, Switzerland.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA507L	Machine Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To comprehend the concept of supervised and unsupervised learning techniques.
2. To differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes:

1. Recognize the characteristics of machine learning that makes it useful to solve real-world problems
2. Provide solution for classification, regression and clustering approaches in real-world applications
3. Gain knowledge to combine machine learning models to achieve better results
4. Realize methods to reduce the dimension of the dataset used in machine learning algorithms

Module:1	Introduction to Machine Learning	5 hours

Machine Learning and its Applications – Learning Problems – Designing a Learning System – Perspectives and Issues in Machine Learning - Version Spaces – Finite and Infinite Hypothesis Spaces – PAC Learning

Module:2	Parametric Learning Algorithms	5 hours

Learning a Class from Examples – VC Dimension – Noise – Learning Multiple Classes – Regression: Linear Regression, Multiple Linear Regression, Logistic Regression – Bayes Classification – Introduction to Neural Networks – Perceptron – Multilayer Perceptron

Module:3	Non Parametric Learning Algorithms	7 hours

Decision Tree - Classification and Regression Trees - Pruning - Support Vector Machines - K-Nearest Neighbors - Evaluation Metrics of Classification Algorithms

Module:4	Combining Multiple Learners	6 hours

Generating Diverse Learners - Model Combination Schemes - Voting - Error Correcting Output Codes - Bagging - Boosting - The Mixture of Experts - Stacking - Random Forest Classifier

Module:5	Unsupervised Learning	7 hours

Introduction - K-Means Clustering - Expectation Maximization Algorithm - Supervised Learning after Clustering - Hierarchical Clustering - Density Based Clustering - Evaluation Metrics - Association Rule Learning

Module:6	Dimensionality Reduction	6 hours

Principal Component Analysis - Feature Embedding - Factor Analysis - Canonical Correlation Analysis - Linear Discriminant Analysis

Module:7	Reinforcement Learning	7 hours

Single State Case - K-Armed Bandit - Elements of Reinforcement Learning - Model Based Learning - Temporal Difference Learning - Generalization - Partially Observable States		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Ethem Alpaydin, "Introduction to Machine Learning", 2020, 4th Edition, MIT press.

Reference Books

1.	Mitchell, Tom M., "Machine Learning", 2007, Vol. 1, McGraw-Hill, New York.
2.	Marsland, Stephen, "Machine Learning: an Algorithmic Perspective", 2015, 2nd Edition, Chapman and Hall/CRC.
3.	Mohri, Mehryar, AfshinRostamizadeh, and Ameet Talwalkar, "Foundations of Machine Learning", 2018, 2nd Edition, MIT press.
4.	Doane, David P., and Lori E. Seward, "Applied Statistics in Business and Economics", 2016, 5th Edition, Mcgraw-Hill.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA507P	Machine Learning Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To implement and differentiate regression, classification and clustering techniques and their algorithms.
2. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes:

1. Provide solution for classification and regression approaches in real-world applications
2. Gain knowledge to combine machine learning models to achieve better results
3. Choose an appropriate clustering technique to solve real world problems
4. Realize methods to reduce the dimension of the dataset used in machine learning algorithms
5. Choose a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems

Exploration of Various Datasets		
Indicative Experiments		**Hours**
1.	Simple Linear Regression – Multiple Linear Regression	4 Hours
2	Decision Tree Classification Algorithm – Entropy – Gini Index	2 Hours
3.	Naive Bayes Classification – Maximum Likelihood	2 Hours
4.	Classification and Regression Trees – Regression Trees	4 Hours
5.	Support Vector Machines – Linear Kernel Functions – Non Linear Kernel Functions	4 Hours
6.	K-Nearest neighbor Classification Algorithm	4 Hours
7.	Bagging – Boosting – Random Forest Classification	4 Hours
8.	K-Means Clustering	2 Hours
9.	Hierarchical – Agglomerative - Divisive Clustering	2 Hours
10.	K-Armed Bandit - Model Based Learning	2 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Alpaydin, Ethem, "Introduction to Machine Learning", 2020, 4th Edition, MIT

Reference Books	
1.	Mitchell, Tom M., "Machine Learning", 2007, Vol. 1, McGraw-Hill, New York.
2.	Marsland, Stephen, "Machine Learning: an Algorithmic Perspective", 2015, 2nd Edition, Chapman and Hall/CRC.
3.	Mohri, Mehryar, AfshinRostamizadeh, and Ameet Talwalkar, "Foundations of Machine Learning", 2018, 2nd Edition, MIT press.
4.	Doane, David P., and Lori E. Seward, "Applied Statistics in Business and Economics", 2016, 5th Edition, Mcgraw-Hill.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No.70	Date	24-06-2023

Discipline Elective

(2023-2024)

Master of Computer Applications

Course Code	Course Title	L	T	P	C
PMCA601L	Full Stack Web Development	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the basics of JavaScript and the importance of MEAN and MERN stack
2. To develop the React and Angular front-end components
3. To design and development of backend components using Node.js and MongoDB

Course Outcomes:

1. Develop interactive and responsive web pages using HTML, CSS and Bootstrap
2. Use JavaScript and JQuery to create dynamic web pages
3. Formulate web applications that employ the MVC architecture
4. Integrate Client and Server using the AJAX
5. Devise sophisticated full-stack web applications by combining advanced web frameworks and technologies

Module:1	Introduction to Web Development	6 hours

Evolution of the Internet and World Wide Web - Introduction to HTML5 - Headings, Linking, Images, Lists, Tables, Forms, New HTML5 Form Input Types, Page Structure Elements - Introduction to CSS - Inline Styles, Embedded Style Sheets, Linking External Style Sheets, Backgrounds, Element Dimensions, Box Model and Text Flow, Positioning, Media Types and Media Queries, Drop Down Menus Selectors, Text Shadows, Box Shadows

Module:2	Introduction to Scripting	7 hours

JavaScript - Introduction, Operators - Control Statements - Functions, Dialog boxes - Arrays - Objects - Document Object Model - JavaScript Event Handling, Form Processing - Introduction to JQuery - JSON - Ajax Enabled Rich Internet Applications with JSON

Module:3	Front End framework - Angular JS	4 hours

Getting Started with Angular - Modules, Directives, Data Binding, Services, Creating a Basic Angular Application - Angular Components - Building Template, Using External Templates, Injecting Directives - Expressions - Using Basic Expressions, Interacting with the Component Class in Expressions - Built-in Directives - Event and Change Detection - Using Browser Events, Emitting Custom Events - Implementing Angular Services in Web Applications - Built-in Service, HTTP Service, Router Service

Module:4	Web Server - Node JS	5 hours

Getting Started with Node.js - Installing Node.js, Working with Node Packages, Creating a Node.js Application - Using Events, Listeners, Timers, and Callbacks in Node.js - Implementing Event emitter, Implementing Callbacks - Accessing the File System from Node.js - Implementing HTTP Services in Node.js - Saving Time with Express - The Request and Response Objects - Form Handling - Sending Client Data to Server, Form Handling with Express - Cookies and Sessions

Module:5	React Framework	8 hours

Introduction - JSX - React Components - Classes, Passing Data using Properties and Children - React State - Initial State, Updating State, Event Handling, Stateless Components, Designing Components -React Forms - Controlled Components, More Filters, Specialized Input Components, Server Rendering - Basic Server Rendering, Webpack for the Server

Module:6	Full Stack Tools and Libraries	8 hours

React Router - Simple Routing, Route Parameters, Query Parameters, Links, Programmatic Navigation, Nested Routes - React Bootstrap - Bootstrap Installation, Buttons, Navigation Bar, Panels, Tables, Form, The Grid System, Inline Forms, Horizontal Forms, Validating Alerts

Module:7	Full Stack Integration and Deployment	5 hours

NoSQL Database - MongoDB Basics - Documents, Collections, Database, Query Language, Installation, The Mongo Shell - MongoDB CRUD Operations - MongoDB Node.js Driver - Schema Initialization - Reading from MongoDB - Writing to MongoDB

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R&D Organizations

	Total Lecture hours:	45 hours

Text Book(s)

1.	Paul Deitel, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web: How To Program", 2018, 5th Edition, Pearson.
2.	Vasan Subramanian, Pro MERN "Stack: Full Stack Web App Development with Mongo, Express, React, and Node", 2019, 2nd Edition, Apress.

Reference Books

1.	Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB, and Angular Web Development", 2017, 2nd Edition, Addison Wesley, Oreilly.
2.	Ethan Brown, "Web Development with Node and Express", 2019, 2nd Edition, O'Reilly Media Inc..

Mode of Assessment: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA601P	**Full Stack Web Development Lab**	0	0	2	1
Pre-requisite	NIL	**Syllabus version**
		**1.0**

Course Objectives:
1. To understand the basics of JavaScript and importance of MEAN and MERN stack
2. To develop the React and Angular front-end components
3. To design and development of backend components using Node.js and MongoDB

Course Outcomes:
1. Develop interactive and responsive web pages using HTML, CSS and Bootstrap
2. Use JavaScript and JQuery to create dynamic web pages
3. Formulate web applications that employ the MVC architecture
4. Integrate Client and Server using the AJAX
5. Devise sophisticated full-stack web applications by combining advanced web frameworks and technologies

**Indicative Experiments**
1.	Design interactive web pages using HTML5
2.	Design responsive web pages using CSS
3.	Implement Client-Side Validations and Dynamic Object Manipulations with Events using Javascript
4.	Implement Client-Side scripting, Animations and Dynamic Object manipulations using JQuery, Asynchronous Client, server, and data storage interactions using AJAX.
5.	Develop component-based User Interface using REACT JS
6.	Develop Single Page Applications using Angular JS framework.
7.	Design web applications with dynamic routing using Node JS, and Express framework
8.	Develop a three tier web application model and data manipulations using Node Js, Express, and Mongo DB.
9.	Develop a three tier web application File upload and Email.
10.	Develop web applications with Session and Cookies.

**Total Laboratory Hours**	**30 hours**

Text Book(s)
1. Paul Deitel, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web: How To Program", 2018, 5th Edition, Pearson.
2. Vasan Subramanian, Pro MERN "Stack: Full Stack Web App Development with Mongo, Express, React, and Node", 2019, 2nd Edition, Apress.

Reference Books
1. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB, and Angular Web Development", 2017, 2nd Edition, Addison Wesley, Oreilly.
2. Ethan Brown, "Web Development with Node and Express", 2019, 2nd Edition, O'Reilly Media Inc.

Mode of Evaluation: CAT, Exercises, FAT

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA602L	Python Programming	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:
1. Understand the basics of python programming constructs and data structures.
2. Learn to develop user-defined functions and handle exceptions.
3. Apply object-oriented techniques using python and handle unstructured data.

Course Outcomes:
1. Develop solutions using the basic programming constructs and data structures in python
2. Demonstrate applications with user-defined functions and applying exception-handling mechanisms
3. Apply object-oriented programming constructs in designing complex real-world problems
4. Examine and visualize the data sets using python packages

Module:1	Python Programming Fundamentals	4 hours

Variables and Simple Data Types - Naming and Using Variables, Numbers, Comments - User Input, Output Statements - Control Flow Statements - If Statements, While Loops, For Loops

Module:2	Working with Specialized Data Structures	4 hours

Working with Lists - Changing, Adding, and Removing Elements - Organizing a List, Looping through Entire Lists, Working with Part of a List - Tuples - Defining a Tuple, Looping through all Values in a Tuple, Writing over a Tuple - Dictionaries - Working with Dictionaries, Looping through a Dictionary

Module:3	Strings and Regular Expression	4 hours

Strings - Basic String Operations, Indexing, and Slicing - String Methods - Regular Expressions - Using Special Characters - Regular Expression Methods

Module:4	Functions	4 hours

Defining a Function, Passing Arguments, Return Values, Passing a List, Passing an Arbitrary Number of Arguments, Storing your Functions in Modules

Module:5	Files and Exceptions	4 hours

Files - Reading from a File, Writing to a File - Exceptions - Handling the ZeroDivisionError Exception, Using try - except Blocks, Using Exceptions to Prevent Crashes, The else Block, Handling the FileNotFoundError Exception

Module:6	Object Oriented Programming	4 hours

Classes - Creating and using a Class, Working with Classes and Instances, Encapsulation - Using Private Instance Variables and Methods, Inheritance, Polymorphism - Importing Classes

Module:7	Introduction to Data Science and Visualization	4 hours

Storing Data - Using JSON, Saving and Reading User - GeneratedData - Packages - NumPy, Matplotlib, Pandas

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture Hours:	30 hours

Text Book(s)

1.	Eric Matthes, "Python Crash Course: A Hands-on, Project-Based Introduction to Programming", 2019, 2nd Edition, No Starch Press, San Francisco.

2.	Gowrishankar S and Veena A, "Introduction to Python Programming", 2019, 1st Edition, CRC Press, Taylor & Francis Group, Boca Raton, FL.
Reference Books	
1.	Mark Lutz, "Learning Python Powerful Object Oriented Programming", 2018, 5th Edition, O'Reilly Media.
2.	John Hunt, "A Beginner's Guide to Python 3 Programming", 2020, 2nd Edition, Springer Nature, Switzerland.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	04-05-2023

Course Code	Course Title	L	T	P	C
PMCA602P	**Python Programming Lab**	**0**	**0**	**2**	**1**
Pre-requisite	**NIL**	**Syllabus version**			
		**1.0**			

Course Objectives:

1. Explore problem solving skills using python programming and find solutions for real time problems.
2. Acquire object-oriented programming skills in python.

