Dharmsinh Desai University
Department of MCA
Proposed Teaching Scheme w.e.f. 2023-2024

Semester-I										
Subject Code	**Subject**	**Teaching Scheme**			**Exam Scheme**					**Credit**
		T	**L**	**Tut**	**S**	**T**	**P**	**TW**	**Total**	
	Algorithm Development & Programming Fundamentals	4	2	0	36	60	25	25	150	5
	DataBase Management System	4	2	0	36	60	25	25	150	5
	Web Designing	4	2	0	36	60	25	25	150	5
	Computer Organization and Architecture	4	0	0	36	60	0	0	100	4
	Communication Skills	0	2	0	0	0	25	0	25	1
	Elective - I	4	0	0	36	60	0	0	100	4
	Computer Networks									
	Management Information Systems									
	Discrete Mathematics									
	Computer Oriented Numerical & Statistical Methods									
	Total								**675**	**24**
Semester-II										
Subject Code	**Subject**	**Teaching Scheme**			**Exam Scheme**					**Credit**
		T	**L**	**Tut**	**S**	**T**	**P**	**TW**	**Total**	
	Software Engineering & Testing	4	2	0	36	60	25	25	150	5
	Object Oriented Programming with Java	4	2	0	36	60	25	25	150	5
	Data Structures	4	2	0	36	60	25	25	150	5
	Pythong Programming	4	2	0	36	60	25	25	150	5
	Seminar Presentation	0	2	0	0	0	25	0	25	1
	Elective – II	4	0	0	36	60	0	0	100	4
	Operating System									
	System Analysis Design & Management									
	Analysis and Design of Algorithms									
	Research Methodology									
	Total								**725**	**25**

Semester-III										
Subject Code	**Subject**	**Teaching Scheme**			**Exam Scheme**					**Credit**
		T	L	Tut	S	T	P	TW	Total	
	Advanced Web Development	4	2	0	36	60	25	25	150	5
	Mobile Application Development	4	2	0	36	60	25	25	150	5
	Elective – III	4	0	0	36	60	0	0	100	4
	Cyber Security									
	Network Security									
	Blockchain Technology									
	Elective – IV	4	2	0	36	60	25	25	150	5
	Advanced Database Management Systems									
	Web Development with PHP									
	Cloud Computing									
	Artificial Intelligence									
	Internet of Things									
	Elective – V	4	2	0	36	60	25	25	150	5
	ASP .Net Programming with C#									
	Advanced Java Programming									
	Applied Machine Learning									
	Big Data Analytics									
	Total								**700**	**24**

	Semester-IV									
Subject Code	**Subject**	**Teaching Scheme**			**Exam Scheme**					**Credit**
		T	**L**	**Tut**	**S**	**T**	**P**	**TW**	**Total**	
	Project	0	40	0	0	0	400	300	700	20
	Total								**700**	**20**
	TOTAL								**2800**	**93**

Exam scheme indicates marks.

Teaching scheme indicates number of hours.

MCA
SEMESTER – I

MCA SEMESTER – I

SUBJECT : ALGORITHM DEVELOPMENT AND PROGRAMMING FUNDAMENTALS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course is designed to provide knowledge of programming fundamentals and fundamental constructs of the C programming language. Students will be able to develop logic for creating basic C programs.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to Program Development Life Cycle, Introduction to Flowchart, Symbols Used in Flowchart, Preparation of Flowchart, Advantages and Limitations of Flowchart, Development of Program Flowchart, Introduction to Pseudo Code. Introduction to Algorithm, Different Ways of Stating Algorithms, Key Features of an Algorithm and the Step-form, Variables, Subroutines, Strategy for Designing Algorithms, Tracing an Algorithm to Depict Logic, Specification for Converting Algorithms into Programs, Structured Programming Concepts.	09	CO1 CO3
[2]	Introduction, Standardizations of C Language, Structure of a Simple C Program, Concept of a Variable in C, Data Types in C, Program Statement, Declarations in C, Memory Storage of Data in Computer, C Tokens, Operators and Expressions in C, Type Conversion in C, Working with Complex Numbers, Basic Screen and Keyboard I/O in C, Non Formatted Input and Output, Formatted Input and Output Functions. Introduction to Compiler – Linker – Preprocessor in C.	10	CO2 CO5
[3]	Specifying Test Condition for Selection and Iteration, Writing Test Expression, Conditional Execution and Selection, Iteration and Repetitive Execution, Which Loop Should be Used?, Goto Statement, Special Control Statements, Nested Loops.	08	CO2 CO3 CO5
[4]	Introduction to Array, One-Dimensional Array, Declaration of a One dimensional Array, Initializing Arrays, Accessing Array Elements, Allowed Operations on Arrays, Internal Representation of Arrays in C, Variable Length Arrays, Working with One-dimensional Array, Strings: One-dimensional Character Arrays, Declaration of a String, String Initialization, Printing Strings, String Input, Character Manipulation in the String, String Manipulation, Introduction to Multidimensional Arrays, Declaration of a Two-dimensional Array, Declaration of a Three Dimensional Array, Initialization of a Multidimensional Array, Unsized Array Initializations, Accessing	10	CO2 CO3 CO5

	Multidimensional Arrays, Working with Two-dimensional Arrays, Understanding Array of Strings its Initialization and Manipulating.		
[5]	Introduction to Functions, Concept of Function, Need of Functions in a Program, Function Prototype Declaration, Function Definition, Function Calling, Call by Value Mechanism, Working with Functions, Passing Arrays to Functions, Concept of Global and Local Variables, Scope Rules, Storage Classes in C, Storage Class Specifiers for Variables, Storage Class Specifiers for Functions, Linkage, Inline Function, Constant Parameters in Functions. Introduction to Recursion, Basic Needs for Implementing Recursion, Implementing Recursion, Comparing Recursion and Iteration.	10	CO2 CO3 CO4 CO5
[6]	Introduction to pointers, Understanding Memory Addresses, Address Operator (&), Declaring a Pointer, Initializing Pointers, Indirection Operator and Dereferencing, Void Pointer, Null Pointer, Use of Pointers, Arrays and Pointers, One-dimensional Arrays and Pointers.	04	CO2 CO3 CO4 CO5
[7]	Introduction to Structures, Declaring Structures and Structure Variables, Accessing the Members of a Structure, Initialization of Structures, Copying and Comparing Structures, typedef and its Use in Structure Declarations, Arrays of Structures and its Initialization, Structures and Pointers, Structures and Functions, Union, Declaring a Union and its Members, Accessing and Initializing the Members of a Union, Structure Versus Union, Introduction to enum Datatype.	05	CO2 CO3 CO4 CO5
[8]	Using Files in C - Declaration of File Pointer, Opening a File, Closing and Flushing Files. Working with Text Files - Character Input and Output, End of File (EOF) Working with Binary Files - Direct File Input and Output, Sequential Versus Random File Access Files of Records - Working with Files of Records, Random Access to Files of Records	04	CO4 CO5

