KUMARAGURU COLLEGE OF TECHNOLOGY

(Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

CURRICULUM & SYLLABUS
CHOICE BASED CREDIT SYSTEM
(REGULATIONS 2020)

I to IV Semester

MCA

Department of Computer Applications

MASTER OF COMPUTER APPLICATIONS (2 YEARS)

VISION

The Department,

- Seeks to create academic programs and a campus culture that imbibes a socially committed professionalism which would in turn feed into the overall development of the society and make global citizens and leaders out of the students.
- Aims to become a highly recognized, research driven department with good infrastructure, developing industry ready products.

MISSION

- The Department is committed to set standards of excellence in its academic programmes by enabling its students to achieve a blending of knowledge acquisition and applications of such knowledge in real life situations.
- It is also aimed to equip them to adapt themselves to changing global and local needs upholding professional ethics and contribute their might in transforming India into a world leader in technological advancement and prosperity.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEOs for MCA programme are designed based on the department mission.

- To prepare students to transact in the field of computer applications by providing technical foundations in the field of computer applications.
- To prepare students to intellect in computing skills and innovation of software products to meet the industry needs.
- To provide exposure to cutting edge technologies and training to work on multidisciplinary. projects in a team.
- To prepare students to life-long learning through professional activities; adapt themselves with ease to new technologies, while exhibiting ethical and professional standards.

PROGRAM OUTCOMES (PO'S):

On successful completion of the program:

1. **Computational Knowledge**: Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.

2. **Problem Analysis:** Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

3. **Design /Development of Solutions:** Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

4. **Conduct Investigations of Complex Computing Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage:** Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

6. **Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

7. **Life-long Learning:** Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

8. **Project management and finance:** Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

9. **Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

10. **Societal and Environmental Concern:** Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

11. **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

12. **Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

REGULATION 2020

MCA CURRICULUM

SEMESTER I							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P20CAT1001	Data Structures and Algorithms	Theory	3	0	0	0	3
P20CAT1002	Database Technologies	Theory	3	0	0	0	3
P20CAT1103	Advanced Operating Systems	Theory	3	1	0	0	4
P20CAT1004	Programming with JAVA	Theory	3	0	0	0	3
P20MAT1101	Probability and Statistics for Data Analysis	Theory	3	1	0	0	4
P20CAP1501	Database Technologies Laboratory	Lab	0	0	4	0	2
P20CAP1502	Data Structures Lab using C	Lab	0	0	4	0	2
P20CAP1503	Programming with Java Lab	Lab	0	0	4	0	2
						Total Credits	**23**
						Total Hours Per Week	**29**

SEMESTER II							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P20CAT2001	Software Engineering Methodologies and Quality Assurance	Theory	3	0	0	0	3
P20CAI2202	Web Technologies	Embedded Theory & Lab	3	0	2	0	4
P20CAT2003	Data Intensive Computing	Theory	3	0	0	0	3
P20CAT2004	Data Communications and Networks	Theory	3	0	0	0	3
E-I	Elective I	Theory	3	0	0	0	3
E-II	Elective II	Theory	3	0	0	0	3
P20CAP2501	Data Intensive Computing Lab using Python	Lab	0	0	4	0	2
P20CAP2702	Mini Project	Project	0	0	0	4	2
P20CAI2603	Engineering Clinics	**Lab & Project**	0	0	2	2	2

						Total Credits	**25**
						Total Hours Per Week	**32**
SEMESTER III							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P20CAI3201	Service Oriented Architecture	Embedded Theory & lab	3	0	2	0	4
P20CAT3002	Ethics in computing	Theory	3	0	0	0	3
P20CAI3203	Cloud Application Development	Embedded Theory & lab	3	0	2	0	4
P20CAT3004	Artificial Intelligence	Theory	3	0	0	0	3
E-III	Elective III	Theory	3	0	0	0	3
E-IV	Elective IV	Theory	3	0	0	0	3
E -V	Elective V	Theory	3	0	0	0	3
P20CAP3501	Mobile Computing Lab	Lab	0	0	4	0	2
						Total Credits	**25**
						Total Hours Per Week	**29**

SEMESTER IV							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P20CAP4701	Project Work / Industry	Project	0	0	0	24	12
						Total Credits	**12**
						Total Hours per week	**24**

Total Credits: 85

LIST OF ELECTIVES

S. No	Course Code	Course Title	Course Mode	L	T	P	J	C
1.	P20CAE0001	Information Security	Theory	3	0	0	0	3
2.	P20CAE0002	Object Oriented Analysis and Design	Theory	3	0	0	0	3
3.	P20CAE0003	Game Development	Theory	3	0	0	0	3
4.	P20CAE0004	Software Project Management	Theory	3	0	0	0	3
5.	P20CAE0005	E-Commerce	Theory	3	0	0	0	3
6.	P20CAE0006	TCP/IPV6 Protocol Suite	Theory	3	0	0	0	3
7.	P20CAE0007	Wireless Networks	Theory	3	0	0	0	3
8.	P20CAE0008	Blockchain Technologies	Theory	3	0	0	0	3
9.	P20CAE0009	Accounting and Financial Management	Theory	3	0	0	0	3
10.	P20CAE0010	Enterprise Resource Planning	Theory	3	0	0	0	3
11.	P20CAE0011	Business Domains in Computer Applications	Theory	3	0	0	0	3
12.	P20CAE0012	Big Data Analytics	Theory	3	0	0	0	3
13.	P20CAE0013	Mixed Reality	Theory	3	0	0	0	3
14.	P20CAE0014	Deep Learning Techniques and Applications	Theory	3	0	0	0	3
15.	P20CAE0015	E-Learning Techniques	Theory	3	0	0	0	3
16.	P20CAE0016	Ethical Hacking	Theory	3	0	0	0	3
17.	P20CAE0017	Middleware Technologies	Theory	3	0	0	0	3
18.	P20CAE0018	Robotic Process Automation	Theory	3	0	0	0	3
19.	P20CAE0019	Linux Administration	Theory	3	0	0	0	3
20	P20CAE0020	User Interface Design and User Experience	Theory	3	0	0	0	3

ONE CREDIT COURSES

S.NO	COURSE CODE	COURSE TITLE
1.	P20CAC0201	Agile Methodology
2.	P20CAC0202	Introduction to Ethical Hacking
3.	P20CAC0203	Soft Skills
4.	P20CAC0204	Technical Writing
5.	P20CAC0205	Human Excellence – Professional Values
6.	P20CAC0206	Data Analytics

KUMARAGURUCOLLEGE OF TECHNOLOGY,
COIMBATORE – 641 049
Department of Computer Applications

Regulations 2020

MCA SYLLABUS

SEMESTER – I

P20CAT1001	DATA STRUCTURES AND ALGORITHMS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Analyze the performance of algorithms.
CO2: Apply the knowledge of basic data structures and their implementations.
CO3: Develop skills in applying linear and nonlinear data structures.
CO4: Apply different algorithmic design strategies.
CO5: Understand the concepts of P and NP classes

Pre–requisite: Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M				M					
CO2	M	W	M				M					
CO3			W	S				M				
CO4	M		M									
CO5	W	W										

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc (as applicable)
4. End Semester Examination

INDIRECT

1.Course-end survey

ALGORITHM ANALYSIS — 7 Hours

Fundamentals of Algorithm Problem Solving- Fundamentals of Analysis of Algorithm – Efficiency – Analysis Framework - Asymptotic Notations – Mathematical Analysis of Recursive and Non–recursive Algorithms– Analysis of Algorithms – Time complexities.

ARRAYS AND LINKED LIST — 9 Hours

Arrays- Representation – Operations on Arrays – Linked List- Basic Concepts and Operations- Types of Linked List : Doubly Linked List – Singly Linked List – Stack :Definition – Operations on Stack – Static and Dynamic Implementation of a Stack – Recursion using Stack - Definition – Operations on Queue – Static and Dynamic Implementation of a Queue.

GRAPHS	**10 Hours**
Introduction –Terminology - Representation of Graph - Graph Traversals: Depth-first and Breadth-first Traversal - Applications of Graphs – Transitive Closure: Warshall's Algorithm -Shortest-path Algorithms: Dijkstra's Algorithm – Floyd's Algorithm - Minimum Spanning Tree – Prim's and Kruskal's Algorithms.	
TREES	**6 Hours**
Trees – Introduction - Binary Search Tree (BST) :Introduction -Operations– B – Trees :Definition, Operations.	
DESIGN STRATEGIES	**9 Hours**
Divide and Conquer - Introduction – Quick Sort- Merge Sort -Binary Search – Analysis-Backtracking: Introduction - n–Queens Problem – Hamiltonian Circuit Problem – Branch and Bound: Introduction – Assignment Problem – Knapsack Problem.	
COMPUTABILITY	**4 Hours**
P, NP, NP-complete and NP-hard.	
Theory: 45 Hours **Tutorial: -** **Total : 45 Hours**	
REFERENCES:	

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education,2006.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein "Introduction to Algorithms", The MIT Press, Third edition, 2009.
4. VijayalakshmiPai G.A, "Data Structures and Algorithms: Concepts Techniques and Applications", McGraw Hill, 2009.
5. Horowitz Ellis and SartajSahni, "Fundamentals of Computer Algorithms", Galgotia Publications, 2004.

P20CAT1002	DATABASE TECHNOLOGIES	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Use the techniques, components and tools of atypical database management system.
CO2: Understand basic database concepts, including the structure and operation of the relational data model.
CO3: Demonstrate the different types of database implementation concepts.
CO4: Understand the emerging database technologies.
CO5: Familiarize with NoSQL concepts.

Pre–requisite :Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S			M							
CO2	M											
CO3	S		M		M							
CO4	M						M					
CO5	M	M										

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc (as applicable)
4. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION **9 Hours**

Introduction – Database Architecture – Structure of Relational Databases – Database Schema – Schema Diagrams – Relational Query Languages – Keys – Basic Structure of Queries and SQL Operations – Integrity Constraints – ER Model.

DATABASE DESIGN **9 Hours**

Relational Database Design – First Normal Form – Second Normal Form – Third Normal Form Boyce - Codd Normal Form – Case Study: Normalization Process – Front end and Back end – MySQL – Connectivity using ODBC/JDBC.

DATABASE IMPLEMENTATION **9 Hours**

Physical Database Design and Tuning – Database Transaction: Transaction Concept and State – Concurrency Control: Two-Phase locking protocol – Recovery: Failure Classification – LogBased Recovery – Shadow Paging.

EMERGING TECHNOLOGIES AND APPLICATIONS	**9 Hours**
Active Database Concepts and Triggers – Distributed Databases: Concepts – Database Design and Types – Database Applications in Mobile Communication – Multimedia Databases – Genome Data Management.	
NoSQL	**9 Hours**
Introduction – Aggregate Data Model – Distribution Model – NoSQL Implementation: Key Value Database – Document Database – MongoDB.	
Theory: 45 Hours **Tutorial: -** **Total : 45 Hours**	
REFERENCES :	

1. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", 7th Edition, Tata McGraw Hill International Edition, 2019.
2. Pramodkumar J. Sadalage and Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st Edition, Addison Wesley Professional, 2012.
3. R. Elmasri and S.B. Navathe, "Fundamentals of Database Systems", 6th Edition, Pearson Education, 2011.

P20CAT1103	ADVANCED OPERATING SYSTEMS	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Know the basic concepts of operating systems.

CO2: Understand process management, synchronization and deadlock concepts.

CO3: Analyze various memory management techniques and disk scheduling algorithms.

CO4: Demonstrate file system, Allocation Methods and Free space management.

CO5: Understand Virtualization.

CO6: Compare various mobile operating System

Pre–requisite: Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S	M									
CO3		S										
CO4		S										
CO5	S			M								
CO6	S										M	

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc (as applicable)
4. End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION **9 Hours**

Operating System - Operating System Structure – Operations – Process Management – Memory Management-Secondary Storage Management – Protection and Security – Open Source Operating System – Operating System Services – User Interface – System Calls – System Programs – Design and Implementation – Debugging.

PROCESS MANAGEMENT **8 Hours**

Process Concepts – Process Scheduling – Operations on Processes – Inter Process Communication – Examples – Threads – Overview – Multi Threading Models – Libraries – Issues.

PROCESS SYNCHRONIZATION	**7 Hours**
Background – Critical Section Problem – Peterson's Solution – Synchronization Hardware – Semaphores – Classic Problem of Synchronization – Monitors.	
CPU SCHEDULING	**6 Hours**
Basic Concepts – Scheduling Criteria – Scheduling Algorithms - Problems	
DEADLOCK	**6 Hours**
Deadlock Characterization – Handling Deadlocks – Deadlock Prevention – Avoidance – Detection – Recovery.	
MEMORY MANAGEMENT	**6 Hours**
Background – Swapping – Contiguous Memory Allocation – Paging – Structure of the Page Table – Segmentation -Virtual Memory Management - Background – Demand Paging – Copy on Write – Page Replacement – Thrashing – Working Set.	
I/O MANAGEMENT, DISK SCHEDULING AND FILE MANAGEMENT	**5 Hours**
Organization of I/O function – Evolution of I/O Function – Types of I/O devices – Logical Structure of I/O Functions – I/O Buffering – Disk I/O – Disk Scheduling Algorithms – Disk Cache. File Concept – Access Methods-Free Space management	
VIRTUAL MACHINES	**4 Hours**
System Model – Implementation of Virtual Machines-Benefits and Features -Building Block - Types of Virtual Machines - Virtualization and Operating-System Components.	
CASE STUDY	**9 Hours**
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer. File System- Google File System-Ocean Store.	
-	
Theory: 45 Hrs Tutorial: 15 Hrs	**Total Hours: 60 Hrs**
REFERENCES	
1. Abraham Silberschatz, Peter B. Galvin, "Operating System Concepts", 10th Edition, John Wiley & Sons, Inc., 2018. 2. P.C.Bhatt, "An Introduction to Operating Systems–Concepts andPractice",4th Edition, Prentice Hall of India., 2013. 3. William Stallings, "Operating Systems: Internals and Design Principles",9th Edition, Prentice Hall of India., 2018. 4. D.M.Dhamdhere, "Operating Systems: A Concept based Approach", 3rdEdition, Tata McGraw Hill, 2017.	