Course Outcomes:

1. Understand and comprehend the basic programming constructs of python programming
2. Implementation of control statements for altering the sequentially execution of programs in solving problems
3. Solve real-time problems using modular programming concepts by handling run time exceptions
4. Identify object-oriented programming constructs and python packages for solving real time problems

Indicative Experiments		Hours
1.	Build applications using operators, expressions and control structures.	4 hours
2.	Manipulations using lists, tuples and dictionaries.	5 hours
3.	Problem solving using string and regular expressions.	5 hours
4.	Demonstrate user defined functions, exception handling and file operations.	5 hours
5.	Implement real time applications using object oriented programming.	5 hours
6.	Exploring NumPy and pandas packages with data visualization.	6 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1.	Reema Thareja, "Python Programming using Problem Solving Approach", 2017, 1st Edition, Oxford University, Higher Education Oxford University Press.

Reference Books

1.	John Hunt. "Advanced Guide to Python 3 Programming", 2019, 1st Edition, Springer Nature, Switzerland.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA603L	Mobile Application Design and Development	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To impart fundamental concepts of mobile application development.
2. To design user interfaces for interacting with apps and to save persistent application data.

Course Outcomes:

1. Understand the working principles of mobile applications
2. Implement interactive user interfaces that work across a wide range of devices
3. Create, test and debug mobile application by setting up a development environment
4. Formulate methods for storing and retrieving data in mobile applications

Module:1	Introduction to Development Environment	4 hours

Introduction to Android - Obtaining the Required tools - Launching your First Mobile Application - Exploring the IDE - Using Code Completion - Debugging your application

Module:2	Activities, Fragments and Intents	4 hours

Understanding Activities - Linking Activities using Intents - Displaying a Dialog Window - Fragments - Adding Fragments Dynamically, Life Cycle of a Fragment

Module:3	Know the Android User Interface	4 hours

Understanding the Components of a Screen - Views and ViewGroups, Linear Layout, Frame Layout, Table Layout, Scroll View - Adapting to Display orientation - Utilizing the Action Bar

Module:4	Designing User Interface with Views	5 hours

Using Basic Views - Using Picker Views - Using List Views to display Long Lists - Understanding Specialized Fragments - using a List Fragment, using a Dialog Fragment, using a Preference Fragment

Module:5	Displaying Pictures and Menus with Views	4 hours

Using Image Views to Display Pictures- ImageView, GridView, ImageSwitcher - Using Menus with Views - Options Menu, Context Menu - Using Web View

Module:6	Data Persistence and Content Providers	4 hours

Saving and Loading User Preferences - Persisting Data to Files- Saving to Internal Storage, Saving to External Storage - Creating and Using Databases - Content Providers - Sharing Data in Android

Module:7	Hybrid Mobile Applications	3 hours

Native vs. Hybrid Mobile Applications - Building Blocks of Hybrid Applications - Architecture, Technologies, Frameworks, Languages - Development and Packaging Frameworks - Ionic, PhoneGap, AppBuilder

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R & D Organizations

	Total Lecture hours:	30 hours

	Text Book(s)
1.	J F DiMarzio, "Beginning Android Programming with Android Studio", 2017, 4th Edition, Wiley India Pvt. Ltd.
2.	Mahesh Panhale, "Beginning Hybrid Mobile Application Development", 2016, 1st Edition, Apress Berkeley, CA.

	Reference Book(s)
1.	Dawn Griffiths and David Griffiths, "Head First Android Development", 2017, 2nd Edition, O'Reilly SPD Publishers.
2.	Google Developer Training, "Android Developer Fundamentals Course - Concept Reference", Google Developer Training Team, 2016.
3.	Joseph Annuzzi, Jr., Lauren Darcey, Shane Conder, "Introduction to Android Application Development", 2016, 5th Edition, Create Space Independent Publishing Platform.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA603P	Mobile Application Design and Development Lab	0	0	2	1
Pre-requisite	NIL		Syllabus version		
			1.0		

Course Objectives:

1. To impart fundamental concepts of Mobile Application Development.
2. To design user interfaces for interacting with apps and to save persistent application data.

Course Outcomes:

1. Understand the working principles of mobile applications
2. Implement interactive user interfaces that work across a wide range of devices
3. Create, test and debug mobile application by setting up a development environment
4. Formulate methods for storing and retrieving data in mobile applications

Indicative Experiments		
1.	UI Design - linear layout, relative layout, constraint layout	2 hours
2.	Usage of Widgets - checkbox, radio button, time picker, date picker	4 hours
3.	UI Operations - button click, dialog handling, list item selection	4 hours
4.	Intent - moving to another activity, passing data between Activities	4 hours
5.	Menu - options menu, context menu	4 hours
6.	Database - SQLite database	4 hours
7	Media Player Application(handling text, video & Audio)	4 hours
8.	JSON file in Android(handling data over Internet)	4 hours
	Total Laboratory Hours	30 hours

Text Book(s)

1.	J F DiMarzio, "Beginning Android Programming with Android Studio", 2017, 4th Edition, Wiley India Pvt. Ltd.
2.	Joseph Annuzzi, Jr., Lauren Darcey, Shane Conder, "Introduction to Android Application Development", 2014, 4th Edition, Create Space Independent Publishing Platform.

Reference Books

1.	Dawn Griffiths and David Griffiths, "Head First Android Development", 2017, 2nd Edition, O'Reilly SPD Publishers.
2.	Google Developer Training, "Android Developer Fundamentals Course - Concept Reference", Google Developer Training Team, 2016.
3.	Joseph Annuzzi, Jr., Lauren Darcey, Shane Conder, "Introduction to Android Application Development", 2016, 5th Edition, Create Space Independent Publishing Platform.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA604L	Soft Computing	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To get acquainted with the Neural Network models, understand their functionalities and apply these in real life situations.
2. To understand the importance of approximation over exactness through the Fuzzy set model, basic concepts and principles of Fuzzy sets and its role in knowledge representation.
3. To develop an idea on approximate reasoning and fuzzy rules with applications in fuzzy inference engine.
4. To visualize the importance of evolutionary computation, its categories with special focus on Genetic algorithms and optimization techniques.

Course Outcomes:

1. Apply the fundamental concepts of neural networks to soft computing problems
2. Identify the architecture and learning of neural networks for classification and prediction problems
3. Apply the fuzzy logic and concept of fuzziness in designing fuzzy inference systems
4. Develop applications using Fuzzy logic control to solve decision making problems
5. Use rough sets to represent uncertainty, ambiguity and vagueness
6. Understand the concepts of genetic algorithm and hybrid systems for optimization problems

Module:1	Soft Computing Fundamentals	8 Hours

Introduction to Soft Computing - Biological Neural Networks - Artificial Neural Network -Introduction, Evolution - Basic Models - Mcculloch-Pitts Model, Hebb's Network, Supervised Neural Networks - Perceptron- Adaline (Adaptive Linear Neuron) - Back-Propagation Network - Radial Basis Function Network

Module:2	Associative Memory Networks	5 Hours

Pattern Association - Memory Models -Auto-Associative and Hetero Associative Models - Bi Directional Associative Memory Model, Hopfield Network

Module:3	Unsupervised Neural Networks	6 Hours

Fixed Weight Competitive Net- Maxnet And Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization Network, Adaptive Resonance Theory Network

Module:4	Fuzzy Sets and Fuzzy Relations	6 Hours

Introduction - Fuzzy Sets - Operations - Fuzzy Relations - Membership Functions - Fuzzification and Defuzzification.

Module:5	Fuzzy Logic and Approximate Reasoning	6 Hours

Fuzzy Truth Values - Fuzzy Propositions, Fuzzy Rules, Formation, Decomposition and Aggregation of Rules, Fuzzy Reasoning - FIS - Fuzzy Decision Making.

Module:6	Rough Sets	6 Hours
Information & Decision Systems - Indiscernibility - Set Approximations - Properties of Rough Sets - Rough Memberships, Reducts, and Approximations.		
Module:7	Genetic Algorithm and Hybrid Soft Computing	6 Hours
Basic Concepts of Genetic Modeling - Encoding, Selection, Crossover, Mutation, Reproduction, Applications in Search and Optimization, Convergence Theory - Problem Solving Using GA, Neuro-Fuzzy, Genetic-Neuro and Genetic-Fuzzy Hybrid Systems		
Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	45 hours

Text Book(s)	
1.	Sivanandam and S N Deepa, "Principles of Soft Computing", 2018, 3rd Edition, Wiley Publications.
	B.K. Tripathy , J. Anuradha,"Soft Computing: Advances and Applications", 2015, 1st Edition, Cengage Learning.

Reference Books	
1.	S. Rajasekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & Applications", 2017, 2nd Edition., PHI Publication, New Delhi, India
2.	George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Application", 2015 Pearson Publication.
3.	Z. Pawlak, "Rough Sets: Theoretical Aspects of Reasoning About Data", 2013, Springer.
4.	Simon Haykin, "Neural Networks and Learning Machines", 2009, 3rd Edition, Pearson.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar.			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA605L	Cyber Security	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand key terms and concepts in cyber-attacks, security issues, associated vulnerabilities.
2. To exhibit knowledge to secure systems, protect personal data, Phishing and Identity Theft using software or tools.
3. To emphasis principles of governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security.

Course Outcomes:

1. Develop a deeper understanding and familiarity with various types of cyberattacks, cybercrimes, vulnerabilities and need of cyber security
2. Apply critical thinking and problem-solving skills to detect the vulnerabilities and safety against cyber-frauds
3. Demonstrate the use of standards and cyber laws to enhance information security in the development process and infrastructure protection
4. Design operational cyber security strategies and policies

Module:1	Introduction to Cyber and Cyber Offenses	6 hours

Definition and Scope - Risks - Threats - Classifications of Cybercrimes - Data Diddling, Web Jacking, Hacking, Software Piracy, Computer Network Intrusions, Password Sniffing -Cyber Offenses - Categories of Cybercrime - Social Engineering, Cyber Stalking, Cyber Cafe and Cybercrimes - Bot Nets - Attack Vector

Module:2	Cybercrime - Mobile and Wireless Devices	6 hours

Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era - Security Challenges Posed by Mobile Devices - Authentication Service Security - Attacks on Mobile Phone - Organizational Measures and Security Policies - Identity and Access Management - Architecture - IAM Standards

Module:3	Tools and Methods in Cybercrime	7 hours

Introduction - Password Cracking - Keyloggers and Spywares - Viruses and Worms - Trojan Horses and Backdoors - Steganography - DoS and DDoS Attacks - SQL Injection - Buffer Overflow - Attacks on Wireless Networks

Module:4	Phishing and Identity Theft	6 hours

Phishing - Methods and Techniques - Spear Phishing - Types of Phishing - Phishing Toolkit - Spy Phishing - Phishing Countermeasures - Identity Theft - Personal Identifiable Information - Types and Techniques - Countermeasures - Case Study - Identify Theft

Module:5	Cybercrimes and Cyber Security - The Legal Perspectives	6 hours

The Legal Perspectives - Need of Cyber law - The Indian Context - The Indian IT Act - Challenges and Consequences - Digital Signature and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment – Cyber law - Technology and Students - Indian Scenario - CIA Triad

Module:6	Cyber Security - Organizational Implications	6 hours

Introduction - Cost of Cybercrimes and IPR Issues - Web Threats - Security and Privacy Implications - Social Media Marketing - Social Computing and the

	Challenges - Protecting People's Privacy - Organizational Guidelines - Incident Handling - Media and Asset Protection - Importance of End Point Security - Case Study - An Indian Case of IPR crime.	
Module:7	**Cybercrime and Cyber Terrorism - Social, Political, Ethical and Psychological Dimensions**	**6 hours**
	Introduction - Ethical Dimensions - Network Hacking - Email Spoofing - Server Hacking - Information Warfare - Spyware- Threat Mitigation - Disaster Recovery - Case Study- Swedish Case of Hacking and Theft of Trade Secrets	
Module:8	**Contemporary Issues**	**2 hours**
	Guest Lecture from Industry and R & D Organizations	
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Nina Godbole, Sunit Belapure, "Cyber Security - Understanding Cybercrimes, Computer Forensics and Legal Perspectives", 2018, 1st Edition, Wiley.

Reference Books	
1.	Charles J .Brooks, Christopher Grow, Philip A. Craig, Donald Short, "Cybersecurity Essentials", 2018, 1st Edition, Wiley Publisher.
2.	Yuri Diogenes, Erdal Ozkaya, "Cybersecurity - Attack and Defense Strategies", 2018, 2nd Edition, Packt Publishers.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA606L	Internet of Things	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To appraise students with basic knowledge of IoT that paves a platform to understand physical, logical design and business models.
2. To teach a student how to analyze requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
3. To interpret the students how to code for an IoT application and deploy for a real-time scenario.