C. TEXT BOOKS

1. Pradip Dey and Manas Gosh,*Programming in C*; 2nd ed.; Oxford Publication.

D. REFERENCE BOOKS

1. V. K. Kapoor, *Introduction to Computer Data Processing and System Analysis*; Sultan Chand and Sons Publication.
2. Brian W. Kernighan and Dennis Ritchie, *C Programming Language;* 2nd ed.; Prentice Hall Publication
3. K. R. Venugopal, *Mastering C*; Tata McGraw Hill Publications.
4. Pradip Dey and Manas Gosh, *COMPUTER FUNDAMENTALS AND PROGRAMMING IN C* Second Edition; Oxford Publication.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Develop algorithms and flowcharts for a given problem.
CO2	Understand	Demonstrate programming fundamentals.
CO3	Apply	Interpret algorithms and Pseudocode to generate computer programs in C language.
CO4	Create	Develop modular programs for given basic problems.
CO5	Apply	Debug basic computer programs written in C language.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	3	3	3	3	-	2	-	2	-	3	-	2
CO2	3	2	2	1	2	-	2	-	2	-	2	-	2
CO3	1	2	2	2	1	-	2	-	2	-	2	-	2
CO4	2	2	3	2	3	-	2	-	2	-	3	-	2
CO5	2	1	2	2	2	-	2	-	2	-	1	-	2
Avg	2	2	2.4	2	2.2	-	2	-	2	-	2.2	-	2

MCA SEMESTER – I
SUBJECT : DATABASE MANAGEMENT SYSTEM

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The purpose of this course is to provide fundamentals of database management system focusing on how to create, organize and maintain structured information in database. The course covers in-depth knowledge of Entity-Relational model, Normalization, Relational model, Relational algebra as well as essential Transaction Processing concepts. It also includes PL/SQL programming concepts.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Database System Applications, Database Systems versus File Systems, View of Data, Database Languages, Database Design, Data Storage and Querying,, Transaction Management, Database System Structure, Database Users and Administrators , History of Database Systems.	04	CO1
[2]	Overview of Design Process, Entity Relationship Model, Constraints, E-R Diagrams, E-R Design Issues: Entity set vs Attributes, Binary vs N-ary Relationship set, Relationship Attributes, Reduction to Relational Schema, Extended E-R Features	06	CO2
[3]	Structure of Relational Databases, Keys, Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations	06	CO3
[4]	Overview of SQL Query Language ,SQL Data Definition, Basic Datatypes, Schema design, Insert Values, SQL Select query, SQL Alternation of Schema, SQL Modification of Data, SQL built-in Functions, SQL Aggregation, SQL Nested Subquery, SQL Join Expression	09	CO3
[5]	Feature of Good Relational Design, keys, Functional Dependency Theory, Normal Forms, Multivalued Dependency, Decomposition using Multivalued Dependency	06	CO2
[6]	Overview of Physical Storage Media, RAID, Storage Access, File Organization, Organization of Records in Files, Data Dictionary Storage	04	CO1
[7]	Basic Concepts, Ordered Indices, B+ Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Multiple Key Access	08	CO5
[8]	Transaction Concept, Simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, Serializability Concept, Transaction Isolation and Atomicity	05	CO6
[9]	Centralized and Client Server Architectures, Server System Architectures, Introduction to Parallel Systems and Distributed	03	CO1

	Systems, and Network Types		
[10]	Basic structure of PL/SQL block, Loops and Control Statements in PL/SQL blocks, Triggers in PL/SQL, Stored Procedure, Stored Functions , Cursor in PL/SQL block,Error handling in PL/SQL block	09	CO4

C. TEXT BOOKS

1. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, *Database System Concepts* ; 6th ed ; McGraw Hill Publication
2. Joel Murach, Mike Murach & Associates , *Murach's MySQL* 3rd ed;

D. REFERENCE BOOKS

1. Carlos Coronel, Steven Morris, Peter Rob, *Database Systems : Design, Implementation and Management;* Cengage Learning
2. Ramez Elmsari, Shamkant B Navathe, *Fundamentals of Database Systems;* 7th ed ;Pearson Education
3. S K Singh, *Database Systems : Concepts, Design and Applications* ; Pearson Education
4. www.mysqltutorial.org

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe building blocks,File Organization, Storage Media and importance of database management system
CO2	Analyse	Design robust relational database for a given problem
CO3	Apply	Construct relational database for a given problem
CO4	Apply	Demonstrate usage of procedural language in relational database environment.
CO5	Apply	Illustrate different indexing techniques
CO6	Understand	Explain transaction concepts

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	-	-	-	-	-	2	-	-	-	-	-	3
CO2	2	3	3	3	3	-	3	-	-	-	3	-	1
CO3	2	3	3	3	3	-	3	-	-	-	3	-	1
CO4	2	3	3	3	3	-	2	-	-	-	3	-	1
CO5	3	2	2	3	3	-	2	-	-	-	3	-	3
CO6	3	1	1	-	-	-	2	-	-	-	-	-	3
Avg	2.5	2.1	2.0	2.0	2.0	-	2.3	-	-	-	2.0	-	2.0