P20CAT1004	PROGRAMMING WITH JAVA	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Apply the fundamental core java, packages, database connectivity for computing.
CO2: Implement Java programs.
CO3: Make use of hierarchy of Java classes to provide a solution to a given set of requirements.
CO4: Use the frameworks JSP, Hibernate, Spring.
CO5: Design and implement server-side programs using Servlets and JSP.

Pre–requisite **:**Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S		M		M					
CO2	S		S		M							
CO3	S		M		M							
CO4	S		M		S							M
CO5			M		M							M

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
. 2. Assignment
. 3. Demonstration etc (as applicable)
. 4. End Semester Examination

INDIRECT

1.Course-end survey

JAVA FUNDAMENTALS **9 Hours**

Java features – Java Platform – Java Fundamentals – Expressions, Operators, and Control Structures – Classes, Methods – Inheritance - Packages and Interfaces – Boxing, Unboxing – Variable-Length Arguments (Vararg), Exception Handling.

COLLECTIONS AND ADVANCE FEATURES **9 Hours**

Utility Packages- Introduction to Collection –Hierarchy of Collection Framework – Generics, Array list, LL, HashSet, Tree-set, HashMap – Comparators – Java annotations – Pre-main method.

ADVANCED JAVAPROGRAMMING **9 Hours**

Input Output Packages – Inner Classes – Java Database Connectivity - Introduction JDBC Drivers - JDBC Connectivity with MySQL/Oracle -Prepared Statement and Result Set – JDBC Stored Procedures Invocation - Servlets - RMI – Lambda Expressions.

OVERVIEW OF DATA RETRIEVAL AND ENTERPRISE APPLICATION DEVELOPMENT	**8 Hours**
Tiered Application development - Java Servers, Containers –Web Container – Creating Web Application using JSP/Servlets – Web Frameworks- Introduction to Spring and Spring Boot- Play Framework – ORM Layer – Introduction to Hibernate.	
JAVA INTERNALS AND NETWORKING	**10 Hours**
Java Jar Files-Introspection – Garbage Collection – Architecture and Design – GC Cleanup Process, Invoking GC, Generation in GC - Networking Basics Java and the Net – InetAddress – TCP/IP Client Sockets – URL –URL Connection – TCP/IP Server Sockets – A Caching Proxy HTTP Server – Datagrams.	
Theory: 45 Hours	**Tutorial: -** **Total: 45 Hours**
REFERENCES:	

1. Amritendu De, "Spring 4 and Hibernate 4: Agile Java Design and Development", McGraw-Hill Education, 2015.
2. Herbert Schildt, "The Complete Reference – Java 2", Ninth Edition, Tata McGraw Hill, 2014.
3. Joyce Farrell, "Java Programming", Cengage Learning, Seventh Edition, 2014.
4. John Dean, Raymond Dean, "Introduction to Programming with JAVA – A Problem Solving Approach", Tata Mc Graw Hill, 2014.
5. Mahesh P. Matha, "Core Java A Comprehensive Study", Prentice Hall of India, 2011.
6. R. Nageswara Rao, "Core Java: An Integrated Approach", Dream Tech Press, 2016.

P20MAT1101	PROBABILITY AND STATISTICS FOR DATA ANALYSIS	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand about data collection, represent data graphically using bar chart and pie chart. and compute various measures of central tendency and dispersion for analysis of data.

CO2: Interpret the correlation between variables and predict unknown values using regression.

CO3: Explore random variables and predict probabilities for situations following normal distribution.

CO4: Perform hypothesis testing using large sample tests and Chi square test and interpret the results, which will form the basis for data analysis.

CO5: Understand the principles of design of experiments and perform analysis of variance.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	M	M										
CO3	W	W										
CO4	W	W										
CO5	W	W										

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Assignment based on R Software
4. End Semester Examination

INDIRECT

1. Course-end survey

COLLECTION OF DATA AND STATISTICAL MEASURES — **13+4 Hours**

Collection of Data-Classification-Tabulation-Graphical Representation – Simple Bar Chart – Pie Chart - Measures of Central Tendency: Arithmetic Mean, Median and Mode – Measures of Variation: Range, Quartile Deviation - Standard Deviation and Coefficient of Variation – Five Number Summary – Box Plot Technique.

CORRELATION AND REGRESSION — **7+3 Hours**

Correlation (Discrete Data) – Scatter Diagram - Karl Pearson's Correlation Coefficient – Spearman's Rank Correlation – Regression Lines (Discrete Data).

RANDOM VARIABLES	**11+3 Hours**
Random Variable – Distribution Function – Properties – Probability Mass Function – Probability Density Function – Expectation - Normal Distribution.	
TESTING OF HYPOTHESIS	**7+3 Hours**
Testing of Hypothesis for Large Samples (Single Mean, Difference of Means, Single Proportion, Difference of Proportions) - Chi-Square Test for Independence of Attributes.	
ANALYSIS OF VARIANCE	**7+2 Hours**
Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD).	
Theory: 45 Hours **Tutorial: 15 Hours** **Total: 60 Hours**	
STATISTICAL LAB USING R-PROGRAMMING (Self-Study Mode)	
List of Experiments 1. Introduction, Basic data representation. 2. Data presentation methods - Bar Chart, Pie Chart. 3. Importing data from MS-Excel. 4. Data manipulation 5. Mean, median, mode. 6. Standard deviation, five number summary, box plot. 7. Scatter diagram, correlation.	
REFERENCES	

1. Devore, J.L., “Probability and Statistics for Engineering and Sciences”, 8th Edition, Cengage Learning Pvt. Ltd., New Delhi, 2014.
2. Johnson, R.A and Gupta C. B., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education Int., Asia, 9th Edition, 2017.
3. Lipschutz, S. “Probability and Statistics”, 4th Edition, McGraw Hill, New Delhi, 2010.
4. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2012.
5. Gareth M. James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: With Applications in R, 2017.
6. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007
7. Gupta S. P, Statistical Methods, Sultan Chand & Sons Publishers, 2014.

P20CAP1501	DATABASE TECHNOLOGIES LABORATORY	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Design and implement a database schema for a given problem domain.
CO2: Construct simple and advanced database queries using Structured Query Language (SQL).
CO3: Populate and query a database using TCL/DCL commands.
CO4: Program in PL/SQL including stored procedures, stored functions, cursors and packages.
CO5: Design and build a GUI application using 4GL.

Pre–requisite :Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M									
CO2	S		W									
CO3	S											
CO4	S	M	M									
CO5	S	M	S		M	M						

COURSE ASSESSMENT METHODS

DIRECT

1. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment
2. Model Examination
3. End Semester Examination

INDIRECT

1.Course-end survey

LIST OF EXPERIMENTS:

1. Execute Data Definition Language and Data Manipulation Language commands.
2. Demonstrate Data Control Language and Transaction Control Language commands.
3. Implement Data Query Language.
4. Execute SQL Functions.
5. Evaluate Set Operations.
6. Implement Join Operations.
7. Execute Complex and Sub Queries.
8. Create Database Objects.
9. Execution of PL/SQL Commands.
10. Record Management using Cursors.
11. Construct Functions.

12. Create Triggers. 13. Exercise of nested table using PL/SQL. 14. Develop a Package using Database Connectivity. 15. Exercise using NoSQL Database.
Total Hours: 60 Hours

P20CAP1502	DATA STRUCTURESLAB USING C	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Develop skills to design and analyze simple linear and nonlinear data structures.
CO2: Design and analyze the time and space efficiency of the data structures.
CO3: Apply the suitable data structure for any given real-world problem.
CO4: Gain knowledge in practical applications of data structures.

COURSE ASSESSMENT METHODS

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M				M					
CO2	M	W		M			M					
CO3	M		M									
CO4		S	S				M		W			

COURSE ASSESSMENT METHODS

DIRECT

1. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment
2. Model Examination
3. End Semester Examination

INDIRECT

1.Course-end survey

LIST OF EXPERIMENTS:

1. Implement linear and binary search in an array.
2. Create a linked list and implement its operations.
3. Implement Stack using array.
4. Implement Stack using linked list.
5. Implement Queue using array.
6. Implement Queue using linked list.
7. Implement Quick sort using recursion.
8. Implement Merge sort using recursion.
9. Implement a binary search tree.
10. Implement the tree traversals on a binary search tree.
11. Implement breadth first and depth first traversals in a graph.
12. Implement Warshall's algorithm for transitive closure.
13. Implement shortest path algorithms.

Total : 60 hours

P20CAP1503	PROGRAMMING WITH JAVA LAB	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Implement object-oriented features using Java.
CO2: Create interfaces, packages and apply exception handling.
CO3: Implement RMI and servlet programs.
CO4: Create applications using JDBC, JSP and Frameworks.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M				S	M				
CO2	M	M	M		M		S					
CO3	M	M	M	M	M			M				
CO4	M	S	S	S	S							

COURSE ASSESSMENT METHODS

DIRECT

1. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment
2. Model Examination
3. End Semester Examination

INDIRECT

1.Course-end survey

LIST OF EXPERIMENTS:

1. Program to illustrate declaration and access control.
2. Program to illustrate assignments.
3. Program to illustrate the use of operators.
4. Program to illustrate flow control.
5. Program to implement various OOPS concepts.
6. Program to illustrate APIs like collection, I/O etc.
7. Program to implement the concept of interfaces and packages.
8. Program to implement exceptions handling mechanism.
9. Program using applets.
10. Program to illustrate the use of RMI (Remote Method Invocation).
11. Create an applications using Servlet.
12. Perform database connectivity using JDBC.
13. Use JSP tag to create an application.
14. Illustrate an application using Spring.
15. Develop applications using Hibernate.

Total : 60 hours

SEMESTER – II

P20CAT2001	SOFTWARE ENGINEERING METHODOLOGIES AND QUALITY ASSURANCE	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Get an insight into the processes of software development.
CO 2: Understand the problem domain and modeling.
CO 3: Apply design techniques to software products.
CO 4: Implement software quality management concepts.
CO 5: Apply software testing techniques for information systems development

Pre–requisite **:** Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M			M		W				M	
CO2	M	S			M						W	
CO3	M		S		S						M	
CO4	S		M								M	
CO5		M			S						M	

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION **9 Hours**

Introduction to Software Engineering – A Generic Process Model – Prescriptive Process Models: Waterfall, Incremental, Prototyping, and Spiral Model – The Unified Process – Introduction to Agile and Scrum methodologies.

MODELING **9 Hours**

Understanding Requirements – Scenario Based Requirements Modeling, Data Modeling Concepts, Class Based Requirements Modeling.

SOFTWARE DESIGN **9 Hours**

Design Concepts – Design Models – Architectural Design: Software Architecture – Architectural Styles – Architectural Design – Component Level Design: Component – Designing Class Based Components

QUALITY MANAGEMENT	**9 Hours**
Quality Concepts – Achieving Software Quality – Review Techniques – Software Configuration Management (SCM) – SCM Repository – SCM Process – Software Maintenance and Supportability.	
SOFTWARE TESTING	**9 Hours**
Unit Testing – Integration Testing – System Testing: Performance, Load, Stress, Security, Recoverability, Compatibility Testing – Regression Testing – Installation Testing – Usability Testing – Acceptance Testing – Alpha Testing and Beta Testing – Static vs. Dynamic Testing – Manual vs. Automatic Testing – Black Box Testing – White Box Testing.	
Theory: 45 Hours	**Tutorial: -** **Total Hours: 45 Hours**
REFERENCES	

1. Roger Pressman S, "Software Engineering: A Practitioner's Approach", 8th Edition, Tata McGraw Hill, 2019.
2. Shari Lawrence Pfleeger & Joanne M. Atlee, "Software Engineering", Pearson Education, 2010.
3. Ron Patton, "Software Testing", 2nd Edition, Pearson Education, 2009.
4. Carlo Ghezzi, Mehdi Jazayari& Dino Mandrioli, "Fundamentals of Software Engineering", Prentice Hall of India, 2010.
5. Ian Sommerville, "Software Engineering", 10th Edition, Pearson Education, 2015.
6. Watts S. Humphrey, "Managing the Software Process", Addison Wesley, 1999

P20CAI2202	WEB TECHNOLOGIES	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Create a basic website using HTML and Cascading Style Sheets.
CO2: Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
CO3: Design rich client presentation using AJAX.
CO4: Design and implement simple web page to present data in XML format.
CO5: Design front end web page and connect to the back-end databases.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W	S		S		S					
CO2		M	S		S		S					
CO3	M	W	S		S		S					
CO4		M	S		S		S					
CO5	M		S		S		S					

COURSE ASSESSMENT METHODS

DIRECT

1.Continuous Assessment Test I, II (Theory component)
2.Assignment (Theory component)
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5.Model Examination (lab component)
6.End Semester Examination (Theory and lab components)

INDIRECT

1.Course-end survey

WEB FUNDAMENTALS AND XHTML — **5 Hours**

Web browsers, web servers, MIME, URL, HTTP. Introduction to XHTML5 tags, Basic syntax and structure, text markups, images, lists, tables, Media tags-audio and video, forms, frames.