Course Outcomes:

1. Describe various layers of IoT protocol stack and describe protocol functionalities
2. Evaluate efficiency trade-offs among alternative communication models for an efficient IoT application design
3. Comprehend advanced IoT applications and technologies from the basics of IoT and understand the working principles of various sensor for different IoT platforms
4. Estimate the cost of hardware and software for low cost design IoT applications
5. Compare various application business models of different domains and solve real-time problems and demonstrate IoT applications in various domains using prototype models

Module:1	Internet of Things - An Overview	5 hours

IoT Conceptual Framework - Design Principles and Needed Capabilities - IoT Architectural View - Technology behind IoT - IoT Levels and Deployment Templates,M2M Communication

Module:2	Design Principles for Connected Devices	7 hours

IoT/M2M Systems Layers and Designs Standardization - Communication Technologies - Bluetooth, Zigbee, Wifi, GPS - IoT Protocols - IPv6, 6LoWPAN, RPL, CoAP, AMQP, DDS, LoRa, LoRaWAN, LWM2M, MQTT, XMPP

Module:3	Sensors, Participatory Sensing, RFIDs and Wireless Sensor Networks	6 hours

Sensor Technology - Participatory Sensing, Industrial IoT and Automotive IoT - Actuator - Sensor Data Communication Protocols - Radio Frequency Identification Technology - Wireless Sensor Networks Technology

Module:4	Prototyping and Designing the Software for IoT Applications	7 hours

Prototyping Embedded Device Software - Programming Embedded Galileo, Raspberry Pi, BeagleBone and mBed Device Platforms - Devices, Gateways, Internet and Web/Cloud Services Software Development, Wamp Autobahn, Xively Cloud, Skynet

Module:5	Data Analytics and Supporting Services	6 hours

Data Analytics - Structured versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M - Supporting Services - Computing using a Cloud Platform for IoT/M2M - Applications/Services, Everything as a Service and Cloud Service Models

Module:6	IoT Privacy, Security and Vulnerabilities Solutions	6 hours

Vulnerabilities, Security Requirements, Threat Analysis - Use Cases and Misuse Cases - IoT Security Tomography and Layered Attacker Model - Security Protocols - DTLS and X.509

Module:7	IoT Case Studies	6 hours
IoT/IIoT Applications in the Premises - Supply-Chain and Customer Monitoring - Connected Car and its Applications and Services - IoT Applications for Smart Homes, Cities, Environment -Monitoring and Agriculture - Smart City Streetlights Control and Monitoring.		
Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Raj Kamal, "INTERNET OF THINGS (IOT) - Architecture and Design Principles", 2022, 2nd Edition, McGraw Hill Education.

Reference Books	
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", 2017, 1st Edition, CISCO Press.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA607L	Big Data Analytics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the big data platform, Hadoop and its ecosystem.
2. To impart knowledge in applying skills and tools to manage and analyze the big data.
3. To develop knowledge of algorithms for massive data sets and methodologies in the context of data mining.

Course Outcomes:

1. Discuss the fundamental elements to meet the challenges in implementing big data systems
2. Apply and develop the NoSQL as part of software development for all types of data
3. Develop applications using large scale analytics tools and MapReduce approach to solve open big data problems
4. Analyze the issues underlying the effective applications of massive data sets
5. Solve the real time problems using unsupervised algorithms for massive data sets in the context of data mining and web advertising techniques

Module:1	Introduction to Big Data Analytics	5 hours

Evolution of Big Data - Types of Data - Elements of Big Data - Key Roles in Big Data - Data Analytics Lifecycle - Challenges and Applications of Big Data in Industry

Module:2	Hadoop and MapReduce	6 hours

Components of Hadoop - Analyzing Big data with Hadoop - Design of HDFS - MapReduce - Different Phases, Classic, Components - MapReduce Features - Counters, Sorting, Joins - YARN - Components, Workflow, Scheduling

Module:3	NoSQL Data Management	6 hours

Introduction to NoSQL - Aggregate Data Models - Key Value Data Model -Columnar Model - Document Data Model - Graph Data Model and its Applications - Relationships - Schema-Less Databases - Materialized Views

Module:4	Analyzing Big Data	7 hours

Hadoop Tools - Flume - Analyzing Unstructured Data - Sqoop - Analyzing Structured Data - Pig Latin - User Defined Functions , Data Processing Operators - Hive - HiveQL, Querying Data , User Defined Functions

Module:5	MapReduce Based Algorithms	7 hours

Matrix - Vector Multiplication, Matrix Multiplication - Relational Algebra Operations - Selections, Projection, Union, Intersection, Difference, Computing Natural Join, Grouping and Aggregation

Module:6	Unsupervised Learning Methods	6 hours

Introduction to Clustering Techniques - Hierarchical Clustering, Parallel K-Means Algorithms, the Algorithm of Bradley Fayyad and Reina - Frequent Item sets - Handling Larger Datasets in Main Memory, Limited-Pass Algorithm, The SON Algorithm

Module:7	Social Network Analysis	6 hours

Social Networks as Graphs - Varieties of Social Networks- Graphs With Several Node Types - Distance Measures for Social-Network Graphs- Applying Standard Clustering Methods- Betweenness- The Girvan-Newman Algorithm - Using Betweenness to Find Communities- Direct Discovery of Communities

Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

	Text Book(s)
Text Book(s)	
1.	DT Editorial Services, "Big Data (covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization) Black Book", 2017, Dreamtech Press.
2.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", 2020, 3rd Edition, Cambridge University Press, UK.
Reference Books	
1.	Tom White, "Hadoop: The Definitive Guide", 2015, 4th Edition, O'Reilly Media.
2.	EMC Education Services, "Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", 2015, Wiley.
Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar.	

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA608L	Deep Learning Techniques	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the fundamentals of deep learning and the learning strategies in deep neural networks.
2. To learn the concepts and methods used to optimize the highly parameterized models.
3. To acquire the knowledge of applying Deep Learning techniques to solve various real-world problems.

Course Outcomes:

1. Understand the fundamental concepts of learning algorithms and the challenges of deep learning
2. Recognize the process of learning, regularization and optimization methods for deep neural networks
3. Design the convolutional neural networks and transfer learning models
4. Explore the architecture of various sequence modeling and deep generative models
5. Familiarize the concepts of modern practical deep networks to solve real-world problems

Module:1	Introduction	5 hours

Learning Algorithms - Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance - Challenges Motivating Deep Learning

Module:2	Deep Feedforward Networks and Regularization	7 hours

Gradient-Based Learning - Hidden Units - Architecture Design - Back-Propagation - Regularization - Parameter Norm Penalties - Constrained Optimization using Norm Penalties - Dataset Augmentation - Early Stopping - Sparse Representation - Bagging and Dropout

Module:3	Optimization for Training Deep Models	6 hours

Neural Network Optimization - Basic Algorithms - Stochastic Gradient Descent, Momentum, Nesterov Momentum - Parameter Initialization Strategies - Algorithms with Adaptive Learning Rates - AdaGrad, RMSProp, Adam

Module:4	Convolutional Networks and Transfer Learning	7 hours

Convolution Operation - Motivation - Pooling - Structured Outputs - Data Types - Popular CNN Architectures - LeNet, AlexNet, VGG - Transfer Learning - DenseNet, PixelNet

Module:5	Sequence Modelling: Recurrent and Recursive Nets	6 hours

Unfolding Computational Graphs - Recurrent Neural Networks - Bidirectional RNNs - Encoder-Decoder Sequence-to-Sequence Architectures - Deep Recurrent Networks - Recursive Neural Networks - Challenges of Long-Term Dependencies - Long Short-Term Memory and Gated RNNs - Optimization for Long-Term Dependencies

Module:6	Deep Generative Models	6 hours

Boltzmann Machines - Restricted Boltzmann Machines - Deep Belief Networks - Deep Boltzmann Machines - Directed Generative Nets - Variational Autoencoders, Generative Adversarial Networks, Generative Moment Matching Networks

Module:7	Modern Practical Deep Networks	6 hours

Performance Metrics - Default Baseline Models - Data Collection - Selecting Hyperparameters - Debugging Strategies - Multi-Digit Number Recognition - Large-Scale Deep Learning - Computer Vision - Speech Recognition- Recent Technical Reports		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**
Text Book(s)		
1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep learning", 2016, MIT Press.	
Reference Books		
1.	Dipanjan Sarkar, Raghav Bali, Tamoghna Ghosh, "Hands-On Transfer Learning with Python", 2018, First edition, Packt Publishing	
2	John D. Kelleher, "Deep Learning", 2019, First edition, The MIT Press	
3	Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", 2018, First edition, Springer	
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar		
Recommended by Board of Studies	04-05-2023	
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA609L	Social Network Analysis	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the insights of Social Networks, Network Measures and Link Analysis.
2. To recognize the concept of semantic web, Knowledge representation using ontology and security features of social network analysis.

Course Outcomes:

1. Understand the social network analysis applications and Graph Visualization Tools
2. Analyze the importance of nodes in a network using different network measures and find the dependencies among the nodes using category of network models
3. Evaluate the different link analysis algorithms and link prediction methods in social network application
4. Categorize community detection methods in social networks
5. Develop semantic web specific applications with ontological representation
6. Interpret the security features of social and information networks

Module:1	Introduction to Social Network Analysis	4 hours

Introduction to Social Network Analysis - Need for Social Networks - Applications of Social Network Analysis - Preliminaries - Three Levels of Social Network Analysis - Historical Development - Graph Visualization Tools

Module:2	Network Measures and Models	6 hours

Network Measures - Network Basics - Node Centrality - Assortativity - Transitivity and Reciprocity - Similarity - Degeneracy - Network Growth Models - Properties of Real-World Networks - Random Network Model - Ring Lattice Network Model - Watts-Strogatz Model - Preferential Attachment Model - Price's Model - Local-world Network Growth Model - Network Model with Accelerating Growth - Aging in Preferential Attachment

Module:3	Link Analysis and Prediction	6 hours

Applications of Link Analysis - Signed Networks - Strong and Weak Ties - Link Analysis Algorithms - PageRank - Personalized PageRank - DivRank - SimRank - PathSIM - Link Prediction - Evaluating Link Prediction Methods - Heuristic - Probabilistic - Supervised Random Walk - Information-Theoretic Model

Module:4	Community Structure in Networks	8 hours

Applications of Community Detection - Types of Communities - Community Detection Methods - Disjoint Community Detection - Overlapping Community Detection - Local Community Detection - Community Detection v/s Community Search - Evaluation of Community Detection Methods - Cascade Behaviors and Network Effects - Cascade Models - The "Indignados" Movement - Probabilistic

Module:5	Semantic Web	8 hours

Web Data and Semantics in Social Network Applications - Electronic Sources for Network Analysis - Knowledge Representation on the Semantic Web - Modelling and Aggregating Social Network Data - Developing Social-Semantic Applications - Semantic-based Social Network Analysis in the Sciences - Ontologies are us: Emergent Semantics in Folksonomy Systems

Module:6	Analysis of Security in Social Networks	8 hours
Social Network Security - Security threats - Managing Trust in Online Social Networks- Security and Privacy in Online Social Networks - Security Requirement for Social Networks
Module:7	Applications and Case Studies	6 hours
Malicious Activities on Online Social Networks - Sockpuppets in Online Social Networks - Collusion on Online Social Networks - Modelling the Spread of COVID-19 - Recommender Systems
Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R & D Organizations
	Total Lecture hours:	45 hours

Text Book(s)	
1.	Tanmoy Chakraborty, "Social Network Analysis" , Wiley, 2021
2	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", 3rd edition, Cambridge Universg ity Press,2020

Reference Books	
1.	M.E.J. Newman, "Networks: An Introduction", Oxford University Press, 2010.
2	Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World". Cambridge University Press, 2010.
3	Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications", Cambridge university press, 2009
4	Jalal Kawash, "Online Social Media Analysis and Visualization" (Lecture Notes in Social Networks), 2015
5	Emmanuel Lazega, Tom A.B Snijders, Nuffield College, "Multilevel Network Analysis for the Social Sciences, Theory, Methods and Applications", Springer 2016
6	Song Yang, Franziska B Keller, Lu Zheng, "Social Network Analysis: Methods and Examples", SAGE Publications, Inc, November 2016
7	John Scott, "Social Network Analysis", 3rd edition, SAGE, 2013.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA610L	Blockchain Technologies	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To provide a conceptual understanding on the function of Blockchain and to discuss the functional elements of bitcoin and its mining process.
2. To understand how Blockchain is applied to different aspects of the business and to describe current Hyper ledger projects and cross-industry use cases.
3. To apply the block chain concepts using Ethereum and solidity platforms.

Course Outcomes:

1. Analyze and determine the decentralization and cryptographic concepts
2. Determine different crypto transaction in blockchain
3. Apply and implement various applications using Ethereum Blockchain
4. Investigate the Hyperledger Fabric development environment
5. Design blockchain based solutions for the real time problems

Module: 1	Basics and Crypto Fundamentals	7 hours

Symmetric & Asymmetric Key Cryptography - Hash Functions - Digital Signatures - Ledgers - Distributed Ledgers - Trusted Third Party Transactions - CAP Theorem - Byzantine Generals Problem.