MCA SEMESTER – I
SUBJECT : WEB DESIGNING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course helps in creating effective web pages, including in-depth consideration of information architecture using HTML5, CSS and Javascript. Use various CSS layouts and models for responsive web design. Develop basic programming skills using Javascript for writing dynamic pages.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to HTML5, Understanding Basic Structure of HTML5 Document, Strict and Loose Type HTML5 Document, Validating HTML Document, Understanding DOCTYPE Element, Root Elements, Metadata Elements, Section Elements, Heading Elements, Introduction to Flow Elements, Introduction to Phrasing Elements, Introduction to Embedded Elements, Introduction to Interactive Elements.	08	CO1 CO2 CO4
[2]	Text Formatting with Physical Style Elements, Text Formatting with Logical Style Elements, Character Entities in HTML5, PRE Element, DIV Element, SPAN Element, Tables Element, Lists, Hyperlinks.	08	CO1 CO2 CO4
[3]	Inserting Image in a Web Page, Image Map, Introduction to Canvas, Exploring FORM Element, Observing Various INPUT Elements, Button Element, Progress Element, Meter Element, Output Element, Datalist Element, Textarea Element, Label Element, Select Element, Option Element, Optgroup Element, Submitting a Form, Details and Summary Element, Time Element, KBD Element, Video Element, Audio Element, Object Element, Figure and Figcaption Element. Introduction to Editable Content and Checking Spelling Mistakes, customdata attributes, Introduction to client side storage, Introduction to drag and drop, Introduction to geolocation API	10	CO1 CO2 CO4
[4]	Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Exploring Background of Webpage using CSS, Exploring Color and Gradient Properties in CSS, Exploring Font Properties in CSS, Exploring Padding and Margin Properties in CSS, Exploring Border Properties in CSS, Controlling the Display of an Element using CSS, Positioning of Element using CSS, Floating and Element using CSS Exploring Different Model in CSS – Box Model, Template Layout Model, Multi- Column Model. Exploring different types of effects in CSS - Opacity, Transition,	10	CO1 CO2 CO3 CO4

	Transformation, Animation		
[5]	Introduction to Java Scripting and <script>, Client-Side JavaScript, Advantages of JavaScript, Limitations of JavaScript, Placement of Script, JavaScript Data Types, JavaScript Variables, JavaScript Variable Scope, JavaScript Variable Names, JavaScript Reserved Words, Operators in JS, Control Statements in JAVASCRIPT, Introduction to Java Script Functions, Hoisting in Javascript, Introduction to Java Script Events, Introduction to Java Script Built-in Objects, Localization in HTML Document via JS and CSS. Introduction to Arrays in Javascript, Introduction to Objects in Javascript, Introduction to Classes and Modules in Javascript.	16	CO1 CO2 CO3 CO4
[6]	Introduction to Document Object in JS, Introduction to Cookies, Introduction to Document Object Model - Nodes and Levels, Verify type of nodes and its child nodes, Change Element value, Count nodes, adding and inserting nodes. Introduction to Browser Control using JS, Introduction to Form Validation using JS, Exploring errors and handling exceptions in validation	08	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. DT Editorial Service, *HTML 5 Black Book*; 2nd ed.; Dreamtech Press Publication

2. David Flanagan. JavaScript: The Definitive Guide 6E; O'ReillyPublications. (latest is 7E)

D. REFERENCE BOOKS

1. Will Train, *HTML 4.0*; BPB Publication.
2. Rob Crowther, Joe Lennon, Ash Blue and Greg Wanish, *HTML5 in Action;* Manning Publication
3. Mark Pilgrim, *HTML5 Up and Running - Dive into the Future of Web Development*; 5th ed.; O'Reilly Media Publication
4. A Smarter Way to Learn JavaScript The new approach that uses technology to cut your effort in half
5. Eloquent JavaScript, 3rd edition Marijn Haverbeke

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Express importance of building blocks for consistent and robust web design.
CO2	Apply	Design and Develop consistent, attractive and animated web pages
CO3	Apply	Validate user input in web pages.
CO4	Create	Create interactive web sites individually and in teams.
CO5	Create	Create scripted web pages using Javascript.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	1	2	2	1	-	1	-	1	-	1	-	2
CO2	3	2	3	2	3	-	3	-	3	3	2	-	2
CO3	1	2	3	1	2	-	3	-	2	2	2	-	2
CO4	2	2	1	2	2	-	2	-	2	2	2	-	2
CO5	3	3	3	2	3	-	1	-	2	2	3	-	2
Avg	2.4	2	2.4	1.8	2.2	-	2	-	2	1.8	2	-	2

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	0	4	4	60	40	25	0	125

A. COURSE OVERVIEW

This course is intended to teach the basics involved in data representation and digital logic circuits used in the computer system. It covers the general concepts of digital logic design, including logic elements, and their use in combinational and sequential logic circuit design. Provide insights in basic architecture of processing, memory and i/o organization in a computer system.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Generation of Computers, Analog and Digital Computer, Block Diagram of Computer, Positive and Negative Numbers, Integers and Reals, Number Systems: Binary, Octal, Decimal and Hexadecimal, Binary Addition, Subtraction, Multiplication and Division, r's and (r-1)'s Complement, Conversion from One System to Another, Characters and Codes ASCII, EBCDIC, UNICODE, Redundant Coding for Error Detection and Correction (Parity and Hamming Code)	9	CO1 CO2
[2]	Basic Gates & its Truth Tables, Boolean Algebra: Fundamental Concepts, Basic Theorem and Properties, Boolean Functions Canonical and Standard Forms, Sum of Product, Product of Sum, K-map Method, Don't Care Condition, Combination Circuit Design with Gates, Universal Gates Functionality.	11	CO1 CO3 CO4
[3]	Block Diagram of ALU, Binary Half and Full Adder, Decimal Adder, Binary Parallel Adder, BCD Adder, Half and Full Subtractor, Multilevel NAND Circuits, Multilevel NOR Circuits.	6	CO1 CO3 CO4
[4]	Encoder, Decoder, Multiplexer, Demultiplexer.	5	CO3 CO4
[5]	Flip Flops: RS, D, T, JK, Asynchronous, Synchronous and Master Slave, Shift Registers, Bidirectional Shift Register with Parallel Load Counters: Synchronous and Ripple Counter, Simple Arithmetic and logic Circuits.	10	CO3 CO4
[6]	Memory Hierarchy, Random Access Memory, Read Only Memory, Serial Access Memory, Direct Access Memory, Cache Memory and Overview of Virtual Memory and Auxiliary Memory.	6	CO5
[7]	Introduction to 8085 Microprocessor, 8085 Hardware Model, Programmable Registers, Instruction Format, Addressing Modes-Direct, Indirect, Immediate, Relative, Indexed, Addressing Formats: Zero, Single, Double, Register etc., Instruction Set, Instruction Execution, Fetch and Execution Cycles, RISC Architecture, CISC Architecture, Design Principles for Modern Computers.	7	CO1 CO5
[8]	Peripheral Devices, Properties of Simple I/O Devices and Their Controllers, Asynchronous Data Transfer, Handshaking, Data Transfer Modes, Programmed I/O, Interrupted I/O, DMA, Transfer of	6	CO5

	Information between I/O Devices, CPU and Memory.		