UI DESIGN — **10 Hours**

Markup Language (HTML5): Basics of Html -Syntax and Tags of Html- Introduction to HTML5 -Semantic/Structural Elements -HTML5 Style Guide and Coding Convention– Html Svg and Canvas – Html API‟s - Audio & Video - Drag/Drop - Local Storage - Web Socket API– Debugging and Validating Html.

Cascading Style Sheet (CSS3): The Need for CSS – Basic Syntax and Structure Inline Styles – Embedding Style Sheets - Linking External Style Sheets - Introduction to CSS3 – Backgrounds - Manipulating text - Margins and Padding - Positioning Using CSS -Responsive Web Design - Introduction to LESS/SASS

JAVASCRIPT	**9 Hours**

Introduction to JavaScript, controls statements, Arrays and functions, pattern matching, Element Access, Event Handling.

BOOTSTRAP	**6 Hours**

Introduction to Bootstrap, First example, containers, Bootstrap elements: colors, tables, images, buttons, button groups, progress bars, Forms, utilities, Classes, alerts, custom forms, Grid System.

JQUERY	**6 Hours**

Introduction to JQuery, Syntax, selectors, events, JQuery HTML, JQuery Effects, JQuery CSS.

ANGULAR JS	**9 Hours**

Introduction to Angular JS, Directives, Expressions, Directives, Controllers, Filters, Services, Events, Forms, Validations, Examples.

Theory: 45 Hours	**Tutorial: -**	**Total: 45 Hours**

List of Experiments :

1. Create a web page with the following using HTML5
    a) To embed an image map in a web page
    b) To fix the hot spots
    c) Show all the related information when the hot spots are clicked.
2. Create a web page with all types of Cascading style sheets.
3. Implement Client-Side Scripts for Validating Web Form Controls using JavaScript
4. Designing Quiz Application Personal Information System/ Using JavaScript
5. Write a JavaScript for Loan Calculation.
6. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
7. Develop and demonstrate a HTML file that includes JavaScript that uses functions for the following problems:
    a) Parameter: A string Output: The position in the string of the left-most vowel
    b) Parameter: A number Output: The number with its digits in the reverse order
8. Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format.
9. Write an AJAX program for parsing a JSON file and formatting the output.
10. Create an online Event Registration form and validate using JQuery

REFERENCES

1. Chris Bates, "Web Programming-Building Internet Applications", 3rd, 2006, John Wiley & Sons.

2. Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web -How To Program”, Fifth Edition, Pearson Education, 2011.
3. DT Editorial Services, “HTML5 Black Book”,2016, Dreamtech Press.
4. Krishna Rungta,”Learn AngularJS in 1 Day: Complete Angular JS Guide with Examples”, Independent Publication,2018.
5. Snig Bhaumik,”Bootstrap essentials”, Packt-open source,2015.
6. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011.
7. James Lee, BrentWare , “Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP” Addison Wesley, Pearson 2009.
8. Thomas A. Powell, “HTML & CSS: The Complete Reference”, Fifth Edition, 2010.
9. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, Tata McGraw Hill, 2013.
10. Thomas A Powell, “Ajax: The Complete Reference”, McGraw Hill, 2008.

Total: 30 Hours

P20CAT2003	DATA INTENSIVE COMPUTING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the fundamentals of Data Mining and Pre-processing
CO2: Apply the regression and classification techniques
CO3: Evaluate the models using performance metrics
CO4: Cluster the high dimensional data and apply the association rules for mining the data
CO5: Apply various methods to detect outliers
CO6: Implement the text analysis

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M		M							W	
CO2	M	S		S	M							
CO3	S	M		S								
CO4	S	M		S	M						M	
CO5	M	S	M		M							
CO6	S			M	S							

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION **3 Hours**

Data Mining – Kinds of Data Mined – Functionalities – Technologies – Applications – Issues – Getting to Know the Data – Types of Data Sets and Attribute Values.

DATA PRE-PROCESSING **3 Hours**

Introduction - Need for Data Pre-processing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation.

SUPERVISED LEARNINGTECHNIQUES **9 Hours**

Basic Concepts – Decision Tree – Naïve Bayes Classification – Bayesian Belief Networks – Back propagation – Support Vector Machines – Linear Regression – Logistic Regression

MODEL EVALUATION AND SELECTION	5 Hours
Metrics for Evaluating Classifier Performance - Holdout Method and Random Sub sampling - Cross-Validation –ROC Curves - Techniques to Improve Classification Accuracy: Bagging – Boosting – Random Forest	
UNSUPERVISED LEARNING TECHNIQUES	**9 hours**
Association Rule Mining - Market Basket Analysis - Apriori algorithm - FP-growth - Cluster Analysis - K-Means - *k*-Medoids - Distance Measures - Expectation-Maximization Algorithm - Subspace Clustering Methods – Bi-clustering - Clustering Graph and Network Data	
EVALUATION OF CLUSTERING	**3 Hours**
Assessing Clustering Tendency - Determining the Number of Clusters - Measuring Clustering Quality	
OUTLIER ANALYSIS	**5 Hours**
Introduction – Types of Outliers - Outlier Detection Methods: Statistical Approaches - Clustering-Based Approaches - Classification-Based Approaches	
TEXT ANALYSIS	**5 Hours**
Overview – Collecting Raw Text – Representing Text – Text Frequency – Categorizing Documents – Determining Sentiments – Gaining Insights	
DATA VISUALIZATION	**3 Hours**
Key Points supported with Data – Evolution of a Graph – Common Representation Methods – Clean up a Graphics	
Theory: 45 Hours	**Tutorial: -** **Total : 45 Hours**
REFERENCES:	

1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data Big data science &Analytics : a hands-on approach”, Wiley, 2015
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques” Third Edition, Elsevier, Reprinted 2012
3. Jared Dean, “Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners”, Wiley, USA, 2014.
4. Andreas C. Müller & Sarah Guido, “Introduction to Machine Learning with Python A Guide for Data Scientists” O’Reilly book, 2017
5. Nataraj Dasgupta, Practical Big Data Analytics: Hands-on techniques to implement enterprise analytics and machine learning using Hadoop, Spark, NoSQL and R, Packt 2018.

P20CAT2004	DATA COMMUNICATIONS AND NETWORKS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify the various computer network components, protocol design models and the usage of various types of transmission media and working of LAN technology.

CO2: Understand the IP addressing schemes, routing protocols, congestion control and flow control concepts.

CO3: Identify the components required to build different types of networks

CO4: Understand the network applications and protocols and network security.

CO5: Familiarize with recent trends in computer network implementations.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M				M	M
CO2	S	S	M									
CO3							M					W
CO4	W					M						
CO5		M			M							

COURSE ASSESSMENT METHODS
DIRECT
1.Continuous Assessment Test I, II 2.Assignment; Group Presentation 3.End Semester Examination
INDIRECT
1.Course-end survey

INTRODUCTION	9 Hours

Introduction – Data Communication - Network Models – OSI Model – Layers in the OSI Model – TCP/IP Protocol Suite – Transmission Media –Switching – Circuit and Packet SwitchedNetworks – Datagram Networks –Virtual Circuit Networks – Data Link Layer - Error Detection and Correction – Data Link Control – Medium Access Control – Wired and Wireless LANs – Connecting Devices – Virtual LANs.

INTERNETWORKING	**9 Hours**
Packet Switching – Network Layer Performance – Logical Addressing – IPv4 Addresses – IPv6 Addresses – Internet Protocol – IPv4 – IPv6 – ICMP v4 – Mobile IP – Unicast Routing.	
RELIABILITY AND QUALITY OF SERVICE	**9 Hours**
Process–to–Process Delivery – Protocols – User Datagram Protocol (UDP) – Transmission Control Protocol(TCP) – Congestion Control and Quality of Service (QoS).	
NETWORK APPLICATIONS AND SECURITY	**9 Hours**
Domain Name System(DNS) – Name Space – DNS – Distribution of Name Space – DNS in the Internet – Resolution – DNS Messages – Types of Records – Remote Logging – Electronic Mail – Simple Mail Transfer Protocol(SMTP) – File Transfer – World Wide Web(WWW) –Secure Shell-Hyper Text Transfer Protocol(HTTP) – Simple Network Management Protocol(SNMP) –Security – Cryptography and Network Security.	
RECENT TRENDS	**9 Hours**
Software Defined Networks Overlay model and network model for cloud computing Network Functions Virtualization Concepts, Benefits, requirements, References architecture – Network Virtualization - Network Virtualization Architecture and Benefits	
Theory: 45 Hours **Tutorial: -**	**Total : 45 Hours**
REFERENCES	

1. Behrouz A. Forouzan, “Data Communication and Networking”, 5th Edition, Tata McGraw Hill, 2013.
2. Andrew S.Tanenbaum, “Computer Networks”, 5th Edition, Prentice Hall, 2011.
3. Larry L. Peterson & Bruce S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufmann Publishers, 2014.
4. James F. Kurose & Keith W. Ross “Computer Networking: A Top-Down Approach”, 6th Edition. Pearson, 2017.

P20CAP2501	DATA INTENSIVE COMPUTING LAB USING PYTHON	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand about the problem solving in real-world machine learning applications.

CO2: Implement the supervised learning principles and concepts through python.

CO3: Implement various unsupervised methods

CO4 :Evaluate Machine Learning Algorithms

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S		M			M				W	
CO2	S	M	S		M							
CO3	S	M	S		M							
CO4	M			S	M						M	

COURSE ASSESSMENT METHODS

DIRECT

1. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment
2. Model Examination
3. End Semester Examination

INDIRECT

1.Course-end survey

List of Experiments:

1. Write a Python program to load the dataset into a data frame and print the shape of the data, type of the data, number of rows-columns, feature names and the description
2. Write a Python program to get the number of observations, missing values and Null values for the given data set.
3. Write a python program to implement various pre-processing techniques in the dataset.
4. Write a Python program to split the dataset into Training and Testing data. Fit the data into the model and calculate the performance measures using Decision Tree.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.
6. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
7. Implement support vector machine for the given data set.
8. Implement the K-Means algorithm for the given data set. Evaluate the performance using various K values.
9. Implement EM algorithm for the given data set.

10. Implement Apriori algorithm and generate the association rules. 11. Write a python program to implement linear and logistic regression. 12. Evaluate the various model using performance metrics and find the find best model for the given dataset. 13. Implement a Python program to analyze the text in the document.
Total: 60 hours

P20CAP2702	MINI PROJECT	L	T	P	J	C
		0	0	0	4	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Identify real-world problems and propose appropriate solutions using programming concepts and tools.

CO2: Create and implement effective software solutions by considering user needs.

Pre–requisite: Nil

COs	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M		S				M	M	M	
CO2	S	S	S		S		M		S		M	

COURSE ASSESSMENT METHODS

DIRECT

1. Project Reviews
2. End Semester Viva Voce

INDIRECT

1.Course-end survey

Total : 60 Hours

P20CAI2603	ENGINEERING CLINICS	L	T	P	J	C
		0	0	2	2	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand and explain the functionality of IoT and cloud concepts

CO2: Design and build simple IoT projects

CO3: Ability to work as a team and apply the IoT and cloud concepts in their own design Project/innovate a viable product

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			S								
CO2		S	S							M		
CO3					S						S	S

List of Experiments:

1. Basics of ARDUINO and IoT
2. Working with LEDs & Digital Switch
3. Adjusting voltage using potentiometer, to find the distance of an object using ultrasonic Sensor
4. Finding the Temperature and Humidity in the surroundings &Detecting the motion of human using PIR
5. Working with Servo motor
6. Establish communication using Bluetooth
7. Examples of Software-as- a-Service (SaaS), Platform-as- a-Service (PaaS), Infrastructure-as- a-Service (IaaS)
8. Creation of virtual Firewall
9. Creation of VM backup
10. Deployment of VMs in Oracle Virtual box
11. Install storage controller and interact with it
12. Hosting Web application in cloud

Total: 30 hours

SEMESTER III

P20CAI3201	SERVICE ORIENTED ARCHITECTURE	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Get the foundations and concepts of service-based computing.
CO2: Understand service - oriented analysis techniques.
CO3: Understanding the basic operational model of web services.
CO4: Gain the knowledge of key technologies in the service-oriented computing arena.
CO5: Apply and practice the learning through a real or illustrative project/case study.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M	M		M					
CO2	M	S		M	W							
CO3	W		S	M	M	M				M		
CO4		W		M	S	M	M					
CO5		S	S	S	S	S						

COURSE ASSESSMENT METHODS

DIRECT

1.Continuous Assessment Test I, II (Theory component)
2.Assignment (Theory component)
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5.Model Examination (lab component)
6.End Semester Examination (Theory and lab components)

INDIRECT

1.Course-end survey

INTRODUCTION **5 Hours**

SOA and MSA Basics- Service Orientation in Daily Life- Evolution of SOA and MSA- Service oriented Architecture and Microservices architecture – Drivers SOA- Dimensions of SOA- Conceptual Model of SOA- Standards and Guidelines for SOA-Emergence of MSA

SERVICE ORIENTED ARCHITECTURE **10 Hours**

Enterprise-Wide SOA-Considerations for Enterprise-wide SOA- Strawman Architecture for Enterprise-wide SOA- Enterprise SOA Reference Architecture- Object-oriented Analysis and Design (OOAD) Process- Service oriented Analysis and Design (SOAD) Process - SOA Methodology for Enterprise. Service-Oriented Applications: Considerations for Service-oriented Applications- Patterns for SOA-Patternbased Architecture for Service-oriented Applications -Composite Applications - Programming Model.