Module: 2	Blockchain Concepts	6 hours

Introduction To Blockchain - Basics - History - Features- Types - Conceptualization - Distributed Ledgers - Verification of Transactions - Blocks Creation - Chaining Blocks - Mining Mechanism - Verification & Confirmation of Blocks.

Module: 3	Blockchain Architectures	7 hours

Merkle Trees - Permissionless - Permissioned Blockchains - Side Chains Blockchain for Enterprise - Consortium Blockchain.

Module: 4	Consensus Mechanism	7 hours

Distributed Consensus - Byzantine General Problem -Practical Byzantine Fault Tolerance - Sybil Attack - Proof of Work - Proof of Stake - Round Robin - Proof of Authority - Proof of Elapsed Time - RAFT Consensus. Writing to the Blockchain

Module: 5	Conflicts and Forks	6 hours

Ledger Conflicts and Resolutions - Soft Forks - Hard Forks - Security and Safeguards - Protecting Blockchain from Attackers - Multiparty Computation over Blockchain

Module: 6	Bitcoin and Smart Contracts	6 hours

Bitcoin Basics - Consensus in Bitcoin - Miners - Introductory Smart Contracts - Inter-Contract Execution - Inter-Contract Execution Inheritance - Different Ecosystems of Blockchains

Module: 7	Blockchain Applications	4 hours

Blockchain in Financial Service - Payments and Secure Trading - Compliance and Mortgage - Escrow - Blockchain in Supply Chain - Blockchain in Government -

Internet of Things, Medical Record Management System - Identity Management - Property Records - Notary		
Module: 8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Bashir I, "Mastering blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptoccurrencies, Ehtereum, and more", 3rd Edition, 2023, Packt Publishing Ltd.

Reference Books

1.	Narayanan A, Bonneau J, Felten E, Miller A and Goldfeder S, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", 2016, Princeton University Press.
2.	Josh Thompson, "Blockchain: The Blockchain for Beginnings, Guide to Blockchain Technology and Blockchain Programming", 2017, Create Space Independent Publishing Platform.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA611L	Artificial Intelligence	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To gain an understanding of the fundamental principles, models, and algorithms of artificial intelligence.
2. To familiarize with techniques for problem-solving, knowledge representation, and reasoning systems capability.
3. To outline the features and development stages of intelligent agents.

Course Outcomes:

1. Understand the foundational concepts of artificial intelligence and intelligent agents
2. Apply the uninformed and heuristic approaches to discover the optimal solution for search problems
3. Implement adversarial search and CSP techniques for decision-making on complex problems
4. Use the knowledge representation and reasoning approaches to solve intelligent decision-making problems
5. Solve sequential decision-making problems using autonomous planning techniques

Module:1	Introduction	5 hours

Foundation of AI - History - Risks and Benefits of AI - Intelligent Agents - Agent and Environment

Module:2	Problem-Solving	8 hours

Solving Problems by Searching - Problem-Solving Agents, Uninformed Search - BFS, DFS, IDS, Uninform cost search - Informed Search- Best first search, A* search, Local search - Hill Climbing

Module:3	Adversarial Search and Constraint Satisfaction Problems	6 hours

Adversarial Search - Game Theory - Minimax, Alpha Beta Pruning - Constraint Satisfaction Problems

Module:4	Knowledge Representation	5 hours

Ontological Representation - Rule-based System - Property Inheritance - Semantic Networks - Reasoning in Semantic Net - Properties of Good Knowledge Representation Systems

Module:5	Reasoning	7 hours

Propositional Logic - Reasoning Patterns in Propositional Logic - First-Order Logic - Inferences in First-OrderLogic - Forward and Backward Chaining, Unification, Clause Form of FOL, Resolution

Module:6	Uncertainty - Probabilistic Reasoning	7 hours

Prior and Posterior Probabilities - Bayes' Theorem - Bayesian Network - Probabilistic Reasoning Over Time - Time and Uncertainty - Non-monotonic Reasoning -Justification-Based Truth Maintenance System		
Module:7	**Planning and Learning**	**5 hours**
Representation for Planning - Planning with State Space Search - Partial Order Planning -Learning - Types of Learning.		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2021, 4th Edition, Pearson.

Reference Books	
1.	Elaine Rich and Kevin Knight, "Artificial Intelligence", 2017, 3rd Edition, Tata McGraw Hill.
2.	George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", 2021, 6th Edition, Pearson.
3.	Deepak Khemani, "A First Course in Artificial Intelligence", 2013, 1st Edition, Mc Graw Hill.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA612L	Domain Specific Predictive Analytics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the importance of predictive models in domain-specific predictive analytics.
2. To apply various data pre-processing and data standardization techniques for target feature selection.
3. To practice the notion of predictive analytics with respect to specialized domains such as healthcare and others.

Course Outcomes:

1. Understand the core concepts of predictive analytics and differentiate it from other analytical strategies
2. Apply data summarization and feature selection techniques for predictive analytics
3. Design various descriptive models and interpret their outcomes
4. Develop an ensemble of predictive models and assess their outcome using various validation techniques
5. Interpret different predictive data analytics and explore the usage of data visualization techniques on heterogeneous data in the healthcare domain

Module:1	Introduction to Predictive Analytics and Problem Setting	6 hours

Introduction to Predictive Analytics - Predictive Analytics vs. Business Intelligence - Predictive Analytics vs. Statistics - Predictive Analytics vs. Data Mining - Challenges in using Predictive Analytics - Problem Setting - Business Understanding, Defining Target Variable, Defining Measures of Success for Predictive Models, Case Study, Recovering lapsed donors

Module:2	Data Understanding and Preparation	6 hours

Single Variable Summaries - Data Visualization in One Dimension - Multiple Variable Summaries - Data Visualization, Two or Higher Dimensions - Data Preparation - Variable Cleaning, Feature Creation

Module:3	Descriptive Modeling and Interpreting Descriptive Models	7 hours

Data Preparation Issues with Descriptive Modeling - Principal Component Analysis - The PCA Algorithm - Clustering Algorithms - Interpreting Descriptive Models - Standard Cluster Model Interpretation, Problems with Interpretation Methods, Identifying Key Variables in Forming Cluster Models, Cluster Prototypes, Cluster Outliers

Module:4	Predictive Modeling	4 hours

Predictive Modeling - Decision Trees -g Decision Tree Splitting Metrics, Decision Tree Knobs and Options, Reweighting Records, Priors and Misclassification Costs - Logistic Regression - Interpreting Logistic Regression Models, Other Practical Considerations for Logistic Regression - Neural Networks - K-Nearest Neighbor - Naïve Bayes

Module:5	Assessing Predictive Models and Model Ensembles	7 hours

Batch Approach to Model Assessment - Percent Correct Classification, Rank Ordered Approach to Model Assessment - Assessing Regression Models - Model Ensembles - Motivation for Ensembles, Bagging, Boosting, Random Forests, Stochastic Gradient Boosting, Heterogeneous Ensembles - Model Ensembles and Occam's Razor - Interpreting Model Ensembles		
Module:6	**Domain-Specific Case Study on Healthcare**	**7 hours**
Healthcare Data Sources and Basic Analytics - Advanced Data Analytics for Healthcare - Applications and Practical Systems for Healthcare - Data Analytics for Pervasive Health, Healthcare Fraud Detection, Data Analytics for Pharmaceutical Discoveries, Clinical Decision Support Systems, Computer-Aided Diagnosis, Mobile Imaging for Biomedical Applications - Healthcare Data Sources - Components of Electronic Health Records		
Module:7	**Data Visualization for Healthcare Data**	**6 hours**
Introduction to Visual Analytics and Medical Data Visualization - Visual Analytics in Healthcare - Visual Analytics for Clinical Workflow, Visual Analytics for Clinicians-Temporal Analysis, Patient Progress and Guidelines, Other Clinical Methods - Visual Analytics for Patients - Assisting Comprehension - Condition Management		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture Hours:	**45 hours**

Text Book(s)	
1.	Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst", 2014, 1st Edition, John Wiley & Sons Inc.
2.	Chandan K. Reddy, Charu C. Aggarwal, "Healthcare Data Analytics", 2015, CRC Press.

Reference Books	
1.	Anasse Bari, Mohamed Chaouchi, Tommy Jung, "Predictive Analytics for Dummies", 2016, 2nd Edition, Wiley.
2.	Ivo D. Dinov, "Data Science and Predictive Analytics: Biomedical and Health Applications using R", 2018, Springer.

Mode of Evaluation: CAT, Written Assignment, Quiz and FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA613L	Digital Forensics	3	0	0	3
Prerequisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand the basics of digital forensics technology, systems and services.
2. To analyze about data recovery, data seizure, digital evidence controls and forensics analysis.
3. To apply different tools for digital forensic acquisition and analysis.

Course Outcomes:

1. Learnthefundamentalsofdigitalforensicstechnologyalongwithdifferentsystemsandservices
2. Recoverandseizedatafromacrimescenewithoutdamage,usinglegalproceduresandstandards
3. Exhibit knowledge in forensic data acquisition and analysis and investigate artifacts in different operating systems
4. Applyforensicstoolsandconceptsonmodernframeworkssuchasnetwork,email,smartphones,cloud and social media

Module:1	Introduction to Digital Forensics	6hours

Computer Forensics Fundamentals - Types of Computer Forensics Technology - Types of Computer Forensics Systems - Vendor and Computer Forensics Services

Module:2	Computer Forensics Evidence and Capture	6 hours

Data Recovery - Evidence Collection and Data Seizure - Duplication and Preservation of Digital Evidence - Computer Image Verification and Authentication

Module:3	Computer Forensic Analysis and Countermeasures	8 hours

Discover of Electronic Evidence - Identification of Data - Reconstructing Past Events - Fighting Against Macro Threats - Information Warfare Arsenal and Tactics of the Military - Tactics of Terrorist and Rogues - Tactics of Private Companies.

Module:4	Network and Operating System Forensics	7 hours

ınvestigation on Virtual Network and Email, Internet Artifacts - Damaging Computer Evidence - System Testing - Operating System Artifacts: Windows System Artifacts, Linux System Artifacts

Module:5	Firewall and IDS Security Systems	6 hours

Storage Area Network Security Systems - Instant Messaging (IM) Security Systems - Biometric Security Systems - Computer Forensics Services: Occurrence of Cyber Crime - Cyber Detectives - Fighting Cyber Crime with Risk Management Techniques

Module:6	Mobile and Cloud Forensics	6 hours

Mobile Forensics- Acquisition Procedures for Mobile - Equipment, Tools, Internet of Anything - Cloud Forensics - Service Levels, Cloud Vendors - Legal Challenges - Technical Challenges - Acquisition, Investigation - Tools - Open-Stack, F-Response, AXIOM

Module:7	Forensics Tools	6 hours

Open Source Tools –The Sleuth Kit(TSK) and Autopsy, SANSSIFT Investigative Tool, Voltality, CAINE Investigative Environment, Windows System Internals, Commercial Tools -Encase, FTK, PRO Discover Basic, Nirsoft		
Module 8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture	**45 hours**

Text Book(s)

1.	Dejey and Murugan, "Cyber Forensics", 2018, 1stEdition, Oxford University Press.

Reference Books

1.	B.Nelson,A.Phillips,F.Enfinger,andC.Steuart,"GuidetoComputerForensicsandInvestigations",2019, 6thEdition, Cengage, India
2.	John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", 2015, 2nd Edition, Charles River Media Inc.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA614L	Software Testing	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To understand and analyze the software testing concepts and their techniques.
2. To create the test cases and apply various automation testing tools.

Course Outcomes:

1. Design the test cases with suitable testing methods
2. Create a test plan and test summary reports
3. Perform unit, integration and system testing
4. Test the web-based systems, object-oriented systems, and mobile apps using recent automation testing tools

Module:1	Fundamentals of Software Testing	4 hours

Basic Definitions - Identifying Test Cases - Myths and Facts - Software Testing Life Cycle (STLC) - Types of Testing - Testing in the Development Life Cycle - Testing Principles - Verification and Validation - Fault Taxonomies - Levels of Testing

Module:2	Black Box Testing	6 hours

Robust and Worst - Case Boundary Value Testing - Special Value Testing - Random Testing - Improved Equivalence Class Partitioning - Edge Testing - State Based Testing - Decision Table Based Testing - Cause-Effect Graph Testing

Module:3	White Box Testing	4 hours

Code Coverage Testing - McCabe's Path Testing - Data Flow based Testing - Object Oriented Complexity Metrics - Specification Based Testing - Slice Testing - Mutation Testing - Graph Matrices

Module:4	Levels of Testing	5 hours

Unit Testing - Integration Testing - Decomposition Based Integration - Call Graph Based Integration - Path Based Integration - System Testing - Acceptance Testing - Regression Testing - Object-Oriented Testing - Software Complexity - Model-Based Testing

Module:5	Static and Performance Testing	3 hours

Inspections - Structured Walkthroughs - Technical Reviews- Performance Testing - Internationalization Testing - Ad-hoc Testing -Testing OO Systems - Usability and Accessibility Testing - Configuration Testing - Compatibility Testing - Website Testing - Databases and SQL Testing - Domain Testing

Module:6	Test Management	3 hours

Test Planning - Test Plan Components - Test Management - Test Process - Reporting Test Results - Building a Testing Group - The Structure of Testing Group -The Technical Training Program

Module:7	Test Automation	3 hours

Software Test Automation using Selenium - Scope of Automation - Design and Architecture for Automation - Challenges in Automation - Test Metrics and Measurements - Mobile App Testing - Mobile Test Automation and Tools

Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R&D Organizations		
	Total Lecture Hours:	**30 hours**

Text Book(s)	
1.	Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", 2021, 5th Edition, Auerbach Publications, Tylor & Francis Group, Boca Raton, Florida, USA.
2.	Dorothy Graham, "Foundations of Software Testing", 2020, 4th Edition, Cengage Publication, Learning India Pvt. Ltd, India.