C. TEXT BOOKS

1. M. Morris Mano, *Digital Logic and Computer Design;* 2nd ed.; PHI
2. Ramesh S. Gaonkar, *Microprocessor Architecture, Programming and Applications with 8085;* 4th Ed.; Penram International Publishing PVT. LTD.
3. Andrew S. Tanenbaum, Todd Austin, *Structured Computer Organization*; 6th ed.; Pearson

D. REFERENCE BOOKS

1. M Morris Mano, *Computer System Architecture*; 3rd ed.; PHI
2. William Stallings, *Computer Organization and Architecture*; 6th ed.; PHI
3. Andrew S Tanenbaum, *Structure Computer Organization* ; 4th ed.; Pearson Education

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe role of various elements of computer organization and architecture.
CO2	Apply	Use various number systems for representation of data.
CO3	Apply	Derive boolean expression and digital circuit from a given logic design problem.
CO4	Understand	Interpret combinational and sequential logic circuit design.
CO5	Understand	Explain microprocessor architecture, I/O architecture and memory hierarchy.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	-	-	1	1	-	2	-	1	-	-	-	3
CO2	2	3	-	2	3	-	2	-	3	-	-	-	2
CO3	2	3	-	3	3	-	2	-	3	-	-	-	2
CO4	2	2	-	3	3	-	2	-	2	-	-	-	2
CO5	2	2	-	1	-	-	2	-	1	-	-	-	1
Avg	2	2	-	2	2	-	2	-	2	-	-	-	2

MCA SEMESTER – I

SUBJECT : COMMUNICATION SKILLS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac
-	-	2	2	1	-	-	-	25

A. COURSE OVERVIEW

The course is intended to familiarize students with the basics of English language and help them to learn to identify language structures for correct English usage. To enable the students to adopt strategies for effective reading and writing skills. It helps students to carry out day to day communication at the work place by adequate understanding of various types of communication to facilitate efficient interpersonal communication.

B. COURSE CONTENT

NO	TOPIC	Prac	COs
[1	Understanding Common Grammar Errors	4	CO1 CO3
[2]	Communication at Organisation Non-verbal Communication: Significance and Forms, Elements of Non- verbal Communication. Cross-cultural Communication: Concept, Different Communication Styles and Strategies. Technology-enabled Business Communication: Tools, Impact, Effec- tiveness. Self Presentation, Fromal Presentations	8	CO2 CO3 CO5
[3]	Types of Written Communication: Formal Letter, Notice, Circular, Memo, E-mail, Proposal, and Report Resume: Format, Types, Video Resumes, Send Resumes, Online Re-cruitment: Process and Techniques. Electronic Resume-HTML	8	CO3 CO5
[4]	Interviews: Principles, General Preparations, Follow up, Questions Group Discussion: Planning and Preparation, Steps.	4	CO3 CO4 CO5

C. TEXT BOOKS

1. Meenakshi Raman and Prakash Singh, *Business Communication;* Oxford University Press
2. Meenakshi Raman and Sangeeta Sharma, *Technical Communication;* Oxford University Press

D. REFERENCE BOOKS

1. Sangeeta Sharma & Vinod Mishra , *Communication Skills for Engineers and Scientists*; PHI
2. William Sanborn Pfeiffer and T. V. S. Padmaja, *Technical Communication*; Pearson

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Effectively use tenses and conditional sentences.
CO2	Analyze	Identify various means of professional communication.
CO3	Apply	Practice effective business writing and correspondence.
CO4	Apply	Exercise interviews and group discussion practices.
CO5	Apply	Enhance Professional Skills

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	1	-	2	-	2	-	-	-	-	-
CO5	2	-	-	-	-	1	1	-	2	-	2	-	-	-	-	-
Avg	1	-	-	-	-	0.4	0.6	-	1.8	-	0.8	-	-	-	-	-

MCA SEMESTER –I
SUBJECT: COMPUTER NETWORKS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

The course aims to provide understanding of computer networks and data communication. It covers various networking devices, layered task and Open Systems Interconnection (OSI) model. The course also introduces the learners to functionalities of various layers of OSI model.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction Data Communications, Networks: Network Criteria, Physical Structures like Types of connections, Topologies, Types of Networks and Network Models, The Internet, Protocols and Standards, Layered Tasks, The OSI Model, Layers in The OSI Model, TCP/IP Protocol Suit, Addressing.	08	CO1 CO5
[2]	Physical Layer Analog and Digital Data, Analog and Digital Signals, Periodic and Non-periodic Signals, Periodic Analog Signals, Digital Signals: Bit Rate, Bit Length, Transmission Impairment: Attenuation, Distortion, Noise, Data Rate Limits, Performance: Bandwidth, Throughput, Latency, Jitter. Digital-To-Analog Conversion, Analog-To-Analog Conversion, Multiplexing: Frequency-Division Multiplexing, Wavelength-Division Multiplexing Guided Media: Twisted-Pair Cable, Coaxial Cable, Fibre-Optic Cable, Unguided Media: Radio Waves, Microwaves, Infrared.	10	CO2 CO3
[3]	Data Link Layer Error Detection and Correction: Types of Errors, Redundancy, Detection versus Correction, Forward Error Correction versus Retransmission, Coding, Block Coding: Error Detection, Error Correction, Hamming Distance, And Minimum Hamming Distance, Cyclic Redundancy Check, Checksum: One's Complement, Internet Checksum, Framing: Fixed and Variable Size Framing, Flow and Error Control, Noiseless Channels: Simplest and Stop-and-Wait, Noisy Channels: Stop-and-Wait Automatic Repeat Request, Go-back-N Automatic Repeat Request Connecting Devices: Passive Hubs, Repeaters, Active Hubs, Bridges, Two-Layer Switches, Routers, Three-Layer Switches, Gateway.	12	CO2 CO3
[4]	Network Layer IPv4 Addresses: Address Space, Notations, Classful Addressing, Classless Addressing, Network Address Translation (NAT) IPv4: Segment Header Format, Datagram, Fragmentation, Checksum, and Options IPv6: Advantages, Packet Format, and Extension Headers, Forwarding Techniques, Forwarding Process, And Routing Table. Introduction to Unicast and Mul-	10	CO2 CO3 CO4