SERVICE-ORIENTED ANALYSIS AND DESIGN	**10 Hours**
Need for Models- Principles of Service Design- Non-functional Properties for Services- Design of Activity Services - Design of Data Services- Design of Client Services - Design of Business Process Services. Technologies for SOA: Technologies for Service Enablement - Technologies for Service Integration- Service Orchestration - SOA Governance and Implementation: Strategic Architecture Governance -Service Design- Time Governance - Service Run-time Governance- Approach for Enterprise-wide SOA Implementation.	
BIG DATA AND SOA	**10 Hours**
Concepts - Big Data and its characteristics - Technologies for Big Data -Service-Orientation for Big Data Solutions - Business Case for SOA - Stakeholder Objectives - Benefits of SOA - Cost Savings - Return on Investment (ROI) - Build a Case for SOA - SOA Best Practices: SOA Strategy – Best Practices- SOA Development – Best Practices- SOA Governance – Best Practices- EA and SOA for Business and IT Alignment: Enterprise Architecture- Need for Business and It Alignment- EA and SOA for Business and Its Alignment.	
MICROSERVICES ARCHITECTURE	**10 Hours**
Trend in SOA: Microservices Architecture (MSA)- Services Model for Cloud and Mobile Solutions - API Adoption on the Rise - Challenges and Takeaways from SOA Implementations- Architecture Trend – Microservices Architecture – Microservices Architecture in Action. Cloud and MSACloud Services- Hybrid Cloud Services- Considerations for Hybrid Cloud Services-Cloud Services and MSA-MSA for SMAC Solutions. Mobile and MSA: Mobile Technologies-Types of Mobile Applications-MSA for mobile solutions.	
Theory: 45 Hours	**Tutorial: -** **Total : 45 Hours**

LIST OF EXPERIMENTS

1. Program to create an application for illustrating SOAP based web service.
2. Program to create an application for illustrating RESTful web service.
3. Program to create different modules in various programming languages and wire them using ESB.
4. Program to create a process template using web service Business Process Execution Language.
5. Program to enable security for web service with HTTPS/SOAP.
6. Program to enable security for web service with digital signature.
7. Program based on Microservices Architecture & Implementation.

Total :30 Hours

REFERENCES

1. Shankar Kambhampaty; Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile, Wiley,3rd Edition, 2018.
2. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2016.
3. Frank. P. Coyle, "XML, Web Services And The Data Revolution", Pearson Education, 2002.
4. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services. An Architect's Guide", Pearson Education, 2005.
5. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
6. Dan woods and Thomas Mattern, "Enterprise SOA designing IT for Business Innovation", O'REILLY, First Edition, 2006.
7. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", McGraw Hill Education, 2013.

P20CAT3002	ETHICS IN COMPUTING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Examine situations and to internalize the need for applying ethical principles, values to tackle with various situations.

CO2: Express the aspects of computer crime, code of ethics and standards of computer professionals.

CO3: Show a responsible attitude towards the use of computer as well as the technology.

CO4: Understand ethical issues in software development and social networking.

CO5: Analyse the professional responsibility and empowering access to information in the work.

Pre–requisite: Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/L Indicates Strength of Correlation) S-Strong, M-Medium, L- Less											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			W			M		S				
CO2		M				M		S				
CO3			W		W	M	M					
CO4	W					M		S		W		
CO5	M						M		W			

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment, Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION TO COMPUTER ETHICS — **7 Hours**

Definition of Ethics - Ethics in Business World- IT Professionals - IT Users.

ASPECTS OF COMPUTER CRIME AND INTELLECTUAL PROPERTY RIGHTS — **10 Hours**

Types of Exploits and Perpetrators– Implementing Trustworthy Computing- Intellectual Property Rights – Copyrights– Patents- Trade Secrets- Key Intellectual Property Issues.

PRIVACY AND FREEDOM OF EXPRESSION — **10 Hours**

Privacy Protection and Law – Privacy and Anonymity Issues- First Amendment Rights – Freedom of Expression: Key Issues.

SOFTWARE DEVELOPMENT AND SOCIAL NETWORKING	10 Hours
Software Development – Strategies for Engineering Quality Standards–Software Product Liability – Key Issues in Software Development- Social Networking –Business Applications of Online Social Networking– Social Networking Ethical Issues – Online Virtual World.	
ETHICS OF IT ORGANIZATIONS	**8 Hours**
Ethical Issues for Organizations- Contingent Workers –Outsourcing – Whistle Blowing – Green Computing - ICT Industry Code of Conduct.	
Theory: 45 Hrs **Tutorial: Nil**	**Total Hours: 45Hrs**
REFERENCES	

1. George W. Reynolds, "Ethics in Information Technology", Cengage Learning, 6th Edition, 2018.
2. Sara Baase, "A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet", 4 th Edition, Prentice Hall, 2018.
3. Penny Duquenoy, Simon Jones and Barry G Blundell, "Ethical, legal and professional issues in Computing", Middlesex University Press, 2008.
4. Caroline Whitback, "Ethics in Engineering Practice and Research", Cambridge University Press, 2011.

P20CAI3203	CLOUD APPLICATION DEVELOPMENT	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Design and develop elegant and flexible cloud software solutions.
CO2: Manage and deploy a cloud-based application.
CO3: Analyze a real-world problem and develop a cloud-based software solution.
CO4: Evaluate the deployment of web services from cloud architecture.
CO5: Evaluate the security issues related to the development of cloud applications.
CO6: Develop services using cloud computing.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S		M		M					
CO2	S		S		M							
CO3	S		M		M							
CO4	S		M		S							
CO5			M									
CO6			S									

COURSE ASSESSMENT METHODS

DIRECT

1.Continuous Assessment Test I, II (Theory component)
2.Assignment (Theory component)
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5.Model Examination (lab component)
6.End Semester Examination (Theory and lab components)

INDIRECT

1.Course-end survey

INTRODUCTION **7 Hours**

Overview – Applications – Intranets and the Cloud – First Movers in the Cloud – Benefits – Limitations – Security Concerns.

CLOUD COMPUTING TECHNOLOGY **8 Hours**

Cloud Computing Services: IaaS – PaaS – SaaS – Software Plus Services – Hardware and Infrastructure: Clients – Security – Network – Services – Accessing the cloud : Platforms – Web Applications – Web APIs – Web Browsers.

CLOUD STORAGE AND STANDARDS	**7 Hours**
Cloud Storage: Overview – Cloud Storage Providers – Standards: Application – Client – Infrastructure – Service.	
DEVELOPING APPLICATIONS	**11Hours**
Google : Payment – Force.com and Google – Google Gears – Microsoft : Live services – MS SQL Services – MS .NET Services – MS SharePoint Services – Dynamic CRM Services – Design – Development : Amazon Web Services - Google App Engine – Salesforce – MS Windows Azure – SAP HANA- Trouble Shooting – Application Management	
CLOUD DESIGN	**5 Hours**
Web Application Design – Machine Image Design – Privacy Design – Database Management.	
CLOUD SECURITY	**7 Hours**
Data Security – Network Security – Host Security – Compromise response.	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
LIST OF EXPERIMENTS	
1. Develop cloud applications using IAAS, PAAS and SAAS. 2. Develop an application using storage services with the help of versioning in cloud. 3. Creating VPC using networking and content delivery services. 4. Develop an application to set up cloud watch to get SNS notifications in Gmail. 5. Develop an application for creating vault in S3 glacier and create user in IAM and storing data in Fastglacier. 6.Develop an application for creating bucket using S3 and create distribution in cloud front to open the website. 7. Create an application for creating role using IAM. 8. Create an application using elastic beanstalk under compute services. 9. Creating a file using elastic file system under storage services. 10. Create a role in IOT device defender under Internet of things.	
TotalHours:30 Hrs	
1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw-Hill Education; FirstEdition , 2017. 2. Denys van Kempen, "SAP HANA 2.0: An Introduction ", SAP Press,2019. 3. George Reese, "Cloud Application Architectures", O'Reilly SPD, First Edition, 2011. 4. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", John Wiley& Sons, 2011.	

P20CAT3004	ARTIFICIAL INTELLIGENCE	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Know the basics and problem-solving approach to AI problems
CO2: Analyze various search strategies for a problem.
CO3: Evaluate different knowledge representation schemes for typical AI problems.
CO4: Design and implement a typical AI problem to be solved Using Machine Learning Techniques.
CO5: Design and implement a futuristic AI application

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S										
CO2		S					M					
CO3		M										
CO4	M	M	S		S					M		
CO5		M	M			M	W			M		

Pre–requisite : Nil

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc
4. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION — 9 Hours

Introduction – Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – AI Applications.

PROBLEM SOLVING METHODS — 9 Hours

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics – Local Search Algorithms and Optimization Problems - Searching with Partial Observations -Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search – Game Playing -Optimal Decisions in Games -Alpha--Beta Pruning -Stochastic Games.

KNOWLEDGE REPRESENTATION — 9 Hours

First Order Predicate Logic – Prolog Programming - Unification -Forward Chaining –Backward Chaining - Resolution –Knowledge Representation - Ontological Engineering - Categories and Objects –Events - Mental Events and Mental Objects - Reasoning Systems for Categories -Reasoning with Default Information

PLANNING AND DECISION MAKING	9 Hours
Probability basics - Bayes Rule and its Applications - Bayesian Networks – Exact and Approximate Inference in Bayesian Networks - Hidden Markov Models-Learning Decision Trees - Regression and Classification with Linear Models	
MACHINE LEARNING	**9 Hours**
Forms of Learning -Supervised Learning - Unsupervised Learning - Artificial Neural Networks - Non parametric Models - Support Vector Machines -Statistical Learning - Learning with Complete Data - Learning with Hidden Variables- Introduction to Expectation Maximization Algorithm – Overview of Reinforcement Learning.	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Fourth edition, 2020.
2. Daugherty, Paul R., and H. James Wilson. Human+ machine: Reimagining work in the age of AI. Harvard Business Press, 2018
3. Kaplan, Jerry. Artificial intelligence: What everyone needs to know. Oxford University Press, 2016.

P20CAP3501	MOBILE COMPUTING LAB	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Get an insight into the components and structure of mobile application development Frameworks for Android and windows OS based mobiles.
CO2: Understand how to work with various mobile application development frameworks.
CO3: Understand the basic and important design concepts and issues of development of mobile applications.
CO4: Design and Implement various mobile applications using emulators.
CO5: Deploy applications to hand-held devices

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									
CO2	M		M		M							
CO3			M	M	M							
CO4			S	S								
CO5			M									

COURSE ASSESSMENT METHODS

DIRECT

1. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
2. Model Examination (lab component)
3. End Semester Examination (lab components)

INDIRECT

1. Course-end survey

LIST OF EXPERIMENTS:

1. Develop an application that uses GUI components, Font and Colours.
2. Develop an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Write an application that draws basic graphical primitives on the screen.
6. Develop an application that makes use of RSS Feed.
7. Implement an application that implements multi threading.
8. Develop a native application that uses GPS location information.
9. Implement an application that writes data to the SD card.
10. Implement an application that creates an alert upon receiving a message.
11. Write a mobile application that creates alarm clock.

Total Hours: 60 Hrs

SEMESTER IV

P20CAP4701	PROJECT WORK/INDUSTRY	L	T	P	J	C
		0	0	0	24	12

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Demonstrate the ability to identify real-world problems, understand the needs of users and stakeholders for software development. (K2)
CO2: Evaluate and assess the challenges in managing project scope, time, and resources and suggest strategies to optimize project performance. (K4)
CO3: Develop innovative solutions to complex software problems by combining industry practices and new technologies. (K6)
CO4: Apply relevant tools and techniques to ensure that the solutions meet customer needs. (K3)
CO5: Work effectively in multidisciplinary teams, contributing to project success through teamwork and communication. (K3)

Pre–requisite: Nil

COs	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	W		M	M			M		
CO2		S	S	M	W			S			M	
CO3	S		S	M	S		W	W	M			S
CO4		M	S	W	S						M	
CO5	W	W	M		M	S		S	S		S	

COURSE ASSESSMENT METHODS

DIRECT

1. Project Reviews
2. End Semester Viva Voce

INDIRECT

1.Course-end survey

ELECTIVES

P20CAE0001	INFORMATION SECURITY	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the basic concepts of information security, its model and development life cycle.
CO2: Assess the need for information security and its legal, ethical and its professional issues.
CO3: Identify the information security needs.
CO4: Enable planning of security solutions.
CO5: Implement and practice security policies.

Pre–requisite courses:

P20CAT2004 Data Communications and Networks.