Reference Books	
1.	Maurício Aniche, "Effective Software Testing; A Developer Guide", 2022, 4th Edition, Manning Publications, USA.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	04-05-2023

Course Code	Course Title	L	T	P	C
PMCA614P	Software Testing Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To design the test cases using various testing techniques.
2. To identify the appropriate tools to perform unit, integration and system testing.
3. To apply automation testing using automation tools in various applications.

Course Outcomes:

1. Design the test cases and create a test plan to improve software quality
2. Perform unit, integration and system testing in any real-time application
3. Evaluate and test the web-based systems and mobile apps using recent automation testing tools

Indicative Experiments		Hours
1.	Write the test cases and create a test plan document for any real-time application	4 Hours
2.	To perform regression testing, user interface testing, data driven testing, and verification testing using RFT tool	8 Hours
3.	To perform unit testing using JUnit testing tool	4 Hours
4.	To perform functional testing and non-functional testing using Selenium Automation testing tool.	4 Hours
5.	To perform performance testing using JMeter testing tool.	4 Hours
6.	To perform mobile app testing using Appium testing tool.	6 Hours
	Total Laboratory Hours	**30 Hours**

Text Book(s)

1	Maurício Aniche, "Effective Software Testing; A Developer Guide", 2022, 4th Edition, Manning Publications, USA.
2.	Dorothy Graham, "Foundations of Software Testing", 2020, 4th Edition, Cengage Publication, Learning India Pvt. Ltd, India.

Mode of Assessment: CAT, Exercises, FAT

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No.70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA615L	Software Project Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To explore the characteristics of software projects and understand the project management activities.
2. To gain knowledge on estimation techniques of software projects and to know about risk management.
3. To provide an exposure to monitor and control of software projects and to learn how to manage people and build an effective team.

Course Outcomes:

1. Demonstrate knowledge of the fundamental elements and concepts related to project management activities and types of software projects thereby ensure efficient software planning
2. Schedule the activities of the project to get a critical path and then further perform PERT for risk management
3. Use and apply visualization techniques for monitoring and controlling of the activities related to software projects
4. To monitor and control the activities of the project, manage contracts, people and team
5. Perform project evaluation, communication, implementation and closeout

Module:1	Introduction to Software Project Management	4 hours

Project Definition - Importance of Software Project Management - Project Portfolio Management - Activities Covered by Software Project Management - Overview of Project Planning - Stepwise Project Planning

Module:2	Project Activity Planning	8 hours

Strategic Assessment - Technical Assessment - Cost Benefit Analysis - Cash Flow Forecasting - Cost Benefit Evaluation Techniques - Risk Evaluation - Objectives - Project Schedule - Sequencing and Scheduling Activities - Network Planning Models - Forward Pass - Backward Pass - Activity Float - Shortening Project Duration - Activity on Arrow Networks g Software Processes and Process Models

Module:3	Software Effort Estimation	8 hours

Basis and Need for Estimation, Problems with Over and Under Estimates, Software Effort Estimation Techniques - Expert Judgment, Estimation by Analogy, Albrecht Function Point Analysis, Function Point Mark II, Object Points, COCOMO, Agile based Software Estimation Techniques

Module:4	Software Project Quality Management	5 hours

Defining Software Quality - Importance of Software Quality - Process of Software Project Quality Management - ISO 9126 - Techniques of Quality Assurance during System Development - Processes and Techniques of Software Project Quality Control

Module:5	Monitoring and Control	6 hours

Creating Framework - Collecting the Data - Visualizing Progress - Cost Monitoring - Earned Value Analysis - Change Control - Contract Management - Types of Contract - Stages in Contract Placement - Typical Terms of a Contract - Contract Management - Acceptance

Module:6	Managing People and Organizing Teams	6 hours

Introduction - Understanding Behaviour - Organizational Behaviour - Selecting the Right Person for the Job - Working in Group - Decision Making - Leadership - Motivation - Oldham-Hackman Job Characteristics Model - Stress, Health and Safety, Ethical and Professional Concerns		
Module:7	**Project Implementation and Closeout**	**6 hours**
Project Evaluation and Communication, Project Review Meetings, Project Management Information Systems (PMIS), Web-Enabled Project Management, Project Termination and Closeout		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", 2017, 6th Edition, McGraw Hill, India.
2.	John Nicholas and Herman Steyn, "Project Management for Engineering, Business and Technology", 2020, 6th Edition, Routledge, Taylor and Francis, UK.

Reference Books	
1.	Ramesh Gopalaswamy, "Managing Global Projects", 2017, 1st Edition, Tata McGraw Hill
2.	Greg Horine, "Project Management Absolute Beginner's Guide", 2017, 3rd Edition, Que Publishing

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	04-05-2023

Course Code	Course Title	L	T	P	C
PMCA616L	Storage Systems and Management	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:
1. To understand the components of data center and types of storage systems.
2. To emphasize on data backup and protection methods.
3. To design a typical storage network architecture.

Course Outcomes:
1. Analyze the data center requirements for a business setup and apply the right information cycle
2. Apply the best storage configuration to protect user data
3. Implementing the concepts of storage virtualization
4. Design, analyze storage systems and select an optimal storage network
5. Deploying Business continuity plans

Module:1	Data Center and Storage Management	8 hours

Information Storage - Types of Storage System Architecture - Data Center Components - Information Lifecycle - Storage System Environment - Zoned Bit Recording - Logical Block Addressing - Host Bus Adapter Working - Disk Drive Performance

Module:2	Data Protection using RAID	6 hours

RAID and its Implementation Aspects - RAID Array Components - RAID Levels and Comparison - RAID Impact of Disk Performance - Hot Spares - Intelligent Storage System

Module:3	Direct-Attached Storage and Introduction to SCSI	4 hours

Benefits - Limitations and Types of Direct - Attached Storage (DAS) - Disk Drive Interfaces - Introduction to SCSI and its Command Model

Module:4	Storage Virtualization	6 hours

SNIA Storage Virtualization Taxonomy - Storage Virtualization Configurations - Storage Virtualization Challenges - Types of Storage Virtualization

Module:5	Network-Attached Storage	6 hours

General Purpose Servers Versus Network Attached Storage (NAS) Devices - NAS File I/O - NAS Components and Implementation - NAS File-Sharing Protocols and I/O Operations - Factors Affecting NAS Performance and Availability

Module:6	Storage Area Networks	8 hours

Fiber Channel - Evolution and Components of SAN - Fiber Channel (FC) - Connectivity - FC Ports and Architecture - Zoning - FC Login Types - FC Topologies

Module:7	Business Continuity	5 hours

BC Planning Lifecycle - Failure Analysis - Business Impact Analysis - Local and Remote Replication

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R&D Organizations

	Total Lecture hours:	45 hours

Text Book(s)

1.	EMC education services, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", 2nd Edition, 2015, Wiley

Reference Books

1.	Tom Clark, "Storage Virtualization", 2018, Pearson.		
2.	Mauricio Arregoces, "Data Center Fundamentals", 2015, Cisco Press.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT and Seminar.			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA617L	Data Visualization	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives :

1. To understand the various types of data, apply and evaluate the principles of data visualization.
2. Acquire skills to apply visualization techniques to a problem and its associated dataset.
3. To apply a structured approach to create effective visualizations.
4. To learn how to bring valuable insight from the massive dataset using visualization.
5. To learn how to build a visualization dashboard to support decision making.
6. To create interactive visualization for better insight using various visualization tools.

Course Outcomes:

1. Identify the different data types, visualization types to bring out the insight
2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on a large dataset
3. Design visualization dashboard to support the decision making on large scale data
4. Demonstrate the analysis of a large dataset using various visualization techniques and tools

Module:1	Introduction to Data Visualization	4 Hours

Overview of Data Visualization - Data Abstraction - Task Abstraction - Dimensions and Measures - Analysis: Four Levels for Validation.

Module:2	Visualization Techniques	4 Hours

Introduction to Various Data Visualization Tools - Scalar and Point Techniques - Vector Visualization Techniques - Multidimensional Techniques - Visualizing Cluster Analysis - K-Means and Hierarchical Cluster Techniques.

Module:3	Basic Visual Analytics	4 Hours

Bar Chart - Stacked Bar Chart - Line Chart - Histogram - Pie Chart - Frequency Polygon - Box Plot - Scatter Plot - Regression Curves.

Module:4	Applied Visual Analytics	5 Hours

Networks and Trees - Heat Map - Tree Map - Map Color and Other Channels Manipulate View - Visual Attributes

Module:5	Diverse Types of Visual Analytics	5 Hours

Time - Series Data Visualization - Text Data Visualization - Multivariate Data Visualization and Case Studies.

Module:6	Visualization Tools And Techniques	3 Hours

Integration of R / Python With Tableau Functions and Logics.

Module:7	Visualization Dashboard Creations	3 Hours

Dashboard Creation Using Visualization Tool for the Use Cases: finance - Marketing - Insurance - Healthcare etc.

Module:8	Contemporary Issues	2 Hours

Guest Lecture from Industry and R&D Organizations

		Total Lecture hours:	30 hours

Text Book(s)

1.	Tamara Munzer, "Visualization Analysis and Design", 2014, 1st Edition, CRC Press, United States.
2.	Stephen Few, "Now You See It", 2009, 1st Edition, Analytics Press, United States.
Reference Books	
1.	Dr. Chun-hauh Chen, W. K. Hardle, A. Unwin, "Handbook of Data Visualization", 2008, 1stEdition, Springer publication, Germany.
2.	Ben Fry, "Visualizing Data", 2008, 1st Edition, O'Reilly Media, United States.
3.	John Verzani, "Simpler- Using R for Introductory Statistics", 2005, 1st Edition, Taylor and Francis, United Kingdom.
4.	Avril Coghlan, "A Little Book of R for Multivariate Analysis", 2013, 1st Edition, Welcome Trust Sanger Institute, United Kingdom.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA617P	Data Visualization Lab	0	0	2	1
Pre-requisite	NIL		Syllabus version		
				1.0	

Course Objectives:

1. Understanding data visualization pipe line
2. Create ad-hoc reports on different kinds of data, data visualizations using R and Tableau
3. Creation of Dashboards using Tableau, Integration of R with Tableau and Python with Tableau.

Course Outcomes:

1. Understanding the ways to acquiring of the data from different data sources
2. Practice of different techniques to visualize data using R and Tableau
3. Understanding of the procedure for creation of dashboards in Tableau

Indicative Experiments			
1.	Acquiring and plotting data	6 hours	
2.	Statistical Analysis Multivariate Analysis, K-means and Hierarchical Cluster techniques, Correlation, regression and analysis of variance.	4 hours	
3.	Financial analysis Clustering, Histogram and Heat Map.	4 hours	
4.	Time-series analysis Stock Market.	2 hours	
5.	Visualization of various massive dataset Finance, Healthcare, Census, Geospatial.	4 hours	
6.	Visualization on Streaming dataset Stock market dataset, weather forecasting	4 hours	
7.	Dashboard Creation	2 hours	
8.	Market-Basket Data analysis-visualization	2 hours	
	Total Laboratory hours:	**30 hours**	

Text Book(s)	
1.	Walter W Piegorsch, "Statistical Data Analytics- Foundations for Data Mining, Informatics and Knowledge Discovery", 2015. Wiley
2.	Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl, Jr., "Data mining for Business analytics -Concepts, Techniques, and Applications in R", 2018 John Wiley & Sons, Inc.

Reference Books	
1.	Ryan Sleeper, "Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master", 2018, Oreilly
2.	Ben Jones, "Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations", 2014

Mode of Assessment: CAT, Exercises, FAT

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA618L	**Industry 4.0**	3	0	0	3
Pre-requisite	NIL	**Syllabus version**			
		**1.0**			

Course Objectives:

1. To understand the essentials and overview of industry 4.0.
2. To gain knowledge of industry 4.0 architecture, cyber-physical systems, IoT frameworks, cybersecurity and risk.
3. To explore the transformation of industrial processes through modern technologies.