	ticast routing.		
[5]	Transport Layer Process-To-Process Delivery: Client/Server Paradigm, Multiplexing and Demultiplexing, Connectionless Versus Connection-Oriented Service, Reliable Versus Unreliable User Datagram Protocol (UDP): Well-Known Ports for UDP, User Datagram Checksum, UDP Operation, Use of UDP, TCP Services, TCP Features, Segment, Segment Header Format, A TCP Connection, Flow Control, Error Control, Congestion, Congestion Control, Quality of Service, Techniques to improve QoS.	80	CO3
[6]	Application Layer Name Space: Flat Name Space, Hierarchical Name Space Domain Name Space, Distribution of Name Space: Hierarchy of Name Servers, Zone, Root Server, Primary and Secondary Servers DNS in the Internet: Generic Domains, Country Domains, Inverse Domain, Resolution: Resolver, Mapping Names to Addresses, Mapping Address to Names, Recursive Resolution, Iterative Resolution, Caching, DNS Messages and Types of Records Introduction to Telnet, Overview of E-Mail, SMTP, FTP, WWW, HTTP	12	CO3 CO6

C. TEXT BOOKS

1. Behrouz Fourozan. *Data Communication and Networking; 4th ed.;* Tata McGraw-Hill Publications

D. REFERENCE BOOKS

1. Andrew S. Tanenbaum. *Computer Networks*; Prentice Hall Publications

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand Networking fundamentals, types of networks and connections
CO2	Apply	Practice Signals, error detection, correction and IP addressing
CO3	Understand	Interpret functionalities of OSI model layers
CO4	Apply	Illustrate use of IPv4 and IPv6 in computer networks
CO5	Understand	Design simple computer networks
CO6	Understand	Explain different protocols used at application layer i.e. HTTP, FTP, TELNET and WWW

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	-	1	-	-	-	3	-	2	-	1	-	2
CO2	3	3	3	-	-	-	2	-	2	-	3	-	2
CO3	3	2	1	-	-	-	3	-	2	-	1	-	2
CO4	2	3	3	-	-	-	3	-	2	-	3	-	2
CO5	2	2	2	-	-	-	2	-	2	-	2	-	2
CO6	3	2	1	-	-	-	2	-	2	-	2	-	2
Avg	2.7	2.4	1.8				2.5		2.0		2.0		2.0

MCA SEMESTER – I
SUBJECT: MANAGEMENT INFORMATION SYSTEMS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	25-	-	125

A. COURSE OVERVIEW

The course is intended to describe the role of information systems in business management. It covers the fundamentals of decision support systems and Enterprise Systems including E-commerce for business and explain the ethical and societal issues related to information systems.To train the students to develop the basic understanding of how ERP enriches thebusiness organizations in achieving a multidimensional growth.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Organizations and Information Systems, Impact of Information Systems on Organizations and Business Firms, Using Information Systems to Achieve Competitive Advantage Management Information System in a Digital Firm: Concept, Definition, Role of MIS, Impact of MIS, MIS and User, MIS as a Control System, MIS A Support to the Management, Management Effectiveness and MIS, Organization as System.	06	CO1
[2]	Introduction, Infrastructure Components, Contemporary Hardware Platform Trends, Management Issues, Dealing with Platform and Infrastructure Change, Management and Governance, Making Wise Infrastructure Investments Development of Long Range Plans of the MIS, Ascertaining the Class of Information, Determining the Information Requirement, Development and Implementation of MIS, Management of the Information Quality in the MIS, Organisation for Development of MIS, MIS: Development Process Model	05	CO1 CO2
[3]	Applications in Manufacturing Sector: Personnel Management, Financial Management, Production Management, Raw Materials Management, Marketing Management, Corporate Overview Applications in Service Sector: Introduction, Creating a Distinctive Service, Service Concept, Service Process Cycle and Analysis, Customer Service Design, Service Management System, MIS Applications in Service Industry.	08	CO1 CO3
[4]	Concept of Decision Support Systems (DSS), DSS Models, Group Decision Support Systems, AI System, Knowledge based Expert System, DSS Application in E-enterprise, MIS and the Benefits of DSS.	08	CO1
[5]	Enterprise Systems, Enterprise Software and Business Value, Supply Chain Management Systems and its Applications, Global Supply Chains and Internet, Business Value of Supply Chain Management Systems E-Commerce: E-Commerce and the Internet, E-Commerce: Business and Technology, The Mobile Digital Platform and Mobile E-Commerce, Building an E-Commerce Web Site.	10	CO1 CO5

[6]	Understanding Ethical and Social Issues Related to Systems, Ethics in an Information Society, The Moral Dimensions Of Information Systems.	05	CO4
[7]	Case Studies Relevant to the Topics.	06	CO1 CO2 CO3 CO4 CO5
[8]	Evolution of ERP, What is ERP?, Reason for the Growth of the ERP Market, Advantages of ERP, Why do many ERP Implementations Fail?, Why are ERP Packages being used now? Finance Sales and Distribution, Manufacturing Human Resources, Plant Maintenance, Quality Management, Purchasing, Marketing, Production Planning, Materials Management. Benefits of ERP: Reduction of Lead Time, On Time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Utilization, Improved Supplier Performance.	12	CO3, CO5

C. TEXT BOOKS

1. Waman S. Jawadekar, *Management Information Systems Texts and Cases;* 5th ed.; Tata McGrawHill Education Pvt. Ltd.
2. Alexis Leon, *Enterprise Resource Planning;* Tata McGraw Hill
3. Kenneth C Laudon and Jane P Laudon, *Management Information System*; 12th ed.; PHI, New Delhi.