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M									W		
CO2		S				S						
CO3		M					M			M		
CO4	M	M	W			M						
CO5		M	M			M						

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

INFORMATION SECURITY (IS) — **9 Hours**

Introduction – History – Security – Critical Characteristics of Information – National Security Telecommunications and Information System Security Committee (NSTISSC) – Security Model – Components of an Information System – Securing the Components – Balancing Information Security and Access – The Systems Development Life Cycle – Security Professionals and the Organization.

SECURITY INVESTIGATION — **9 Hours**

Need for Security – Business Needs – Threats – Attacks – Legal, Ethical and Professional Issues in Information Security – Selecting Risk Control Strategy – Risk Management – Recommended Risk Control Practices.

SECURITY PLANNING	**9 Hours**
Information Security Policy, Standards and Practices – Information Security Blueprint – Design of Security Architecture – Security Education – Training and Awareness Program – Continuity Strategies.	
SECURITY TECHNOLOGY	**9Hours**
Physical Design – Firewalls – Protecting Remote Connections – Intrusion Detection and Prevention Systems – Honey Pots, Honey Nets, Padded Cell Systems – Scanning and Analysis Tools – Access Control Devices.	
IMPLEMENTATION	**6 Hours**
Implementing IS – IS Project Management – Technical and Non Technical Aspects of Implementation - Security and Personnel – Introduction – Positioning and Staffing the Security Function – Credentials of IS Professionals – Employment Policies and Practices – Internal Control Strategies – Privacy and the Security of Personal Data.	
MAINTENANCE	**3 Hours**
Information Security Maintenance – Security Management Models – Maintenance Model – Digital Forensics.	
Theory: 45 **Tutorial: Nil** **Total : 45 Hours**	
REFERENCES	
1. Michael E Whitman and Herbert J Mattord, "Principles and Practices of Information Security", Cengage Learning, 2018. 2. Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing" Pearson Education Pvt. Ltd., 2015. 3. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2010.	

P20CAE0002	OBJECT ORIENTED ANALYSIS AND DESIGN	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the basic concepts to identify state and behavior of real world objects.

CO2: Apply the various object oriented methodologies and choose the appropriate one for solving the problem with the help of various case studies.

CO 3: Understand the concept of analysis, design and testing to develop a document for the project.

CO 4: Implement analysis, design and testing phases in developing a project using object orientation.

CO 5: Understand and apply testing techniques for object oriented software.

Pre–requisite :Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	W										
CO2	M	M	W	W								
CO3	S	S	M	W							W	
CO4	S	M	W							W		
CO5	M		S									

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION **6 Hours**

An Overview – Object Basics – Object State and Properties – Behavior – Methods – Messages – Information Hiding – Class Hierarchy – Relationships – Associations – Aggregations – Identity – Dynamic Binding – Persistence – Meta Classes – Object Oriented System Development Life Cycle.

METHODOLOGY AND UML **12 Hours**

Introduction – Survey – Rumbaugh, Booch and Jacobson Methodologies – Unified Approach – Unified Modeling Language – UML Diagrams – Class Modeling – State Modeling – Interaction Modeling – Introduction to Patterns and Frameworks.

OBJECT ORIENTED ANALYSIS	**9 Hours**
Identifying Use Case – Business Object Analysis – Use Case Driven Object Oriented Analysis – Use Case Model – Documentation – Classification – Identifying Object, Relationships, Attributes, Methods – Super – Sub Class – A–Part–of Relationships, Identifying Attributes and Methods – Object Responsibility.	
OBJECT ORIENTED DESIGN	**7 Hours**
Design Process and Benchmarking – Axioms – Corollaries – Designing Classes – Class Visibility – Refining Attributes – Methods and Protocols – Object Storage and Object Interoperability – MVC Architectural Pattern and Design – Designing the System.	
ACCESS LAYER	**3 Hours**
Object Persistence – Object Oriented Database Management Systems – Object Relational Systems – Multi Database Systems – Designing Access Layer Classes	
VIEW LAYER	**3 Hours**
User Interface Design – Designing View Layer Classes – Macro Level Process – Micro Level Process – The purpose of a View Layer Interface.	
SOFTWARE QUALITY ASSURANCE AND TESTING	**5 Hours**
Testing Strategies – Impact of Object Orientation on Testing – Test Cases – Test Plan – Usability Testing – User Satisfaction Testing.	
Theory: 45 **Tutorial: -** **Total : 45 Hours**	
REFERENCES	

1. Ali Bahrami, "Object Oriented System Development", McGraw Hill International Edition, 2017.
2. Michael R Blaha and James R Rumbaugh, "Object Oriented Modeling and Design with UML", 2nd Edition, Pearson, 2011.
3. Craig Larman, "Applying UML and Patterns", 2nd Edition, Pearson, 2002.
4. Brahma Dathan and Sarnath Ramnath, "Object–Oriented Analysis, Design and Implementation", Universities Press, 2010.
5. Grady Booch, James Rumbaugh and Ivar Jacobson, "The Unified Modeling Language User Guide", Pearson Education INC, 2009.

P20CAE0003	GAME DEVELOPMENT	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the concepts of Game design and development.
CO2: Analyze the processes, mechanics and issues in Game Design.
CO3: Be exposed to the Core architectures of Game Programming.
CO4: Know about Game programming platforms, frame works and engines.
CO5: Design and develop games

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M									
CO2		S	M									
CO3										W		M
CO4		S					M					
CO5	S		M		M							

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

3D GRAPHICS FOR GAME PROGRAMMING — **9 hours**

3D Transformations – Quaternions - 3D Modeling and Rendering - Ray Tracing - Shader Models – Lighting – Color – Texturing - Camera and Projections - Culling and Clipping - Character Animation - Physics-based Simulation - Scene Graphs.

GAME ENGINE DESIGN — **9 hours**

Game Engine Architecture - Engine Support Systems - Resources and File Systems - Game Loop and Real-Time Simulation - Human Interface Devices - Collision and Rigid Body Dynamics - Game Profiling.

GAME PROGRAMMING — **9 hours**

Application Layer - Game Logic - Game Views - Managing Memory - Controlling the Main Loop - Loading and Caching Game Data - User Interface Management - Game Event Management.

GAMING PLATFORMS AND FRAMEWORKS	**9 hours**
2D and 3D Game Development using Flash, DirectX, Java, Python - Game development with PyGame- Game engines – DX Studio - Unity.	
GAME DEVELOPMENT	**9 hours**
Developing 2D and 3D interactive games using DirectX or Python – Isometric and Tile Based Games - Puzzle games - Single Player games - Multi-Player games.	
Theory: 45 Hours **Tutorial: Nil** **Total : 45 Hours**	

REFERENCES

1. Mike McShaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.
2. Jason Gregory, "Game Engine Architecture", Third Edition, CRC Press, 2019.
3. David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2nd Editions, Morgan Kaufmann, 2006.
4. Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", 2nd Edition Prentice Hall / New Riders, 2009.
5. Eric Lengyel, "Mathematics for 3D Game Programming and Computer Graphics", 3rd Edition, Course Technology PTR, 2011.
6. Jesse Schell, The Art of Game Design: A book of lenses, 1st Edition, CRC Press, 2008.

P20CAE0004	SOFTWARE PROJECT MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the principles and techniques of software project management.

CO2: Describe and apply the evaluation and estimation techniques.

CO3: Perform planning, resource allocation and risks.

CO4: Understand about monitoring and controlling of projects.

CO5: Explain how to manage contracts and people.

Pre–requisite: P20CAT2001- Software Engineering Methodologies and Quality Assurance

Cos	PROGRAMME OUTCOMES (POs) (S/M/L Indicates Strength of Correlation) S-Strong, M-Medium, L- Less											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	W							M			M	
CO2	M	M	S		W							
CO3		S	W	W	W						M	
CO4	S	M	M	W								
CO5							W		M	W		

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION **5 Hours**

Software Project Definition – Need for Software Project Management – Software Projects versus Other Types of Projects – Activities Covered by Software Project Management – Categories of Software Projects – An Overview of Project Planning.

PROJECT EVALUATION AND APPROACH **7 Hours**

Strategic and Technical Assessment – Cost Benefit Analysis and Evaluation – Risk Evaluation - Selection of an Appropriate Project Approach.

SOFTWARE EFFORT ESTIMATION **8 Hours**

Software Effort Estimation – Basics – Effort Estimation Techniques – Top Down and Bottom Up Estimating Approaches – Function Point Analysis – COCOMO Models.

ACTIVITY PLANNING	**7 Hours**
Activity Planning – Objectives – Project Schedules – Sequencing and Scheduling Activities – Network Planning Models – Formulation of a Network Model – Forward Pass – Backward Pass – Critical Path – Activity Float – Shortening Project Duration – Activity on Arrow Networks.	
RISK MANAGEMENT	**3 Hours**
Nature and Types of Risk – Managing Risk – Risk planning and control.	
RESOURCE ALLOCATION	**5 Hours**
Resource Allocation – Nature of Resources – Identifying Resources – Scheduling Resources – Creating Critical Paths – Cost Schedules.	
MONITORING AND CONTROL	**5 Hours**
Monitoring and Control – Creating Framework – Collecting the Data – Visualizing Progress – Cost Monitoring.	
MANAGING CONTRACTSAND PEOPLE	**5 Hours**
Managing Contracts – Types of Contracts – Stages in Contract Placement – Organizational Behavior- Selecting the Right Person – Motivation.	
Theory: 45 Hours **Tutorial: Nil** **Total : 45 Hours**	
REFERENCES	

1. Bob Hughes, Mike Cotterell and Rajib Mall, “Software Project Management”, Sixthedition, McGraw Hill, 2017.
2. Pankaj Jalote, “Software Project Management in Practice”, Pearson, 2016.
3. Robert.T.Futrell, Donald F.Shafer and Linda I.Shafer, “Quality Software Project Management”, Pearson Education, Asia, 2002.

P20CAE0005	E-COMMERCE	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand the differences between E–Commerce and traditional commerce.
CO 2: Analyse the legal, ethical and social issues of E-Commerce.
CO 3: Understand the selling and marketing on web.
CO 4: Analyse the features of Business to business activities.
CO 5: Understand the current technological advancements in E-commerce.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M									S		
CO2		M				S				M		
CO3	M						M			S		
CO4	M						M					
CO5	S		S		M		M				W	

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION **5 Hours**

Introduction to Electronic Commerce: The Evolution of Electronic Commerce – Business Models – Revenue Models and Business Processes – Economic Forces and Electronic Commerce– Identifying Electronic Commerce Opportunities – International Nature of Electronic Commerce.

ENVIRONMENT OF ELECTRONIC COMMERCE **4 Hours**

Legal, Ethical, and Tax Issues: The Legal Environment of Electronic Commerce – Use and Protection of Intellectual Property in Online Business – Online Crime, Terrorism and Welfare – Ethical Issues – Taxation and Electronic Commerce.

COMMERCE ON WEB	**9 Hours**
Selling on the Web: Revenue Models for Online Business - Changing Strategies: Revenue Models in Transition - Revenue Strategy Issues for Online Businesses - Creating an Effective Business Presence Online - Web Site Usability -Using the Web to Connect with Customers. Marketing on the Web: Web Marketing Strategies – Communicating with Different Market Segments – Beyond Market Segmentation: Customer Behavior and Relationship Intensity – Advertising on the Web – E–Mail Marketing – Technology Enabled Customer Relationship Management – Creating and Maintaining Brands on the Web – Search Engine Positioning and Domain Names.	
BUSINESS ACTIVITIES	**9 Hours**
Business-to-Business Activities: Improving Efficiency and Reducing Costs – Introduction - Purchasing, Logistics, and Business Support Processes - Electronic Data Interchange - Supply Chain Management Using Internet Technologies - Online Business Marketplaces and Networks. Social Networking, Mobile Commerce, and Online Auctions – Introduction - From Virtual Communities to Social Networks - Mobile Commerce - Online Auctions.	
SECURITY	**5 Hours**
Electronic Commerce Security: Online Security Issues Overview – Security for Client Devices– Communication Channel Security – Security for Server Computers – Organizations that Promote Computer Security.	
WEB SERVER HARDWARE AND SOFTWARE	**4 Hours**
Web Server Basics – Software for Web Servers – Electronic Mail – Web Site Utility Programs – Web Server Hardware	
PAYMENT SYSTEMS	**9 Hours**
Common Online Payment Methods - Payment Cards - Digital Cash - Digital Wallets - Internet Technologies and the Banking Industry - Payment System Threats: Phishing and Identity Theft. Case Studies: E–Commerce Web Sites.	
Theory: 45Tutorial: -	**Total: 45 Hours**
REFERENCES	
1. Gary P.Schneider, “Electronic Commerce”, 12th Edition, Cengage Learning India Private Limited, New Delhi, 2017. 2. Kenneth C.Laudon & Carol Guercio Traver, “E–Commerce – Business, Technology & Society”, Pearson Education, 2008. 3. Dave Chaffey, “E–Business and E–Commerce Management”, 4th Edition, Pearson Education, 2011.	

P20CAE0006	TCP/IPV6 PROTOCOL SUITE	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the implementation of various standards in the network protocols.
CO2: Interact with the network utilities.
CO3: Know the design aspects involved in the protocols of the TCP/IP protocol suite.
CO4: Design, implement, configure and manage a computer network.
CO5: Understand the functionality of the process in the protocol suite

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S					S					
CO2		S	M		M							
CO3	M	S		M	S		S					
CO4	M			M								
CO5	M		M									

COURSE ASSESSMENT METHODS

DIRECT

1.Continuous Assessment Test I, II
2.Assignment; Group Presentation
3.End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION **10 Hours**

Standards – Internet – OSI Model – TCP/IP Protocol suite – Addressing – Wired Local Area Networks – Wireless Local Area Networks – Connecting Devices.