Course Outcomes:

1. Understand the fundamentals and framework of industrial 4.0
2. Comprehend various architectures of cyber-physical systems connect industrial 4.0
3. Study the framework to value industry 4.0 and operator 4.0
4. Evaluate and design Cobot for automating industrial operations

Module:1	**Fundamentals of Industry 4.0**	**5 hours**

Introduction - Definition - Key Paradigm - Evolution of Industry 4.0, Framework of Industry 4.0 - Nine Pillars - Macro and Micro Perspective of Industry 4.0 - Components - Design Principles - Reference Architecture Model Industry 4.0 (RAMI 4.0)

Module:2	**Industry 4.0 Architecture and Cyber- Physical Systems**	**6 hours**

Cyber-Physical Systems - CPS 5C Level Architecture - Implementation of 5C CPS Architecture in Factories - Classification of CPS in Context of Industry 4.0 - Operational Technology and Information Technology

Module:3	**IoT and the need for Data Rationalization**	**5 hours**

Internet of Things Vision, Frameworks, Architecture, Visualizing the Internet of Things (IoT), Enablers of IoT, Transforming Industry and Society, Services of IoT, The Internet of Things Tomorrow, Ecosystem

Module:4	**Collaborative Robots (Cobot)**	**8 hours**

Introduction - Characteristics of Cobots - Cobots in Complex Environments - Working Alongside Humans - Level of Automation and Collaboration - Conflicts and Trust - Guidelines for Designing a Cobot - Cobots in Industry Operations - Cobots as Workforce - Applications of Cobots

Module:5	**Operator 4.0.**	**5 hours**

Augmented Reality for O&M, Wearable Devices, Wearables and Localization Devices, Intelligent Health and Safety Devices for Operators, Sensors used in Wearable Devices, Collaborative Robotics in Industry 4.0, Human Factors in Industry 4.0: Ergonomic and Psychological Issues and Challenges

Module:6	**Cybersecurity and Risk**	**7 hours**

Cybersecurity in OT level - Cybersecurity in IT level - IT-OT Cybersecurity Convergence - Risks and Threats of Sharing Data - Blockchains in Cybersecurity

Module:7	**Industry 4.0 across the Sectors**	**7 hours**

Introduction - Transportation 4.0 - Rail 4.0- Logistics 4.0- Manufacturing 4.0 - Digital Twin- Case Studies: Smart Factories - Smart Cities - Smart Products - Smart Healthcare - Supply chain management - Smart Agriculture and Smart Education

Module:8	**Contemporary Issues**	**2 hours**

Guest Lecture from Industry and R&D Organizations

		Total Lecture Hours:	45 hours

Text Book(s)

1. Diego Galar Pascual, Pasquale Daponte, and Uday Kumar, "Handbook of Industry 4.0 and Smart Systems", 2020, 1st Edition, CRC Press.
2. Peter Matthews and Steven Greenspan, "Automation and Collaborative Robotics: A Guide to the Future of Work", 2020, Apress Publisher.

Reference Books

1. Jesús Hamilton Ortiz, "Industry 4.0 Current Status and Future Trends", 2020, Intech Open.
2. Christian Schröder, "The Challenges of Industry 4.0 for Small and Medium-Sized Enterprises", 2017, Friedrich-Ebert-Stiftung.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing the Digital Transformation", 2018, Springer Cham, Switzerland.
4. Bartodziej, Christoph Jan, "The Concept Industry 4.0", 2016, 1st Edition, Springer Gabler Wiesbaden.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA619L	Game Programming	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To provide an in-depth introduction to technologies and techniques currently used in the game industry.
2. To understand game design and development.
3. To understand the processes, mechanics, issues in game design, and game engine development.

Course Outcomes:

1. Understand modelling, techniques, handling situations, and logic
2. Learn and use software engineering, team project management, and prototype presentation principles in a game development context
3. Design, develop, test, evaluate, debug, and modify code to meet design specifications for games
4. Design unique gaming environments, levels and characters by choosing appropriate game strategies and patterns based on an analysis of past and present trends
5. Create and document various games by applying programming concepts using various tools to meet the requirements of the current marketplace
6. Able to build and then integrate technologies such as multimedia, artificial intelligence, and physics modelling into a cohesive, interactive game application

Module:1	Introduction to Game Programming	2 hours

Overview of Game Programming - Structure of a Typical Game Team - Game Industry - Game Engine History

Module:2	Game Engine Architecture	8 hours

Real Time Game Architecture - Engine Support - Subsystem Start-Up and Shut-Down, Memory Management - Containers and Strings - Resource Management - File System, Resource Manager

Module:3	Graphics for Game Programming	8 hours

Graphics Device Management - The Rendering Engine - The Rendering Pipeline, Lighting and Global Illumination - Sprites - Tile-Based Graphics and Scrolling - GUI Programming For Games

Module:4	Artificial Intelligence for Interactive Environments	8 hours

Why Artificial Intelligence For Games - AI Methods In Gaming - Tree Search - Reinforcement Learning - Path Finding Algorithms - Dijkstra's Algorithm - A* Algorithm -D* Algorithm - Navigation Meshes

Module:5	Game Physics	8 hours

Physics Based Modeling - Rigid Body Dynamics - Integrating a Physics Engine Into The Game - Collision Detection - Object Boundaries - Sphere Algorithms- Cuboid Algorithms - Point Algorithms - Line Algorithms

Module:6	Game Design	5 hours

Game Design - Game Genres - Modes - Perspectives - Scripting - Audio Engineering - Sound And Music - Level Design - Render Threading

Module:7	Project Management in Game Development	4 hours

Game Project Management - Game Design Documentation - Rapid Prototyping - Game Testing

Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R&D Organizations		
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Jason Gregory, "Game Engine Architecture", 2018, 3rd Edition, A K Peters, CRC Press.
2. Yannakakis GN, Togelius J, "Artificial intelligence and games", 2018, 1st Edition, Springer, New York.
3. House Donald, Keyser, John C, "Foundations of Physically Based Modeling and Animation", 2016, 1st Edition, United States, CRC Press.

Reference Books

1. Sellers M, "Advanced game design: a systems approach", 2017, 1st Edition, Addison, Wesley Professional.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA619P	Game programming Lab	0	0	2	1
Pre-requisite	NIL		Syllabus version		
			1.0		

Course Objectives:

1. To understand the processes, mechanics, issues in game design, and game engine development.
2. To understand modeling, techniques, handling situations, and logics
3. To build and integrate technologies such as multimedia, artificial intelligence, and physics modelling into a cohesive, interactive game application.

Course Outcomes:

1. Design, develop, test, evaluate, debug, and modify code to meet design specifications for games
2. Design unique gaming environments, levels and characters by choosing appropriate game strategies and patterns based on an analysis of past and present trends
3. Able to build and then integrate technologies such as multimedia, artificial intelligence, and physics modelling into a cohesive, interactive game application

Indicative Experiments		Hours
1.	Game engines - UNITY Basics/ Unreal/ Scratch, etc.,	3 hours
2.	Model Creation - Unity/MAYA	3 hours
3.	2D Game environment	3 hours
4.	3D Game environment	3 hours
5.	Create a game environment to apply different types of light effects	3 hours
6.	Create a physics based game play to realize all basic Newtonian effects	3 hours
7.	Create a Tile map based Game environment	3 hours
8.	Apply Multiple Levels for any of the Games developed	3 hours
9.	AI as Player	3 hours
10.	AI as Non Player Character (NPC) - Navigation Mesh creation	3 hours
	Total Laboratory Hours	30 hours

Text Book(s)

1. Ben Tristem, Mike Geig,"Unity Game Development in 24 Hours, Sams Teach Yourself Unit Game Deve 24 Hour Sams 2", 2015, Pearson Education.

Reference Books

1. Felicia P, "Unity From Zero to Proficiency (Foundations) A step-by-step guide to creating your first game with Unity", 2017, Patrick Felicia.
2. Shankar AR. "Pro HTML5 Games: Learn to Build Your Own Games Using HTML5 and JavaScript", 2017, Apress.

Mode of Assessment: CAT, Exercises and FAT

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA620L	Programming in C#	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To utilize the .NET framework to build distributed enterprise applications and leverage the major namespaces and classes of the .NET Framework.
2. To acquire knowledge on object oriented programming, multi-threaded, database connectivity, and web service programs.
3. To design and develop C# console, windows application, ASP.NET web application and services.

Course Outcomes:

1. Demonstrate the knowledge of .NET Framework and the fundamentals of developing modular application by using C# programming
2. Design and develop solutions for real time problems using object oriented principles
3. Analyse and evaluate user requirements for software functionality and create rich interactive UIs using C#
4. Execute component services, develop windows based applications and implement interactive executable web applications using remoting and web services
5. Create database driven applications and web applications using ADO.NET with ASP.NET and ASP.NET Blazor respectively

Module:1	.NET Framework with C# Fundamentals	7 hours

.NET Framework - Common Language Runtime (CLR) - Common Type System (CTS) - Common Language Specification (CLS) - C# Language Fundamentals - Programming Constructs - Command Line Arguments - Value Types and Reference Types - Operators - Decision Making Statements - Looping Constructs - Arrays - 2 Dimensional - Jagged Array

Module:2	C# - OOPs	8 hours

Object Oriented Concepts - Classes and Objects - Methods - Static Methods - Non Static Methods - Encapsulation - Abstract Class - Inheritance - Polymorphism - Interfaces - Collections - Multithreading - Thread Class, Runnable Interface

Module:3	Events and Delegates	7 hours

Properties - Indexers - Multicast Delegates - Events - Registry Programming - File I/O - Serialization - Binary Format - SOAP Format - Type Reflection and Attribute-based Programming - Late Binding - Windows Forms

Module:4	ADO.Net	5 hours

Data Access with ADO.NET - Architecture - Data Reader - Data Adapter - Command - Connection - Data Set - Data Binding - Data Grid Control - XML based Data Sets - LINQ

Module:5	Web Service and Windows Communication Foundation (WCF)	5 hours
.Net Remoting - Architecture - Marshal By Value - Marshal By Reference - WCF - Basics Life Cycle - Hosting Services - Building Clients - Web Services - Client - Server		
Module:6	Web Development using ASP.NET	6 hours
Introduction to ASP.Net - Architecture - Life Cycle - ASP.Net Core - Cross Platform Support -Capabilities of ASP.Net Core - Web Forms and Controls - ADO.Net with ASP.NET - MVC - Session Management Techniques - Client Side - Server Side		
Module:7	Web Application Framework	5 hours
Blazor Architecture - Serverless Computing - Containerization - Integration (DB, Cloud and Front-end JS), Other Tools and IDEs.		
Module:8	Contemporary Issues	2 hours
Guest Lecture from Industry and R & D Organizations		
	Total Lecture Hours:	**45 hours**

Text Book(s)

1.	Andrew Troelsen, and Phil Japikse , "Pro C# 10 with .NET 6: Foundational Principles and Practices in Programming", 2022, 11thEdition, A Press.

Reference Books

1.	Marino Posadas, "Mastering C# and .NET Framework", 2016, 1stEdition, Packt.
2.	Ian Griffiths, "Programming C# 8.0", 2019, 1stEdition, O'Reilly Media.
3.	Joydip Kanjilal, "Master C# Skills with Hands-on Code Examples", 2019, 1stEdition, BPB.
4.	David Pine, "Learning Blazor", 2022, 1stEdition, O'Reilly Media.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA620P	Programming in C# Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To utilize the .NET framework to build distributed enterprise applications and leverage the major namespaces and classes of the .NET Framework.
2. To acquire knowledge on object oriented programming, multi-threaded, database connectivity, and web service programs.
3. To design and develop C# console, windows application, ASP.NET web application and services.

Course Outcomes:

1. Demonstrate the knowledge of .NET Framework and the fundamentals of developing modular application by using C# programming
2. Design and develop solutions for real time problems using object oriented principles
3. Analyze and evaluate user requirements for software functionality and create rich interactive UIs using C#
4. Execute component services, develop windows based application and implement interactive executable web applications using remote and web services
5. Create database driven applications and web application using ADO.NET with ASP.NET and ASP.NET Blazor respectively

Indicative Experiments		Hours
1.	Basic Programming in C# - Loops, Strings and Arrays	4 hours
2.	OOPs - Class & Objects, Encapsulation, Inheritance, Abstract , Polymorphism, Interface, Multithreading	7 hours
3.	Properties, Indexers, Multicast delegates, Events, File I/O , Serialization, Windows Forms	7 hours
4.	ASP.Net , WebService, LINQ	6 hours
5.	ADO.Net - Console, Window Form, ASP.Net Blazor	6 hours
	Total Laboratory Hours	30 hours

Text Book(s)

1.	Andrew Troelsen, Phil Japikse , "Pro C# 10 with .NET 6: Foundational Principles and Practices in Programming", 2022, 11th Edition, A Press.

Reference Books

1.	Marino Posadas, "Mastering C# and .NET Framework", 2016, 1st Edition, Packt.
2.	Ian Griffiths, "Programming C# 8.0", 2019, 1st Edition, O'Reilly Media.
3.	Joydip Kanjilal, "Master C# Skills with Hands-on Code Examples", 2019, 1st Edition, BPB.

Mode of assessment: CAT, Exercises, FAT

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA621L	Data Science	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:
1. To learn the Statistical and Algorithmic foundations of Data Science.
2. To understand how to manage diverse data and visualize them for easier comprehension.
3. To provide insights on open source data science tools for Data Analysis.