D. REFERENCE BOOKS

1. S. Sadagopan, *Management Information Systems* ; PHI, New Delhi
2. Sanjay Mahapatra, *Cases in Management Information Systems*; PHI, New Delhi
3. Uma G. Gupta, *Management Information Systems*; Galgotia Publications
4. Alexis Leon, *ERP Demystified*; 2nd ed.; McGraw-Hill Education (India) Ltd., 2007

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Interpret the Role and Applications of Information Systems in Business Management.
CO2	Understand	Express Relationships Between Information Systems, Organization, Management and Strategy.
CO3	Understand	Explain the importance of information quality and the development process of MIS. Describe steps and activities in the ERP life cycle.
CO4	Understand	Summarize ethical aspects of the information system in professional practices and social issues.
CO5	Evaluate	Evaluate the applicability of relevant IT infrastructure in management of various business processes.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	3	2	-	-	2	2	2	-	2	-	-	2
CO2	2	2	2	-	-	2	2	1	-	2	-	-	2
CO3	2	1	2	-	-	2	2	3	-	2	-	-	2
CO4	1	2	2	-	-	3	2	1	-	2	-	-	2
CO5	3	2	2	-	-	1	2	3	-	2	-	-	2
Avg	2	2	2	-	-	2	2	2	-	2	-	-	2

MCA SEMESTER – I
SUBJECT: DISCRETE MATHEMATICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

This course focuses on fundamental concepts of discrete mathematics and its applications in computer science. Topics include logic, sets theory, probability, relation & functions, graph theory and group theory. It will help the learners to think logically for solving mathematical problem.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Definition of Sets, Venn Diagrams, Types of set, Finite, Infinite, Power, Countable and Uncountable Sets, Operations on Sets, Mathematical Induction, Principles of Inclusion and Exclusion, Propositions, Tautology and Contradiction	10	CO1 CO2
[2]	Rules of Sums and Products, Permutations, Permutation with Repetition of Objects, Restricted Permutation, Circular Permutation, Combinations, Restricted Combinations, Combinations with Repetition, Difference between Permutation and Combination. Probability: Important Definition, Theorems, Conditional Probability.	10	CO4
[3]	Relation: Definition, Domain and Range of Relation, Kinds of Relation, Types of Relation, Composition of Relations, Partial Ordering and Equivalent Relation Functions: Definition and Types of Functions, Composition of functions, Inverse of a Function and Pigeon-hole Principle.	12	CO3
[4]	Basic Terminology, Multi- and Weighted Graphs, Paths, Circuits, Eulerian Path, Traveling Salesman Problem, Isomorphic Graphs, Factors of a Graph, Planar Graphs, Operations on a Graph Trees, Rooted Trees, Path Length, Prefix Codes: Generation , Application, Spanning Trees, Transport Networks Using Ford-Fulkerson	14	CO5
[5]	Groups and Sub-Groups, Evaluation of Powers, Cosets, Lagrange's Theorem, Permutation Group and Burnsides Theorem, Group, Codes, Isomorphism, Automorphism, Homomorphism, Normal Subgroups, Rings, Integral Domains and Fields, Rings.	14	CO1

C. TEXT BOOKS

1. S. K. Chakraborty and B. K. Sarkar, *Discrete Mathematics*; Oxford University Press
2. Rosen K. H., *Discrete Mathematics and its Applications;* 7th ed.; Tata McGraw-Hill Pub. Co. Ltd.

D. REFERENCE BOOKS

1. Birkoff and Bartee, *Modern Applied Algebra;* McGraw-Hill, CBS
2. Stephen A. Wiitala., *Discrete Mathematics A Unified Approach*; Computer Science Series,McGraw-Hill

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand fundamentals of set theory and group theory.
CO2	Apply	Interpret propositions for given truth value.
CO3	Understand	Compare usage of relations and functions.
CO4	Apply	Solve relevant given problems using counting techniques.
CO5	Apply	Use graph theory for solving relevant mathematical problems.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	-	2	-	-	-	3	-	-	-	-	-	2
CO2	2	-	2	-	-	-	-	-	-	-	-	-	3
CO3	3	-	2	-	-	-	1	-	-	-	-	-	2
CO4	-	-	2	-	-	-	3	-	-	-	-	-	3
CO5	2	-	2	-	-	-	3	-	-	-	-	-	1
Avg	2	-	2	-	-	-	2	-	-	-	-	-	2.2

MCA SEMESTER – I

SUBJECT: COMPUTER ORIENTED NUMERICAL & STATISTICAL METHODS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

The course is intended to make the learner understand and use various concepts of numerical and statistical methods for solving relevant real life problems. It enables the learner to gain fundamentals of probability distributions, testing of hypotheses. It makes the learner solve numerical integration, algebraic/transcendental, ordinary differential equations and interpolation function.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction & Scope of Statistics, Scales of Measurements, Collection of data, Frequency Distribution (F.D.). Arithmetic Mean, Geometric Mean, Harmonic Mean, Median and Mode.	12	CO1 CO3
[2]	Mean Deviation, Standard Deviation, Coefficient of Variation, Coefficient of Skewness : Karlpearson's& Bowley's.	08	CO2 CO3
[3]	Introduction Probability, Addition Theorem – Examples, Multiplication Theorem – Examples, Conditional Probability Examples, Bayes theorem Examples	07	CO3
[4]	Random Sampling, Test of Hypothesis. Test of Significance of Attributes, Test of Significance of Variables for Large Samples and Small Samples.	09	CO3 CO4
[5]	Solution of Algebraic and Transcendental Equations: Bisection, False-Position, Newton-Raphson Methods Numerical Solution of Ordinary Differential Equations: Euler's Methods and Runge-Kutta (2nd and 4th) Methods.	10	CO3 CO6
[6]	Polynomial interpolation, difference tables, Newton forward and backward Interpolation formula, Extrapolation, Divided Differences, Lagranges formula, Newton's Divided Difference Formula, Inverse Interpolation. Trapezoidal rule, Simpson's 1/3 and 3/8 Rules.	14	CO3 CO5

C. TEXT BOOKS

1. S S Sastry, *Introductory Methods of Numerical Analysis*; 4th ed.; PHI Learning Pvt. Ltd.
2. S. P. Gupta, *Statistical Methods;* Sultan Chand & Sons

D. REFERENCE BOOKS

1. Bobby Srinivasan & C.L. Sandblom ,*Quantitative Analysis for Business Decisions ;* 1st ed.; McGraw Hill.
2. Manish Goyal, *Computer Based Numerical and Statistical Methods*; Laxmi Publications

(P) Ltd.