INTERNET PROTOCOL **10 Hours**

IP addressing – Introduction – Classful Addressing – Classless Addressing – Special Address – NAT IP Packets – Delivery – Forwarding – Structure of Router – IPv4 Introduction – Datagram – Fragmentation – Checksum – IP Package – Address Resolution Protocol (ARP) – Internet Control Message Protocol (ICMP) – Internet Protocol Version 6 (IPV6) Addressing – IPV6 Protocol.

TRANSPORT PROTOCOL	**8 Hours**
User Datagram Protocol (UDP) – UDP Applications – UDP Package – UDP Design – Transmission Control Protocol (TCP) Services – TCP Features – Segment – Connection – State Transition Diagram – Windows in TCP – Flow Control – Error Control – Congestion Control.	
APPLICATION LAYER AND CLIENT SERVER MODEL	**8 Hours**
Client Server Paradigm – Dynamic Host Configuration Protocol(DHCP) – DHCP Operation – DHCP Configuration – Domain Name System (DNS) – Name Space – DNS in the Internet – Resolution – DNS Message – Types of Records – TELNET.	
APPLICATION PROTOCOLS	**9 Hours**
File Transfer Protocol (FTP) – Connections – Communication – World Wide Web and Hypertext Transfer Protocol (HTTP) – Electronic Mail – Simple Network Management Protocol (SNMP) – Management Components – Structure Management Information (SMI) – Management Information Base (MIB).	
Theory: 45Tutorial: - Total Hours: 45 Hours	
REFERENCES	

1. Behrouz A. Forouzan, "TCP/IP Protocol Suite", 4th Edition, Tata McGraw Hill, 2017.
2. Douglas E. Comer & David L. Stevens, "Internetworking with TCP/IP –Volume I, II and III", 5th Edition, Prentice–Hall of India Pvt. Ltd., 2005.

P20CAE0007	WIRELESS NETWORKS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Explain about wireless networks, protocol stack and standards.
CO 2: Conversant with the latest 3G/4G and WiMAX networks and its architecture.
CO 3: Design and implement wireless network environment for any application using latest wireless protocols and standards.
CO 4: Describe the platform architectures that are suitable for mobile computing and communications.
CO 5: Implement different type of applications for smart phones and mobile devices with latest network strategies.
CO 6: Understand various security threats and describe proposed solutions.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2									M			
CO3		S	M									M
CO4												M
CO5	S		M		M					W		
CO6		S		M								

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

WIRELESS LAN **9 Hours**

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum -IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM,BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security - IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

MOBILE NETWORK LAYER	**9 Hours**
Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6- Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing.	
MOBILE TRANSPORT LAYER	**9 Hours**
TCP enhancements for wireless protocols - Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility - Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks.	
WIRELESS WIDE AREA NETWORK	**9 Hours**
Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3GSGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol.	
4G NETWORKS	**9 Hours**
Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.	
Theory: 45 Hours	**Tutorial: - Total : 45 Hours**
REFERENCES	
1. Jochen Schiller, ”Mobile Communications”, Second Edition, Pearson Education 2012. 2. Vijay Garg , “Wireless Communications and networking”, First Edition, Elsevier 2007. 3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband”, Second Edition, Academic Press, 2008. 4. Anurag Kumar, D.Manjunath, Joy kuri, “Wireless Networking”, First Edition, Elsevier 2011. 5. Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communications”, First Edition, Pearson Education 2013.	

P20CAE0008	BLOCKCHAIN TECHNOLOGIES	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the technology components of Blockchain and how it works behind the scenes.
CO2: Be aware of different approaches to developing decentralized applications.
CO3: Understand the Bitcoin and its limitations by comparing with other alternative coins.
CO4: Establish deep understanding of the Ethereum model, its consensus model and code execution.
CO5: Understand the architectural components of a Hyperledger and its development framework.
CO6:Aware of the alternative blockchains and emerging trends in blockchain

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S	S								
CO2		S	S			S				S		
CO3				S								
CO4			S	S	M				M			
CO5				S	S				S			
CO6									S			S

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc
4. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION TO BLOCKCHAIN — **9 Hours**

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

INTRODUCTION TO CRYPTOCURRENCY — **9 Hours**

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

ETHEREUM	**9 Hours**
The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language	
WEB3 and HYPER LEDGER	**9 Hours**
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.	
ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS	**9 Hours**
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	
1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", 2 nd , Edition, Packt Publishing, 2018. 2. ArshdeepBahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT Publisher,2017. 3. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly, 2014. 4. Roger Wattenhofer, "The Science of the Blockchain" Create Space Independent Publishing, 2016. 5. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016. 6. Alex Leverington, "Ethereum Programming", Packt Publishing, 2017.	

P20CAE0009	ACCOUNTING AND FINANCIAL MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the balance sheet preparation and do analysis.

CO2: Understand the cost sheet, budget preparation and control of a company.

CO3: Decide about the state of affairs of a particular firm / company.

CO4: Ensure the preparation of fiscal policies of the organization.

CO5: Ensures the factors to be considered in investment policies.

CO6: Estimate the various business activities such as purchase, sale, production and cash budgets.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S						M				
CO2								M				S
CO3									M			M
CO4									M			
CO5										M		
CO6								S			M	

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

FINANCIAL ACCOUNTING — **9 Hours**

Meaning and Scope of Accounting – Principles – Concepts and Conventions – Double Entry Book Keeping – Books of Accounts: Preparation of Journals – Ledger – Trial Balance – Trading, Profit and Loss Account – Balance Sheet.

COST ACCOUNTING — **9 Hours**

Meaning – Objectives – Elements of Cost – Preparation of Cost Sheet – Methods of Costing – Marginal Costing – Cost Volume Profit Analysis – Break Even Analysis – Fund Flow Analysis – Cash Flow Analysis.

BUDGETS AND BUDGETARY CONTROL	**9 Hours**
Budgets and Budgetary Control – Meaning – Types – Sales Budget – Production Budget – Cost of Production Budget – Flexible Budgeting – Cash Budget – Master Budget – Zero Base Budgeting.	
FINANCIAL MANAGEMENT AND COST OF CAPITAL	**9 Hours**
Objectives and Functions of Financial Management – Cost of Capital – Factors Affecting Cost of Capital – Capital Budgeting: Net Present Value – Internal Rate of Return – Profitability Index – Pay – Back and Discounted Pay – Back Method	
CAPITAL STRUCTURE AND WORKING CAPITAL MANAGEMENT	**9 Hours**
Capital Structure – Factors Affecting Capital Structure – Dividend Policy – Types of Dividend Policy – Concepts of Working Capital – Working Capital Policies – Factors Affecting Working Capital – Estimation of Working Capital Requirements.	
Theory: 45 **Tutorial: NIL** **Total : 45 Hours.**	
REFERENCES	

1. S.N.Maheswari, “Financial and Management Accounting”, Sultan Chand & Sons, 2015.
2. R.K Sharma and Shashi V. K.Gupta, “Management Accounting: Principles of Practice”, Kalyani Publishers, 2015.
3. I.M.Pandey, “Financial Management”, Vikas Publications, 2014.
4. S.P.Iyengar, “Cost and Management Accounting”, Sultan Chand & Co, 2014.
5. I.M.Pandey, “Elements of Management Accounting”, Vikas Publishing House, 2014.
6. R.L Gupta and V.K.Gupta, “Financial Accounting”, Sultan Chand & Sons, 2015.

P20CAE0010	ENTERPRISE RESOURCE PLANNING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Have a sound knowledge on the basic concept of ERP.
CO2: Build a business model in an ERP package.
CO3: Understand the advantages of the ERP solution.
CO4: Be aware of the various commercial ERP packages.
CO5: Know the architecture concepts and services of an ERP package

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S			S	M					
CO2		W										W
CO3	M	S	M			M			W			
CO4				M			M					M
CO5	W		S			W	W					

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment; Group Presentation
3. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION TO ERP **4 Hours**

Integrated Management Information Seamless Integration – Supply Chain Management – Integrated Data Model – Benefits of ERP

BUSINESS ENGINEERING **5 Hours**

Business Engineering and ERP – Definition of Business Engineering – Principle of Business Engineering – Business Engineering with Information Technology-Introduction to Business Process Reengineering.

BUSINESS MODELLING FOR ERP	**9 Hours**
Building the Business Model – ERP Implementation – An Overview – Role of Consultant, Vendors and Users – Customization – Precautions – ERP Post Implementation Options – ERP Implementation Technology – Guidelines for ERP Implementation.	
ERP AND THE COMPETITIVE ADVANTAGE	**9 Hours**
ERP domain Manufacturing (MFG)/Pro – Industrial and Financial Systems (IFS)/Avalon – Industrial and Financial Systems – Baan IV, Systems Applications and Products (SAP) – Market Dynamics and Dynamic Strategy.	
COMMERCIAL ERP PACKAGE	**9 Hours**
Description – Multi–Client/Server Solution – Open Technology – User Interface – Application Integration.	
ARCHITECTURE	**9 Hours**
Basic Architectural Concepts – The System Control Interfaces – Services – Presentation Interface – Database Interface.	
Theory: 45 Hours. **Tutorial:**	**Total 45 Hours.**
REFERENCES	

1. Vinod Kumar Garg & N.K.Venkita Krishnan, "Enterprise Resource Planning – Concepts and Practice", 2nd Edition, PHI Learning Pvt. Ltd., 2011.
2. Alexis Leon, "Enterprise Resource Planning, Fourth Edition, McGraw Hill Publications, 2019
3. Jose Antonio Fernandz, "The SAP R/3 Handbook", TMH, 2005.
4. M. S. Jayaraman, Ganesh Natarajan, & A.V. Rangaramanujan, "Business Process Reengineering", McGraw Hill, 2001
5. R. Srinivasan, "Business Process Reengineering, 2nd Edition, McGrawhill,2019.

P20CAE0011	BUSINESS DOMAINS IN COMPUTER APPLICATIONS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1**:** Describe about marketing, consumer behaviour and marketing segmentation.
CO2**:** Explain about human resource management and terms associated with it.
CO3**:** Understand the need for supply chain management and inventory control techniques.
CO4**:** Explain about customer relationship management in various domains.
CO5**:** Know the basics of banking and insurance process.

Pre–requisite **:**Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S						M				
CO2						M		S		S		
CO3												S
CO4											S	
CO5										S		

COURSE ASSESSMENT METHODS

DIRECT

. 1. Continuous Assessment Test I, II
. 2. Assignment
. 3. Demonstration etc (as applicable)
. 4. End Semester Examination

INDIRECT

1.Course-end survey

MARKETING **8 Hours**

Definition - Importance of Consumer Behavior- Steps in Buyer Decision Process - Market Segmentation- Marketing Mix: 7 Ps of Marketing.

HUMAN RESOURCEMANAGEMENT **7 Hours**

Employee Database- Recruitment -Selection Processes- Employee Appraisal- Leave Types- Payroll – Salary Calculation - Income Tax Calculation – Reporting – PF – Gratuity - Bonus.

SUPPLY CHAIN MANAGEMENT (SCM)	**10 Hours**
Introduction to Supply Chain -Major Drivers of Supply Chain- Value in Supply Chain- Quality, Delivery, Flexibility- Source Management in Supply Chain- In Sourcing-Outsourcing- Make Vs Buy- Managing Inventory in Supply Chain- Definition of Inventories- Role of Inventory- Inventory Control Techniques (ABC Analysis, VED Analysis)- Vendor Managed Inventory- Transportation– Modes of Transportation-Transportation Management System (TMS).	
CUSTOMER RELATIONSHIP MANAGEMENT (CRM)	**10 Hours**
Introduction to CRM -Need for CRM- Customer Life Cycle- Use of CRM in Business - CRM Implementation Strategy- CRM Applications in Hospital Management-Travel Industry- Hotel Industry.	
BANKING AND INSURANCE	**10 Hours**
Accounts and Deposits- Types of Accounts-Saving Account-Current Account- Demat Account- Digital Payments – NEFT- RTGS- IMPS- BHIM- UPI-Wallets. Loans - Various Types of Loans- Personal-Home Loan-Vehicle Loan - Loan Against Security - Business Loans- Loan Sanction Process- Insurance- Types of Insurance- Life- Health- Accident- Home- Motor- Loan Insurance- Insurance Processes.	
Theory: 45 Hours	**Tutorial: -** **Total : 45 Hours**
REFERENCES:	

1. Philip Kotler, K.Keller, "Marketing Management: A South Asian Perspective", Pearson Education, 15th Edition, 2017.
2. Sunil Chopra, Peter Meindl, "Supply Chain Management Strategy, Planning and Operation" Pearson Education, 6th Edition, 2016.
3. J. John Bernardin," Human Resource Management ", Tata McGraw Hill Publishing, 6th Edition 2012.
4. Kristin Anderson , Carol Kerr,"Customer Relationship Management", Tata McGraw- Hill,2001
5. Padmalatha Suresh, Justin Paul ,"Management of Banking and Financial Services", Pearson Education, 8th Edition, 2017.
7. Francis Buttle, Stan Maklan, "Customer Relationship Management: Concepts and Technologies", Routledge, 3rd edition,2015

P20CAE0012	BIG DATA ANALYTICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Work with big data platform and Understand the fundamentals of various big data analysis techniques.