Course Outcomes:
1. Solve Data Science problems by applying Linear Algebra and Statistical Knowledge
2. Build proficiency in the Statistical Analysis of Data
3. Examine the usage of various Optimization Techniques in the domain of Data Science
4. Recognize diverse data kinds and use programming constructs for knowledge representation
5. Apply industrial case studies to better understand open source data science tools in solving practical issues

Module:1	Fundamentals of Data Science	4 hours

Introduction - Typology of Problems - Importance of Linear Algebra - Statistics and Optimization from a Data Science Perspective - Approaches in Solving Data Science Problems - Structured and Unstructured Data

Module:2	Algorithmic Foundations	4 hours

Linear Algebra- Matrices and their Properties - Eigenvalues and Eigenvectors - Matrix Factorizations - Inner Products - Markov Chain Monte Carlo Algorithms - Learning, PAC Learning

Module:3	Statistical Foundations	5 hours

Descriptive Statistics - Statistical Features - Summarizing the Data - Outlier Analysis, Understanding Distributions and Plots, Univariate Statistical Plots and Its Usage - Bivariate and Multivariate Statistics - Dimensionality Reduction Techniques

Module:4	Optimization Techniques	4 hours

Unconstrained Optimization - Necessary And Sufficiency Conditions for Optima - Gradient Descent Methods - Constrained Optimization - KKT Conditions - Introduction to Non-Gradient Techniques - Introduction to Least Squares Optimization

Module:5	Exploratory Data Analysis	4 hours

Data Acquisition, Data Pre-Processing And Preparation, Data Quality And Transformation ,Data Analytics Life Cycle, Numpy and Pandas, Exploratory Data Analysis (EDA) - Steps in Data Exploration, Basic Tools of EDA

Module:6	Data Visualization	4 hours

Introduction to Data Visualization, Visualization Workflow, Describing Data Visualization Workflow - Analysis - Four Levels for Validation - Data Representation, Chart Types, Categorical, Hierarchical, Relational, Temporal & Spatial

Module:7	Data Science Tools and Techniques	3 hours

Outline and Demonstration of Open Source Tools such as R, Octave, Scilab - Python Libraries, SciPy and Sci-Kitlearn, Pybrain, Pylearn2 - Weka Tool

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R&D Organizations			
		Total Lecture Hours:	**30 hours**

Text Book(s)s	
1.	R. V. Hogg, J. W. McKean and A. Craig, "Introduction to Mathematical Statistics", 2019, 8th Edition, Pearson Education, India.
2.	Avrim Blum, John Hopcroft, RavindranKannan, "Foundations of Data Science", 2020, Cambridge University Press.

Reference Books	
1.	Ani Adhikari and John DeNero, "Computational and Inferential Thinking: The Foundations of Data Science", 2019, GitBook.
2.	HosseinPishro-Nik, "Introduction to Probability, Statistics, and Random Processes", 2014, Kappa Research, LLC.
3.	Carl Shan, Henry Wang, William Chen, Max Song. "The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists." 2016, The Data Science Bookshelf.
4.	James, G., Witten, D., T., Tibshirani, R. "An Introduction to Statistical Learning with Applications in R", 2013, Springer.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar.			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA621P	Data Science Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To provide necessary data manipulation knowledge and to perform practical problem analysis using statistical and machine learning approaches.
2. To generate a report and visualize the results in graphical form using a programming tool.

Course Outcomes:

1. Gain insights from the data through statistical inferences.
2. Create appropriate models using data analytics.
3. Analyze the model's effectiveness and the accuracy of the output.
4. Demonstrate problem-solving skills and provide solutions to real-world problems

Indicative Experiments		Hours
1.	Get Familiar with Online Data Repositories Like UCI Machine Learning Repository, Kaggle and Others.	3
2	Perform Outlier Detection, Missing Value Imputation, Dimensionality Reduction for Benchmarking Dataset.	3
3.	Normalize Data Using Different Methods and Perform Descriptive Statistics.	3
4.	Automate Email Classification and Response.	2
5.	Customer Segmentation in Business Model Based on their Demographic, Psychographic Data.	2
6.	Analysis of Tweet And Retweet Data to Identify The Spread of Fake News	3
7.	Analyze Crime Data Using Suitable Techniques on Reported Incidents of Crime Based on Time and Location	2
8.	Recommendation System Based on the Customer Transaction Using Descriptive Data Models.	3
9.	Analysis on Power Consumption Data to Suggest for Minimizing the Usage.	2
10.	Behavioral Analysis of Customers for any Online Purchase Model.	3
11.	Data Analysis for Yield Prediction and Crop Selection on Indian Terrain Data Set in Agriculture	2
12.	Business Model Development to Predict the Trend in Investment and Funding.	2
	Total Laboratory Hours	30 hours
Text Book(s)		

1	Carl Shan, Henry Wang, William Chen, Max Song. "The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists."2016, The Data Science Bookshelf.
2	Sergios Theodoridis, Konstantinos D Koutroumbas, Pattern Recognition,2009, 4th Edition, Academic Press, Inc.

Mode of assessment: CAT, Exercises, FAT			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA622L	Optimization Techniques	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To acquire knowledge about optimization techniques and their importance.
2. To introduce the concept of linear and nonlinear optimization methods.
3. To choose appropriate optimization methods and solve real-world problems.

Course Outcomes:

1. Comprehend the need, characteristics and applications of the Optimization Methods
2. Understanding the concepts of Linear programming and its methods
3. Solve problems using the Simplex method and its variants
4. Recognize and solve the nonlinear Optimization Methods
5. Explore the various Bio-Inspired and fuzzy-based Optimization Methods
6. Learn the practical aspects of Optimization

Module:1	Introduction to Optimization Techniques	6 hours

Introduction - Engineering Applications of Optimization - Classification of Optimization Problems - Single Variable Optimization - Multivariable Optimization with No Constraints - Multi-Variable Optimization with Equality and Inequality Constraints - Lagrange Multipliers Method, Kuhn-Tucker Conditions

Module:2	Linear Programming	7 hours

Introduction Properties of Linear Programming - Basic Assumptions - Mathematical Formulation of Linear Programming - Limitations or Constraints - Methods for The Solution of Lp Problem - Graphical Analysis of Lp - Graphical Lp Maximization Problem - Graphical Lp Minimization Problem, Simplex Method - Basics Of Simplex Method - Formulating The Simplex Method-Simplex Method With Two Variables

Module:3	Non-Linear Programming	7 hours

Direct Search Methods - Univariate Method - Pattern Directions - Hook and Jeeves' Method - Indirect Search Methods - Gradient of a Function - Cauchy Method - Fletcher-Reeves Method

Module:4	Non-Linear Programming - One-Dimensional Minimization Methods	6 hours

Introduction - Unimodal Function - Region Elimination Methods - Unrestricted Search- Exhaustive Search - Dichotomous Search - Fibonacci Method - Golden Section Method

Module:5	Bio-Inspired Optimization	5 hours

Introduction - Particle Swarm Optimization - Ant Colony Optimization - Firefly Algorithm - Cuckoo Search Optimization

Module:6	Advanced Optimization Methods	6 hours

Genetic Algorithms - Working Principle, Genetic Operators - Simulated Annealing - Optimization of Fuzzy Systems

Module:7	Practical Aspects of Optimization	6 hours

Parallel Processing - Multi-Objective Optimization - Lexicographic Method - Goal Programming Method - Introduction to Game Theory		
Module:8	**Contemporary Issues**	**2 hours**
Guest Lecture from Industry and R & D Organizations		
	Total Lecture Hours:	**45 hours**

Text Book(s)	
1.	Singiresu S. Rao, "Engineering Optimization - Theory and Practice", 2022, 4^{th}Edition, John Wiley & Sons, Inc.

Reference Books	
1.	Sherali, H.D., Shetty, C.M., "Optimization with Disjunctive Constraints",2016, Springer,
2.	Shubham Agarwal, "Computer Based Optimization Techniques", 2015, Alpha Science International Ltd.
3	C. B Gupta, "Optimization Techniques in Operation Research", 2012, I.K. International House Pvt.Ltd.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA623L	Business Data Analytics	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To familiarize the fundamentals of data analytics.
2. To understand the various analytical approaches that can be applied to various business domains.
3. To develop business decision models.

Course Outcomes:

1. Understand the basic concepts of Business Data Analytics and its approaches.
2. Identify the appropriate data analytical approach for business decision
3. Implement data analytics for different use cases
4. Visualization of results

Module:1	Introduction to Business Data Analytics	5 hours

Business Analytics - Terminologies, Process, Importance, Relationship with Organizational Decision Making- Analytics in Decision Making-BA for Competitive Advantage

Module:2	Managing Resources For Business Analytics	5 hours

Managing Business Analytics Personnel-Data and Technology- Organizational Structures aligning BA- Managing Information Policy- Data Quality and Change in BA

Module:3	Descriptive Analytics	7 hours

Introduction to Descriptive Analytics - Visualizing, and Exploring Data - Descriptive Statistics - Sampling and Estimation - Probability Distribution for Descriptive Analytics - Analysis of Descriptive Analytics

Module:4	Predictive Analytics	7 hours

Introduction to Predictive Analytics - Logic and Data-Driven Models - Predictive Analysis Modeling and Procedure - Data Mining for Predictive Analytics, Analysis of Predictive Analytics

Module:5	Prescriptive Analytics	6 hours

Introduction to Prescriptive Analytics - Prescriptive Modeling - Non-Linear Optimization -Demonstrating Business Performance Improvement

Module:6	Diagnostic Analytics	6 hours

Importance of Diagnostics Analytics-Working of Diagnostic Analytics- Diagnostic Analytics Techniques-Diagnostic through Cause-and-Effect-Correlation Analysis and Data Drilling- Applications of Diagnostic Analytics

Module:7	Data Analytics with Python	7 hours

Python Using Jupyter Notebook- Exploration of Python Packages to Understand Analytical Projects as using Matplotlib- Numpy, and Pandas

Module:8	Contemporary Issues	2 hours

Guest Lecture from Industry and R & D Organizations

		Total Lecture hours:	45 hours

Text Book(s)	
1.	Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, "Business Analytics Principles, Concepts, and Applications - What, Why, and How", Pearson Edition, 2014.
Reference Books	
1.	Christian Albright S and Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", Fifth edition, Cengage Learning, 2015.
2.	James R. Evans, "Business Analytics - Methods, Models and Decisions", Pearson Edition, 2012.
Mode of Evaluation: CAT, Written Assignment, Quiz, FAT and Seminar	

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Projects and Internship

(2023-2024)

Master of Computer Applications

Course Code	Course Title	L	T	P	C
PMCA696J	Study Oriented Project	0	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. Use insight and creativity for better understanding of the domain of interest.
2. Scrutinize technical literature and identify research gaps

Course Outcomes:

1. Retrieve, analyse, and interpret published literature/books providing information related to niche areas/focused domains.
2. Examine technical literature, resolve ambiguity, and develop conclusions.
3. Synthesizing novel information and use the insights for further development.
4. Publish the findings in the peer reviewed Journals / National / International Conferences

Module Contents	Project Duration: One Semester

This is oriented towards reading published literature or books related to niche areas or focused domains under the guidance of a faculty.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Report to be submitted, presentation and project reviews – Presentation in the National / International Conference on Science, Engineering Technology.

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA697J	Design Project	0	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. Students will be able to design a prototype or process or experiments.
2. Describe and demonstrate the techniques and skills necessary for the project.
3. Acquire knowledge and better understanding of design systems.

Course Outcomes:

1. Develop new skills and demonstrate the ability to upgrade a prototype to a design prototype or working model or process or experiments.
2. Utilize the techniques, skills, and modern tools necessary for the project.
3. Synthesize knowledge and use insight and creativity to better understand and improve design systems.
4. Publish the findings in the peer reviewed Journals / National / International Conferences.

Module Contents	Project Duration: One Semester
Students are expected to develop new skills and demonstrate the ability in developing design prototypes or working models	

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Report to be submitted, presentation and project reviews – Presentation in the National / International Conference on Science, Engineering Technology

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PMCA698J	Internship I/ Dissertation I				12
Pre-requisite	NIL	Syllabus version			
				1.0	

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field and also to give research orientation.

Course Outcome:

Upon successful completion of this course students will be able to
1. Formulate specific problem statements for real life problems with reasonable assumptions and constraints
2. Perform literature search and / or patent search in the area of interest
3. Develop a suitable solution methodology for the problem
4. Conduct experiments / Design & Analysis / solution iterations and document the results
5. Perform error analysis / benchmarking / costing
6. Synthesize the results and arrive at scientific conclusions / products / solution
7. Document the results in the form of technical report / presentation

Module Content	(Project duration: one semester)

1. Dissertation may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Dissertation should be individual work.
3. Carried out inside or outside the university, in any relevant industry or research institution.
4. Publications in the peer reviewed Journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - Dissertation report to be submitted, presentation, project reviews and Final Oral Viva Examination.