3. V. Rajaraman, *Computer Oriented Numerical Methods*; 3rd ed.; PHI Publication

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Compute various measures of central tendency.
CO2	Apply	Calculate and apply measures of dispersion – groupedand ungrouped datacases.
CO3	Understand	Use appropriatestatistical and numerical methods for a given problem.
CO4	Analyse	Identify suitable Test for a given hypothesis.
CO5	Apply	Interpret which interpolation and integration techniques should be used on given data.
C06	Apply	Apply numerical methods to solve equation using appropriate method for a given condition.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3	-	3	-	1	-	-	-	-	-	2
CO2	2	2	1	-	3	-	1	-	-	-	-	-	2
CO3	2	2	2	-	2	-	3	-	-	-	-	-	2
CO4	-	2	3	-	1	-	3	-	-	-	-	-	2
CO5	3	2	2	-	2	-	2	-	-	-	-	-	2
CO6	3	2	2	-	2		2						2
Avg	2.16	2	2.16		2.16		2						2

MCA
SEMESTER – II

MCA SEMESTER – II
SUBJECT : SOFTWARE ENGINEERING AND TESTING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course describes software engineering approaches and principles. Learners will gain knowledge of various software process models as well as phases of software development to impart a way of thinking about real world information system design problems and their solutions using various UML models. It covers various phases of the software testing life cycle enabling the learners to use various testing techniques. It introduces knowledge of various quality measures for software and development processes. The course also includes agile development and testing approaches used for software development.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Evolution an Engineering Discipline, A solution to the Software Crisis, Software Development Projects, Types of Software Development Projects, Exploratory Style of Software Development, Perceived Problem Complexity, Principles Deployed by Software Engineering to Overcome Human Cognitive Limitations, Emergence of Software Engineering, Early Computer Programming, High-level Language Programming, Control Flow-based Design, Data Structure-oriented Design, Data Flow-oriented Design, Object-oriented Design, Notable Changes in Software Development Practices.	05	CO1
[2]	Waterfall Model and its Extensions - Classical Waterfall Model, Iterative Waterfall Model, V-Model, Prototyping Model, Incremental Development Model, .Evolutionary Model. Rapid Application Development (RAD), Working of RAD, Applicability of RAD Model, Comparison of RAD with Other Models. Spiral Model, Phases of the Spiral Model, A Comparison of Different Life Cycle Models, Selecting an Appropriate Life cycle Model for a Project. Agile Development Models, Essential Idea behind Agile Models, Agile versus Other Models, Extreme Programming Model, Scrum Model.	06	CO1
[3]	Software Project Management Complexities, Responsibilities of a Software Project Manager, Project Planning - Sliding Window Planning, The SPMP Document of Project Planning. Metrics for Project Size Estimation - Lines of Code (LOC), Function Point (FP) Metric. Project Estimation Techniques - Empirical Estimation Techniques	06	CO1 CO3

	[Expert Judgement, Delphi Cost Estimation], Heuristic Techniques [COCOMO], Analytical Estimation Techniques [Halstead's Software Science]. Scheduling - Work Breakdown Structure, Activity Networks, Critical Path Method (CPM), PERT Charts, Gantt Charts. Organization and Team Structures, Staffing and its Estimation, .Risk Management, .Software Configuration Management		
[4]	Requirements Gathering and Analysis, Software Requirements Specification (SRS), Formal System Specification.	06	CO1 CO2
[5]	Overview of the Design Process, .Characterize a Good Software Design, Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design. Function-Oriented Software Design - Overview of SA/SD Methodology, Structured Analysis	03	CO1 CO2
[6]	The Importance of Modeling. Object-Oriented Modeling and Principles, An Overview and Conceptual Model of UML. Object Modelling Using UML - Basic Object-Orientation Concepts, .Unified Modelling Language (UML), UML Diagrams, Use Case Model, Class Diagrams, Interaction Diagrams, Activity Diagram, State Chart Diagram, Package, Component, and Deployment Diagrams, UML 2.0 Object-Oriented Software Development - Patterns, Some Common Design Patterns, Introduction to Object-Oriented Analysis and Design (OOAD) Methodologies [*Unified Process,Overview of The OOAD Methodology, Use Case Model Development, Domain Modelling, Identification of Entity Objects, Booch's Object Identification Method, Interaction Modelling, Class-Responsibility-Collaborator (CRC) Cards*], Applications of the Analysis and Design Process	08	CO2
[7]	Coding Standards and Guidelines, Code Review[Code Walkthrough, Code Inspection, Clean Room Testing], Software Documentation, Verification, Verification of Requirements, High-level and Low-Level Design, How to Verify Code? Validation, Validation Activities: Unit Testing, Integration Testing, Function Testing, System Testing, Acceptance Testing, Overview of Regression Testing Introduction to Testing, Effective and Exhaustive Testing, Software Testing Life Cycle (STLC), Definition and Goals of Testing, Black-box Testing [Equivalence Class Partitioning, Boundary Value Analysis], White-Box Testing [Basic Concepts, Statement Coverage, Branch Coverage, Multiple Condition Coverage, Path Coverage, McCabe's Cyclomatic Complexity Metric, Data Flow-based Testing, Mutation Testing], Debugging, Introduction Program Analysis Tools - Static and Dynamic, Integration Testing, Testing Object-Oriented Programs,	10	CO4