CO2: Analyze the big data analytic techniques for useful business applications.

CO3: Design efficient algorithms for mining the data from large volumes

CO4: Analyze the HADOOP and Map Reduce technologies associated with big data analytics.

CO5: Explore the applications of Big Data.

Pre–requisite : P20CAT1002 **-** Database Technologies

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S			M							
CO2					M				M		M	
CO3		W	M	W	W				M		M	
CO4					M						M	
CO5									W		W	

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc (as applicable)
4. End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION TO BIG DATA — 9 Hours

Introduction to Big Data Platform –Challenges of Conventional Systems -Intelligent data analysis –Nature of Data-Analytic Processes and Tools -Analysis vs Reporting -Modern Data Analytic Tools -Statistical Concepts: Sampling Distributions -Re-Sampling -Statistical Inference -Prediction Error

MINING DATA STREAMS	**9 Hours**
Introduction To Streams Concepts –Stream Data Model and Architecture -Stream Computing -Sampling Data in a Stream –Filtering Streams –Counting Distinct Elements in a Stream –Estimating Moments–Counting Oneness in a Window –Decaying Window -Real time Analytics Platform(RTAP)Applications –-Case Studies -Real Time Sentiment Analysis, Stock Market Predictions.	
HADOOPENVIRONMENT	**9 Hours**
History of Hadoop-The Hadoop Distributed File System –Components of Hadoop-Analyzing the Data with Hadoop -Scaling Out-Hadoop Streaming-Design of HDFS-Hadoop file systems-Java interfaces to HDFS-Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort –Task execution -Map Reduce Types and Formats-Map Reduce Features -Setting up a Hadoop Cluster -Cluster specification -Cluster Setup and Installation –Hadoop Configuration-Security in Hadoop.	
DATA ANALYSIS SYTEMS AND VISUALIZATION	**9 Hours**
Link Analysis –Page Rank -Efficient Computation of Page Rank-Topic-Sensitive Page Rank –Link Spam-Recommendation Systems-A Model for Recommendation Systems-Content-Based Recommendations -Collaborative Filtering -Dimensionality Reduction-Visualizations -Visual data analysis techniques-interaction techniques-Systems and applications.	
FRAMEWORKS AND APPLICATIONS	**9 Hours**
IBM for Big Data –Framework -Hive –Sharding –NoSQL Databases –Mango DB-Casandra-Hbase –Impala –Analyzing big data with twitter –Big data for Ecommerce –Big data for blogs.	
Theory: 45 Hours	**Tutorial: - Total: 45 Hours**
REFERENCES	

1. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly Media, 2012.
2. Paul Zikopoulos, Chris Eaton, Dirk Deroos, Tom Deutsch, George Lapis, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill Publishing, Indian Edition, 2017.
3. Bill Franks," Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley &Sons, 2012.
4. Zikopoulos, Paul & Chris Eaton, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", Tata McGraw Hill Publications, 2011.
5. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014
6. Paul Zikopoulos, DirkdeRoos , Krishnan Parasuraman ,Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012

P20CAE0013	MIXED REALITY	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Discuss the basic concepts of Mixed Reality.
CO2: Design and develop the Mixed Reality applications in different domains.
CO3: Design various models using modelling techniques.
CO4: Perform Mixed Reality Programming with toolkits.
CO5: Understand the working principles of input output devices used in mixed reality applications.
CO6: Evaluate mixed reality based applications.

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S						M				
CO3			S	M								
CO4					S							
CO5			S		S							
CO6				S						M		M

COURSE ASSESSMENT METHODS

DIRECT

. 1.Continuous Assessment Test I, II
. 2. Assignment
. 3. Demonstration etc
4. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION — 9 Hours

Introduction to Virtual Reality (VR)– Definition – Three I's of VR – VR Vs 3D Computer Graphics – Benefits - Components of VR– Introduction to AR – System Structure– Key Technology in AR – 3D Vision – Approaches - Alternative Interface Paradigms – Spatial AR – Input Devices – 3D Position Trackers – Performance Parameters – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display –Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays –Human Auditory System.

MR COMPUTING ARCHITECTURE — 9 Hours

Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering –PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures – Multi-pipeline

Synchronization – Collocated Rendering Pipelines – Distributed Virtual Environments – AR Architecture.

MR MODELING	**9 Hours**

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing The 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing And Mapping – Behavior Modeling – Model Management.

MR PROGRAMMING	**9 Hours**

VR Programming – Toolkits and Scene Graphs – World Toolkit – Java 3D – Comparison of World Toolkit and Java 3D - GHOST – People Shop – Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society –Mixed Reality Coding –Trajectories through Mixed Reality Performance – Mobile Interface Design – Quantitative Evaluation – Qualitative Evaluation.

APPLICATIONS	**9 Hours**

Medical Applications of MR – Education, Arts and Entertainment – Military MR Applications – Emerging Applications of MR – MR Applications in Manufacturing – Applications of MR in Robotics – Information Visualization –Wearable Computing – Games

Theory: 45	**Tutorial: -**	**Total Hours: 45 Hrs**

REFERENCES

1. Grigore C. Burdea, Philip Coiffet, “Virtual Reality Technology”, Second Edition, Wiley India, 2017.
2. Benford, S., Giannachi G., “Performing Mixed Reality”, MIT Press, 2011.
3. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create Compelling VR Experiences for Mobile”, Packt Publisher, 2018.
4.Jason Jerald, “The VR Book: Human-Centered Design for Virtual Reality” Association for Computing Machinery and Morgan , Claypool Publishers,2015
5. William R. Sherman, Alan B.Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003
6.Kelly S. Hale , Kay M. Stanney Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition, CRC press,2014

P20CAE0014	DEEP LEARNING TECHNIQUES AND APPLICATIONS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the role of deep learning in machine learning applications.
CO2: Get familiar with the use of Tensor Flow and Keras in deep learning applications.
CO3: Design and implement deep learning applications.
CO4: Critically analyze different deep learning models in image related projects.
CO5: Design and implement convolutional neural networks.

Pre–requisite : P20CAT2003 – Data Intensive Computing

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M							W			
CO2					S		M				M	
CO3		M					M				M	
CO4		W			M				W			
CO5							M					

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc
4. End Semester Examination

INDIRECT

1. Course-end survey

BASICS OF NEURAL NETWORKS — **9 Hours**

Basic Concept of Neurons – Perceptron Algorithm – Feed Forward and Backpropagation Networks

INTRODUCTION TO DEEP LEARNING — **9 Hours**

Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training –Nestor's Accelerated Gradient Descent – Regularization for Deep Learning – Dropout – Adversarial Training – Optimization for Training Deep Models

CONVOLUTIONAL NEURAL NETWORKS — **9 Hours**

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks-Applications

ADDITIONAL DEEP LEARNING ARCHITECTURES	**9 Hours**
Long Short Term Memory (LSTM) Networks – Sequence Prediction – Gated Recurrent – Encoder/Decoder Architectures – Autoencoders – Standard – Sparse – Denoising – Contractive – Variational Autoencoders – Applications of Autoencoders – Representation Learning – Deep generative Models – Belief Networks – Generative Networks – Generative Schemes – Evaluating Generative Models.	
APPLICATIONS OF DEEP LEARNING	**9 Hours**
Images segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Attention models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	

1. Ian J. Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018
3. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
4. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
5. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
6. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications 2016.

P20CAE0015	E-LEARNING TECHNIQUES	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Distinguish the phases of activities in the models of E-learning.
CO2: Identify appropriate instructional methods and delivery strategies.
CO3: Choose appropriate E-learning authoring tools.
CO4: Create interactive E-Learning courseware.
CO5: Evaluate the E-learning courseware.
CO6: Manage the E-learning courseware

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S					S					
CO2		M	S		M							
CO3			M			W	W					
CO4		S	M		S	W						
CO5				M								
CO6								M		W		

COURSE ASSESSMENT METHODS

DIRECT

. 1.Continuous Assessment Test I, II
. 2. Assignment
. 3. Demonstration etc
4. End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION — **9 Hours**

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

DESIGNING E-LEARNING COURSE CONTENT — **9 Hours**

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies -Case Study

CREATING INTERACTIVE CONTENT	**9 Hours**
Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development – Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool.	
LEARNING PLATFORMS	**9 Hours**
Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.	
COURSE DELIVERY AND EVALUATION	**9 Hours**
Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning – Course Evaluation.	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	

1. Clark, R. C. and Mayer, R. E, "eLearning and the Science of Instruction", Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, "Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies", Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, "Understanding the Learning Personalities of Successful Online Students", Educause Review, 2014.
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Riley Media, 2017.
5. Madhuri Dubey, "Effective E – learning Design, Development and Delivery", University Press, 2011.

P20CAE0016	ETHICAL HACKING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Apply various open source security tools to assess the network and computing system.

CO2: Practice penetration testing to predict the vulnerabilities across any computing system.

CO3: Explain how to prevent the information and computing assets from any kind of attacks.

CO 4: Understand how to protect the devices in a network from malicious software and worms.

CO 5: Assess the wireless network flaws and be able to provide security solution.

Pre–requisite :P20CAT2004 - Data Communications and Networks

Cos	PROGRAMME OUTCOMES (POs) (S/M/L Indicates Strength of Correlation) S-Strong, M-Medium, L- Less											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				S	M						
CO2	M	W			M	S				M		
CO3	M	M							W			
CO4	W		S	M	M							
CO5	M	S					M					

COURSE ASSESSMENT METHODS

DIRECT

. 1.Continuous Assessment Test I, II
. 2. Assignment
. 3. Demonstration etc
4. End Semester Examination

INDIRECT

1.Course-end survey

INTRODUCTION — 9 Hours

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports.

INFORMATION GATHERING AND SCANNING — 9 Hours

Information Gathering Techniques – Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute – ICMP Traceroute – TCP

Traceroute – Usage – UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – DNS Enumeration – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

NETWORK ATTACKS	**9 Hours**

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous versus Non-promiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks –Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic –DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.

EXPLOITATION	**9 Hours**

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Acquiring Situation Awareness – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials

WIRELESS AND WEB HACKING	**9 Hours**

Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Types of Authentication – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – Automating It with Burp Suite – Session Attacks – SQL Injection Attacks

Theory: 45	**Tutorial: -**	**Total Hours: 45 Hrs**

REFERENCES

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.
2. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.
3. Jon Erickson , “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2007.

P20CAE0017	MIDDLEWARE TECHNOLOGIES	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Implement the distributed services using RMI .
CO2: Implement programs in EJB.
CO3: Map and differentiate the functions between COM and .NET.
CO4: Understand the functionalities of various types of middleware technologies.
CO5: Design web services using SOAP, UDDI, WSDL.
CO6: Design middleware applications for real time usage.

Pre–requisite: P20CAT1004 - Programming with JAVA

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	S		M		M					
CO2	S		S		M							
CO3	S	M	M				S					
CO4	S		S		S							M
CO5												
CO6					M							M

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
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4. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION — **9 Hours**

General Middleware, Service Specific Middleware, Client/Server Building blocks – RPC - Messaging – Peer – to – Peer, Java RMI - Computing standards – OMG - Overview of EJB - Middleware types - Middleware in distributed Applications.

EJB — **9 Hours**

EJB architecture - Overview of EJB software architecture, EJB Conversation, Building and Deploying EJBs, Roles, applications - EJB Session Beans, EJB entity beans - Lifecycle of Beans - EJB clients - developing an application - Deployment.