Recommended by Board of Studies	04-05-2023			
Approved by Academic Council	No. 70	Date	24-06-2023	

Course Code	Course Title	L	T	P	C
PMCA699J	Internship II/ Dissertation II				15
Pre-requisite	NIL		Syllabus version		
			1.0		

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcomes:

Upon successful completion of this course students will be able to

1. Formulate specific problem statements for real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / design and analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing.
5. Synthesize the results and arrive at scientific conclusions / products / solution.
6. Document the results in the form of technical report / presentation.

Module Content	(Project Duration: One Semester)

1. Dissertation may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Dissertation should be individual work.
3. Carried out inside or outside the university, in any relevant industry or research institution.
4. Publications in the peer reviewed journals / International conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - Dissertation report to be submitted, presentation, project reviews and Final Oral Viva Examination.

Recommended by Board of Studies	04-05-2023		
Approved by Academic Council	No. 70	Date	24-06-2023

Open Elective

(2023-2024)

Master of Computer Applications

Course Code	Course Title	L	T	P	C
PSTS601L	Advanced Competitive Coding	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the basic concepts of data structures and algorithm.
2. To develop the step by step approach in solving problems with the help programming techniques of data structures.
3. To deploy algorithms in real time applications.

Course Outcome

At the end of the course the student should be able to
1. Provide a basic understanding of core Java concepts
2. Use linear and non-linear data structures to solve practical problems.
3. Identify Bitwise algorithms for solving real world problems.
4. Illustrate various techniques for searching, sorting and hashing
5. Understand and implement Dynamic Programming.
6. Design new algorithms or modify existing algorithms for new application.

Module:1	Algorithms	6 hours

Java Introduction, Features, Structure, Data Types, Basic I/O Operators, Decision making and Control structure, Time & Space complexity

Module:2	Math based problems and Bitwise algorithms	6 hours

Simple Sieve, Segmented & Incremental Sieve, Euler's phi Algorithm, Strobogrammatic Number, Remainder Theorem, Toggle the switch & Alice Apple tree, Binary Palindrome, Booth's Algorithm, Euclid's Algorithm, Karatsuba Algorithm, Longest Sequence of 1 after flipping a bit Swap two nibbles in a byte.

Module:3	Arrays , Searching, Sorting and Strings	6 hours

Block Swap Algorithm , Max product subarray, Maximum sum of hour glass in matrix ,Max Equilibrium Sum ,Leaders in array, Majority element, Lexicographically first palindromic string, Natural Sort order , Weightes substring ,Move hyphen to beginning, Manacher's Algorithm

Module:4	Recursion, Back tracking, Greedy Algorithm	6 hours

Sorted Unique Permutation, Maneuvering, Combination, Josephus trap, Maze Solving, N Queens Problem, Warnsdorff's Algorithm, Hamiltonian Cycle, Kruskal's Algorithm ,Activity Selection Problem, Graph Coloring, Huffman Coding

Module:5	Dynamic Programming	6 hours

Longest Common Subsequence ,Longest Increasing Subsequence , Longest Bitonic Subsequence ,Longest Palindromic Subsequence ,Subset sum problem ,0-1 Knapsack, Traveling Salesman, Coin Change, Shortest Common, Supersequence, Levenshtein Distance problem, Rod Cutting problem, Wildcard pattern matching , Pots of gold game

Module:6	Linked list, Stack, Queue	6 hours

Loop Detection, Sort the bitonic DLL, Segregate even & odd nodes in a LL , Merge sort for DLL ,Minimum Stack, The Celebrity problem, Iterative Tower of Hanoi Stock

Span problem, Priority Queue using DLL, Sort without extra Space, Max Sliding Window, Stack permutations		
Module:7	**Trees, Graphs , Heaps, Maps**	**6 hours**
Recover the BST, Views of tree Vertical order traversal ,Boundary traversal, BFS, DFS, Dial's Algorithm ,Bellman-Ford Algorithm, Topological Sort ,Heap Sort Binomial heap, K-array heap, Winner tree, Hash Map to Tree Map.		
Module:8	**Interview Preparation**	**3 hours**
Networking, Security, Operating Systems, Data Base Management Systems.		
Total Lecture hours		**45 hours**
Text Book		
1.	Mark Allen Weiss, "Data structures and algorithm analysis in C++", 2019, 4th Edition, Pearson Education.	
Reference Books		
1.	J.P. Tremblay and P.G. Sorenson, "An Introduction to Data Structures with applications", 2017, Second Edition, Tata Mc Graw Hill.	
2.	Richard M. Reese, Jennifer L. Reese, Alexey Grigorev, Java: Data Science Made Easy, 2019 Pocket Publishing.	
Mode of Evaluation: CAT, Written assignment, Quiz, Project & FAT.		
Recommended by Board of Studies	24-02-2023	

Approved by Academic Council	No. 70	Date	24-06-2023

Skill Enhancement

(2023-2024)

Master of Computer Applications

Course Code	Course Title	L	T	P	C
PENG501P	Technical Report Writing	0	0	4	2
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To develop writing skills for preparing technical reports
2. To analyze and evaluate general and complex technical information
3. To enable proficiency in drafting and presenting reports

Course Outcomes

At the end of the course, the student will be able to

1. Construct error free sentences using appropriate grammar, vocabulary and style
2. Apply the advanced rules of grammar for proofreading reports
3. Interpret information and concepts in preparing reports
4. Demonstrate the structure and function of technical reports
5. Improve the ability of presenting technical reports

Indicative Experiments	
1.	**Basics of Technical Communication** General and Technical communication, Process of communication, Levels of communication
2.	**Vocabulary& Editing** Word usage: confusing words, Phrasal verbs Punctuation and Proof reading
3.	**Advanced Grammar** Shifts: Voice, Tense, Person, Number Clarity: Pronoun reference, Misplace and unclear modifiers
4.	**Elements of Technical writing** Developing paragraphs, Eliminating unnecessary words, Avoiding clichés and slang Sentence clarity and combining
5.	**The Art of condensation** Steps to effective precis writing, Paraphrasing and summarizing
6.	**Technical Reports:** Meaning, Objectives, Characteristics and Categories
7.	**Formats of reports and Prewriting**: purpose, audience, sources of information, organizing the material
8.	**Data Visualization** Interpreting Data - Graphs - Tables – Charts - Imagery - Info graphics
9.	**Systematization of Information:** Preparing Questionnaire Techniques to Converge Objective-Oriented data in Diverse Technical Reports
10.	**Research and Analyses:** Writing introduction and literature review, Reference styles, Synchronize Technical Details from Magazines, Articles and e-content
11..	**Structure of Reports**

	Title – Preface – Acknowledgement - Abstract/Summary – Introduction - Materials and Methods – Results – Discussion - Conclusion - Suggestions/Recommendations
12.	**Writing the Report:** First draft, Revising, Thesis statement, Developing unity and coherence
13.	**Writing scientific abstracts:** Parts of the abstract, Revising the abstract Avoiding Plagiarism, Best practices for writers
14.	**Supplementary Texts** Appendix – Index – Glossary – References – Bibliography - Notes
15	**Presentation** Presenting Technical Reports Planning, creating and digital presentation of reports

	Total Laboratory hours :	**60 hours**

Text Book(s)

1.	Raman, Meenakshi and Sangeeta Sharma, (2015).Technical Communication: Principles and Practice, Third edition, Oxford University Press, New Delhi.

Reference Books

1.	Aruna, Koneru, (2020). English Language Skills for Engineers. McGraw Hill Education, Noida.
2.	Rizvi,M. Ashraf (2018)Effective Technical Communication Second Edition. McGraw Hill Education, Chennai.
3.	Kumar, Sanjay and Pushpalatha, (2018). English Language and Communication Skills for Engineers, Oxford University Press.
4.	Elizabeth Tebeaux and Sam Dragga, (2020).The Essentials of Technical Communication, Fifth Edition, Oxford University Press.

Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	19-05-2022		
Approved by Academic Council	No. 70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PSTS501P	Qualitative Skills Practice	0	0	3	1.5
Pre-requisite	NIL		Syllabus version		
			1.0		

Course Objectives:

1. To develop the quantitative ability for solving basic level problems.
2. To improve the verbal and professional communication skills.

Course Outcomes:

At the end of the course, the student will be able to
1. Execute appropriate analytical skills
2. Solve problems pertaining to quantitative and reasoning ability
3. Learn better vocabulary for workplace communication
4. Demonstrate appropriate behavior in an organized environment

Module:1	**Business Etiquette: Social and Cultural Etiquette; Writing Company Blogs; Internal Communications and Planning: Writing press release and meeting notes**	**9 hours**

Value, Manners- Netiquette, Customs, Language, Tradition, Building a blog, Developing brand message, FAQs', Assessing Competition, Open and objective Communication, Two way dialogue, Understanding the audience, Identifying, Gathering Information,. Analysis, Determining, Selecting plan, Progress check, Types of planning, Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph., Body– Make it relevant to your audience.

Module:2	**Time management skills**	**3 hours**

Prioritization, Procrastination, Scheduling, Multitasking, Monitoring, Working under pressure and adhering to deadlines

Module:3	**Presentation skills – Preparing presentation; Organizing materials; Maintaining and preparing visual aids; Dealing with questions**	**7 hours**

10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions

Module:4	**QuantitativeAbility-L1–Number properties; Averages; Progressions; Percentages; Ratios**	**11 hours**

Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position, Averages, Weighted Average, Arithmetic Progression, Geometric Progression, Harmonic Progression, Increase & Decrease or successive increase, Types of ratios and proportions

Module:5	**Reasoning Ability - L1 – Analytical Reasoning**	**8 hours**

Data Arrangement (Linear and circular & Cross Variable Relationship), Blood Relations, Ordering / ranking / grouping, Puzzle test, Selection Decision table		
Module:6	**Verbal Ability -L1 – Vocabulary Building**	**7 hours**
Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies		
	Total Lecture hours:	**45 hours**

Reference Books

1.	Kerry Patterson, Joseph Grenny, Ron McMillan and Al Switzler, (2017).2nd Edition, Crucial Conversations: Tools for Talking when Stakesare High .McGraw-Hill Contemporary, Bangalore.
2.	Dale Carnegie,(2016).How to Win Friends and Influence People. Gallery Books, New York.
3.	Scott Peck. M, (2003). Road Less Travelled. Bantam Press, New York City.
4.	SMART, (2018). Place Mentor, 1st edition. Oxford University Press, Chennai.
5.	FACE, (2016). Aptipedia Aptitude Encyclopedia. Wiley publications, Delhi.
6.	ETHNUS, (2013). Aptimithra. McGraw – Hill Education Pvt .Ltd, Bangalore.

Websites:

1.	**www.chalkstreet.com**
2.	**www.skillsyouneed.com**
3.	**www.mindtools.com**
4.	**www.thebalance.com**
5.	**www.eguru.ooo**

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	19-05-2022		
Approved by Academic Council	No.70	Date	24-06-2023

Course Code	Course Title	L	T	P	C
PSTS502P	Quantitative Skills Practice	0	0	3	1.5
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

1. To develop the students' advanced problem solving skills
2. To enhance critical thinking and innovative skills

Course Outcomes:

At the end of the course, the student will be able to
1. Create positive impression during official conversations and interviews
2. Demonstrate comprehending skills of various texts
3. Improve advanced level thinking ability in general aptitude
4. Develop emotional stability to tackle difficult circumstances

Module:1	Resume skills – Resume Template; Use of power verbs; Types of resume; Customizing resume	2 hours

Structure of a standard resume, Content, color, font, Introduction to Power verbs and Write-up, Quiz on types of resume, Frequent mistakes in customizing resume, Layout-Understanding different company's requirement, Digitizing career portfolio

Module:2	Interview skills – Types of interview; Techniques to face remote interviews and Mock Interview	3 hours

Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds

Module:3	Emotional Intelligence - L1 – Transactional Analysis; Brain storming; Psychometric Analysis; SWOT analysis	12 hours

Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure ,Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways, SWOT analysis

Module:4	Quantitative Ability - L3–Permutation - Combinations; Probability; Geometry and menstruation; Trigonometry; Logarithms; Functions; Quadratic Equations; Set Theory	14 hours

Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability, Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes, Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram

Module:5	Reasoning ability - L3 – Logical reasoning; Data Analysis and Interpretation	7 hours
Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data interpretation-Advanced, Interpretation tables, pie charts & bar chats		

Module:6	Verbal Ability - L3 – Comprehension and Critical reasoning	7 hours
Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion,(b) Assumption & Inference, (c) Strengthening & Weakening an Argument		

	Total Lecture hours:	45 hours

Reference Books

1.	Michael Farra and JIST Editors,(2011).Quick Resume & Cover Letter Book: Write and Use an Effective Resume in Just One Day. Jist Works, Saint Paul, Minnesota.
2.	Flage Daniel E, (2003).The Art of Questioning: An Introduction to Critical Thinking. Pearson, London.
3.	David Allen, (2015).Getting Things done: The Art of Stress-Free productivity. Penguin Books, New York City.
4.	SMART, (2018). Place Mentor 1st edition. Oxford University Press, Chennai.
5.	FACE, (2016).Aptipedia Aptitude Encyclopedia. Wileypublications, Delhi.
6.	ETHNUS, (2013).Aptimithra. McGraw-Hill Education Pvt Ltd, Bangalore.

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Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	19-05- 2022		
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