COM and .NET	**9 Hours**
Evolution of DCOM - Introduction to COM - COM clients and servers - COM IDL - COM Interfaces COM Threading Models – Marshalling - Custom and standard marshalling - Introduction to .NET - Overview of .NET architecture - Remoting	
SOA and WEB SERVICES	**9 Hours**
Defining SOA - Business value of SOA - SOA characteristics - Concept of a service, Basic SOA - Enterprise Service Bus (ESB) - SOA enterprise Software Models -Services and SOA – WSDL - SOAP, UDDI, WS Standards -Web Services and Service Oriented Enterprise (SOE) - Coordination and Transaction - Business Process Execution Language for Web Services.	
OTHER TYPES OF MIDDLEWARE	**9 Hours**
Other types of Middleware, Real-Time Middleware, Embedded Systems Middleware, Mobile Middleware, Oracle Fusion Middleware	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	

1. Letha Hughes Etzkorn,Introduction to Middleware: Web Services, Object Components, and Cloud Computing, 1st Edition, Chapman and Hall/CRC ,2017.
2. Judith M. Myerson, "The Complete Book of Middleware" Auerbach Publications, 1 st Edition, 2017
3. G. Sudha Sadasivam, Radha Shankarmani, "Middleware and Enterprise Integration Technologies", Wiley, 2009. Tentative
4. Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju, "Web Services: Concepts, Architectures and Applications", Springer, 2010.
5. Ian Gorton, "Essential Software Architecture", Springer, 2nd Edition, 2011.
6. Distributed Systems Architecture: A Middleware Approach", Morgan Kaufmann, 2005.
7. Reza Shafii, Stephen Lee, and Gangadhar Konduri, "Oracle Fusion Middleware 11g Architecture and Management", McGraw-Hill Osborne Media, 1 edition, 2011.
8. Grigoris Antoniou & Frank Van, "Semantic Web Primer", 2012

P20CAE0018	ROBOTIC PROCESS AUTOMATION	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the need and use of automation
CO2: Describe RPA, where it can be applied and how its implemented
CO3: Describe the different types of variables, Control Flow, and data manipulation techniques
CO4: Identify and understand Image, Text, and Data Tables Automation
CO5: Describe automation to Email and various types of Exceptions and strategies to handle
CO6: Build Bots which can do automation

Pre–requisite : Nil

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										
CO2		S	M		M							
CO3					S							
CO4	M			M								
CO5			M									
CO6			M									

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
3. Demonstration etc
4. End Semester Examination

INDIRECT

1. Course-end survey

RPA CONCEPTS — **9 Hours**

RPA Basics - History of Automation - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - Processes Automation - Types of Bots - Workloads which can be automated - Advanced Concepts - Standardization of processes - Tentative Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case -Team - Process Design and Solution Design Document - Industries suited for RPA - Risks & Challenges - RPA and Emerging Ecosystem

RPA TOOL	**9 Hours**
Introduction to RPA Tool - User Interface - Variables - Managing Arguments - Naming Best Practices - Arguments Panel - Using Arguments -Imported Namespaces - Control Flow : Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - Control Flow Activities - Data Manipulation -Introduction - Scalar variables, Collections and Tables - Text Manipulation - Gathering and Assembling Data	
AUTOMATION CONCEPTS	**9 Hours**
Recording and Advanced UI Interaction -Introduction – Basics - Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors	
ADVANCED AUTOMATION CONCEPTS AND TECHNIQUES	**9 Hours**
RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Information Retrieval - Challenges - Best Practices - Using tab for Images - Starting Apps - Excel Data Tables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel - Extracting Data from PDF - Anchors - Anchors in PDF.	
EMAIL AUTOMATION & EXCEPTIONAL HANDLING	**9 Hours**
Email Automation - Email Automation - Incoming Email automation - Sending Email automation - Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	
1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 . 2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: A Primer, Institute of Robotic Process Automation”, 2015. 3. Richard Murdoch, “Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant”, 2018. 4. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, 2018	

P20CAE0019	LINUX ADMINISTRATION	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand an overall view of the structure of Linux.
CO2: Access the different devices through commands.
CO3: Work with kernel and user spaces in Linux environment.
CO4: Automate tasks using scheduling tools.
CO5: Configure network files based on the specific need.
CO6: Acquire Linux Administration skills to manage a server.

Pre–requisite : P20CAT1103- Advanced Operating Systems

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S					M					
CO2	S	M				M						
CO3	W				S	M	M					
CO4		W			S							
CO5	S				S		M					
CO6	S				S	M	M					

COURSE ASSESSMENT METHODS

DIRECT

. 1.Continuous Assessment Test I, II
. 2. Assignment
. 3. Demonstration etc
4. End Semester Examination

INDIRECT

1. Course-end survey

INTRODUCTION **9 Hours**

Levels and Layers of Abstraction in a Linux System – Hardware – Kernel: Process Management, Memory Management, Device Drivers and Management, System Calls and Support – User Space – Shell Commands

DEVICES, DISKS and FILE SYSTEMS	**9 Hours**
Device Files – Device Path – Device Name Summary – udev – SCSI and Linux Kernel – Partitioning Disk Devices – Filesystems – Swap Space	
KERNEL SPACE AND USER SPACE	**9 Hours**
How the Linux Kernel Boots: Startup messages – Kernel initialization and Boot options – Kernel Tentative Parameters – Bootloaders – GRUB – UEFI – Chainloading other operating systems – How the User space starts: Introduction to Init – System V Runlevels – systemd – Upstart – System V init – Shutting down the System – Initial RAM Filesystem – Emergency booting and Single-User modeling	
SYSTEM CONFIGURATION, PROCESS AND RESOURCE UTILIZATION	**9 Hours**
Structure of etc – System Logging – User Management Files – Time – Scheduling Tasks with cron and at – Identification and Authentication – Process and Resource Utilization: Tracking Processes – lsof – Tracing Program Execution and System Calls – Threads – Measuring CPU Time – Adjusting Process Priorities – Load Averages – Memory – I/0 Monitoring	
NETWORK CONFIGURATION AND SERVICES	**9 Hours**
Network basics – Layers – Routes and Kernel Routing table – Basic ICMP and DNS tools – Physical Layer and Ethernet – Kernel Network Interfaces – NIC configuration – Resolving Hostname – Localhost – Transport layer: TCP, UDP and Services – Revisiting a Simple Local Network – Understanding DHCP – Configuring Linux as a Router – Firewalls – Ethernet, IP and ARP - Wireless Ethernet – Secure Shell ssh – Diagnostic Tool.	
Theory: 45	**Tutorial: -** **Total Hours: 45 Hrs**
REFERENCES	
1. Brian Ward, How Linux Works – what every superuser should know, Second edition , starch press, 2015 2. https://developer.ibm.com/technologies/linux/	

P20CAE0020	USER INTERFACE DESIGN AND USER EXPERIENCE	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Build UI for user Applications.
CO2: Know the UI Interaction behaviours and principles.
CO3: Evaluate UX design of any product or application.
CO4: Demonstrate UX Skills in product development.
CO5: Implement Sketching principles
CO6: Create Wireframe and Prototype

Pre–requisite : P20CAI2202- Web Technologies

Cos	PROGRAMME OUTCOMES (POs) (S/M/W Indicates Strength of Correlation) S-Strong, M-Medium, W- Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				M		M					
CO2	W	M										
CO3	M	M	M									
CO4		M			M							
CO5	M											
CO6	M				M							

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II
2. Assignment
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4. End Semester Examination

INDIRECT

1. Course-end survey

FOUNDATIONS OF DESIGN — **9 Hours**

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

FOUNDATIONS OF UI DESIGN — **9 Hours**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviours and Principles – Branding - Style Guides

FOUNDATIONS OF UX DESIGN — **9 Hours**

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	9 Hours
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture	
WIREFRAMING, PROTOTYPING AND TESTING	**9 Hours**
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration	
Theory: 45 **Tutorial: -** **Total Hours: 45 Hrs**	
REFERENCES	
1. Steve Krug, "Don't Make Me Think, Revisited: A Common sense Approach to Web & Mobile", Third Edition, 2015 2. Steve Schoger, Adam Wathan "Refactoring UI"2018.	

ONE CREDIT COURSES

SYLLABUS

P20CAC0201	AGILE METHODOLOGY

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand and apply agile principles while developing software.
CO 2: Establish a healthy collaboration between development teams.

AGILEPROCESS

Beginning Agility – Agile Manifesto and Principles – Agile Success Factors– Delivering what users want – Agile Planning – Caring about Quality – Collaboration – Listening to Feedback – Combining Scrum with XP – Case Studies.

Theory: 15 Hours	Tutorial: -	Total: 15 Hours

REFERENCES

1. Rachel Davies & Liz Sedley, "Agile Coaching", The Pragmatic Bookshelf, 2012.
2. Henrik Kniberg, "Scrum and XP from the Trenches–How we do Scrum", InfoQ Enterprise Software Development Series, 2007.

P20CAC0202	INTRODUCTION TO ETHICAL HACKING

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Defend a computer and network against a variety of security attacks using a number of hands–on techniques.

CO 2: Practice and use safe techniques on the World Wide Web and develop security policies.

INTRODUCTION

Introduction to Ethical Hacking – Hacking Operating System – Hacking Network – Website Hacking – Foot Printing – Checking the Status of Ports.

Phishing – Password – Privacy – Denial of Service Attacks – Microsoft Operating System Vulnerabilities – Linux Operating System Vulnerabilities – Viruses and Worms – Network Security Devices.

Theory: 15 Hours **Tutorial: -** **Total: 15 Hours**

REFERENCES

1. Michael T. Simpson, "Ethical Hacking and Network Defense", Cengage Learning India Private Limited, New Delhi, 2010.
2. Ankit Fadia, "An Unofficial Guide to Ethical Hacking", Macmillan India Ltd., New Delhi, 2010.

P20CAC0203	SOFT SKILLS

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Perform well in a team and positively resolve conflict in timely manner.
CO 2: Set realistic goals and manage stress well.

SELF ANALYSIS & INTERPERSONAL SKILLS

Self Analysis: SWOT Analysis – Who Am I – Attributes – Importance of Self Confidence– Self Esteem. Attitude: Factors Influencing Attitude – Challenges – Lessons from Attitude – Motivation: Factors of Motivation – Self Talk – Intrinsic and Extrinsic Motivators. Goal Setting: Wish List – Smart Goals – Blue Print for Success – Short Term – Long Term – Life Time Goals.

Interpersonal Skills: Understanding the Relationship between Leadership Networking and Team Work – Necessity of Team Work – Stress Management: Causes of Stress and its Impact – How to Manage Distress – Understanding the Circle of Control – Stress Busters. Decision Making: Importance and Necessity of Decision Making – Process of Decision Making – Practical Way of Decision Making – Weighing Positives and Negatives.

Theory: 15 Hours **Tutorial: -** **Total: 15 Hours**

REFERENCES

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford Publisher, 2011.
2. Nitin Bhatnagar, "Effective Communication and Soft Skills", Pearson Education India 2012.

P20CAC0204	TECHNICAL WRITING

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Express themselves in different kind of writing from creative to critical and factual writing.
CO 2: Identify and critique effective technical writing techniques and practices.

WRITING TECHNIQUES

Techniques of Writing – Emails – Minutes – Reports of different Kinds – Annual Report – Status Report – Survey Report – Proposals – Memorandums – Presentations – Interviews – Profile of Institutions – Speeches – Responding to Enquiries – Complaints – Resumes – Applications – Summarizing – Strategies for Writing.

Theory: 15 Hours **Tutorial: -** **Total: 15 Hours**

REFERENCES

1. Sharan J Gerson & Steven M Gerson, "Technical Writing: Process and Product", 8th Edition, Pearson Education, New Delhi, 2013.

P20CAC0205	HUMAN EXCELLENCE – PROFESSIONAL VALUES

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Acquire knowledge through personality development.
CO 2: Demonstrate skills of self–control.

INTRODUCTION,LEADERSHIP & EMPOWERMENT OF MIND

Human Excellence: Introduction – Objective – Personal Values – Importance – **Life:** Self – Society – Nature – Yoga – Purpose and Philosophy of Life – **Personality Concepts**: Introspection – Six Temperaments and their Maneuvering – Analysis of Thought – Moralizing of Desire – Neutralization of Anger – Eradication of Worries – Training: Stress Management – Time Management.

Leadership Traits: Carrying Oneself – Factors of Leadership – Principles of Leadership – **Self Control**: Importance – Techniques to Development Oneself – Ten Commandments of Self–Development – Self–Control Technique for Teenagers – Training: Method of Self Control – **Empowerment of Mind**: Body, Soul and Mind – Bio Magnetism – Genetic Centre – Mind: Origin and its Ten Stages – Simplified Physical Exercises – **KayaKalpa Yoga**: Aim – Kayakalpa Philosophy – Importance of Kayakalpa Training – Training: Kaya Kalpa Yoga – **Meditation**: Introduction of Meditation – Benefits of Meditation – Training: Agna Meditation – Santhi Meditation.

Theory: 15 Hours **Tutorial: -** **Total: 15 Hours**

REFERENCES

1. Vethathiri's Maharishi's, "Yoga for Modern Age", The World Community Service Centre, Vethathiri Publications, 2009.
2. Vethathiri's Maharishi's, "Genetic Centre", The World Community Service Centre, Vethathiri Publications, 2003.
3. Vethathiri Maharishi's, "Rejuvenating Life Force and Mind" – paper–III for M.A. Yoga for Human Excellence", 3rd edition, The World Community Service Centre, Vethathiri Publications, 2010.
4. Swami Vivekananda, "Selections from the Complete Works", 23rd Edition, The Ramakrishna Mission Institute of Culture, 2007
5. Vethathiri's Maharishi's, "Mind", The World Community Service Centre, Vethathiri Publications, 1999.
6. Russell Kelfer, "Self Control", Tyndale House Publishers, 1985.
7. Dr. A. Chandra Mohan, "Leadership and Management", Himalaya Publication House.
8. Robert W. Bly, "Make Every Second Count", Career Press, Incorporated, 2010.
9. Vethathiri's Maharishi's, "Manavalakalai Part 1, 2 and 3", 11th Edition, The World Community Service Centre, Vethathiri Publications, 1994.
10. Swami Vivekananda, "Karma Yoga", 39th Edition, The Ramakrishna Mission Institute of Culture, 2008.

P20CAC0206	DATA ANALYTICS

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Analyze and interpret data using an ethically responsible approach.
CO2: Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
CO3: Interpret data findings effectively to any audience, orally, visually and in written formats

BASICS OF DATA ANALYTICS

Basic Analysis Techniques-Statistical Hypothesis Generation and Testing-Chi-Square Test – T – TestAnalysis of Variance-Correlation Analysis-Maximum Likelihood Test-Practice And Analysis With R-Data Analysis Techniques-Regression Analysis-Classification Techniques—Clustering-Association Rules Analysis-Practice and Analysis With R

Theory: 15 Hours **Tutorial: -** **Total: 15 Hours**

REFERENCES

1. Rajendra Akerkar **&** Priti Srinivas Sajja, Intelligent Techniques for Data Science Springer International Publishing 2016.
2. Big Data: "Analytics for Enterprise Class, Hadoop and Streaming Data", McGrawHill Publishing, 2012.