	Smoke Testing. Issues in OOT, Issues in testing Inheritance, Various OO Testing Techniques. Test Organization, Structure of Testing Group, Test Planning, Detailed Test Design and Test Specifications.		
[8]	Agility and Cost of Change, Agile Process, Extreme Programming, Introduction to Agile Process Models: Adaptive Software Development, Dynamic Systems Development Method, Scrum, Crystal, Feature Driven Development, Lean Software Development, Agile Modeling, Agile Unified Process, Advantages and Disadvantages of Agile. Agile Requirements Abstraction Model, Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modeling and Generation, Collaborative User Story Creation.	05	CO5
[9]	Agile Testing – Principles, Methods & Advantages, Agile Testing Quadrants: the Purpose of Testing, Technology- Facing Tests that Supports the Team, Overview of Agile Testing Methods: Test Driven, Acceptance Test Driven, and Behaviour Driven Development.	05	CO5
[10]	Need for Automation, Categorization of Testing Tools, Selection of Testing Tools, Cost Incurred in Testing Tools, Guidelines for Automated Testing, Overview of some Commercial Testing Tools.	03	CO6
[11]	Software Reliability, Software Quality, Software Quality Management System, ISO 9000 certification, SEI Capability Maturity Model, Software Process Improvement and Capability Determination (SPICE), Personal Software Process (PSP), Six Sigma.	03	CO6

C. TEXT BOOKS

1. Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI Publication
2. "Agile Software Development, Principles, Patterns and Practices", by Robert C. Martin, Prentice Hall
3. “Agile Testing – A Practical Guide For Testers And Agile Teams”, by Lisa and Janet

D. REFERENCE BOOKS

4. “Software Testing Principles and Practices“ by Naresh Chauhan, Oxford Publication
5. “The Unified Modeling Language User Guide” by Grady Booch, James Rumbaugh, and Ivar Jacobson. Low Price Edition, Pearson Education
6. ”Software Engineering A practitioner’s Approach”, 6th Edition, by Roger Pressman Mcgraw-Hill International Edition

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe the importance of software engineering approaches, principles, models and processes.
CO2	Create	Prepare robust software design using UML for given system requirements individually and in team.
CO3	Apply	Calculate basic estimates for project planning
CO4	Apply	Understand software testing life cycle and efficiently use modern testing techniques and tools to test software.
CO5	Understand	Demonstrate Agile software development and testing.
CO6	Understand	Understand significance of Automation tools, software reliability and quality measures for lifelong software practices

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	2	2	-	-	3	2	2	-	2	-	-
CO2	2	3	3	3	-	2	3	2	3	-	3	-	-
CO3	2	3	2	2	-	2	1	2	1	-	2	-	-
CO4	2	3	3	2	-	3	2	2	2	-	1	-	-
CO5	3	2	2	2	-	2	2	2	3	-	3	-	-
CO6	-	1	1	1	-	-	2	1	1	-	1	-	-
Avg	1.83	2.16	2.16	2	-	1.5	2.16	1.83	2	-	2	-	-

MCA SEMESTER – II

SUBJECT : OBJECT ORIENTED PROGRAMMING WITH JAVA

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course provides the basic concepts and fundamentals of platform independent object oriented programming language. Provides hands-on experience in writing, compiling, and executing Java programs. Enables to build cross platform robust applications.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Object Oriented Paradigm, Concepts of Object Oriented Programming (OOP): Object and Class, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Communication, Benefits of OOP, Applications of OOP .	05	CO1 CO2
[2]	History of Java, Salient features of Java, How Java Differs from C, Java and Internet, Java and World Wide Web, Java Development Kit, Using JDK's Command-line tools, Application Programming Interface. A Simple Java Program, Identifying a Class, Using predefined classes, Defining your own Class, Object Construction, Access Specifiers, Data types, Variables and Constants, Operators, Strings & String Buffer, Input & Output, Control Flow, Arrays, Conversions, Static Fields & Methods, Constructors, Packages, Documentation Comments.	09	CO1 CO2
[3]	Classes, Super Classes & Subclasses, Object – The Universal Superclass, Wrapper Classes, Reflection, Enumeration Classes, Inner Classes, the Interface Concept, Properties of Interfaces, Interfaces and Abstract Classes, Static and Private Methods, Default Methods, Interfaces and Callbacks, Object Cloning, The Comparator Interface.	10	CO1 CO2
[4]	Java Collection Framework: Separating Collection Interfaces and Implementation, Collection Interface, Iterators, Generic Utility Methods, Interfaces in the Collections Framework Concrete Collections: Arraylist, Linkedlist, Hashset, Tree Sets, Queues Lambda Expression: Why Lambdas?, Syntax Of Lambda Expression, Functional Interfaces, Method References, Constructor References, Variable Scope, Processing Lambda Expressions.	10	CO2 CO3 CO4
[5]	Classification of Exceptions, Exception Handling Techniques, User Define Exception, The Finally Clause, Thread Basics, Thread States, Thread Properties, Implementation of Thread Class and Runnable Interface, Thread Synchronization.	08	CO2 CO4
[6]	Creating Frame, Frame Properties, The Delegation Event Model, Basics of Event Handling, Specifying Listeners Concisely, The AWT Event Hierarchy, Implementation of Click Event.	05	CO2 CO4 CO6
[7]	Streams, Text Input and Output, Reading Writing Binary Data, Object Streams and Serialization, Zip Archives, String Tokenizer, Working With Files, JDBC Architecture, Basic JDBC Programming Concepts	08	CO4 CO5 CO6

	(Making Connection, Creating Statement and Executing Query), Classes of Java.sql.		
[8]	Introduction to Networking, Introduction to Client/Server Programming, Introduction to Socket Programming.	05	CO2 CO4

C. TEXT BOOKS

1. Cays Horstmann, Gary Cornell, *Core Java volume I & II*; 11th ed.; Pearson Education
2. Herbelt Schildt, *The Complete Reference JAVA 2;* 11th ed.; Tata McGraw Hill
3. E Balagurusamy, *Programming with Java*; Tata McGraw Hill

D. REFERENCE BOOKS

4. Y. Danial Liang, *Introduction to Java Programming*; Pearson
5. Rajkumar Buyya, *Object Oriented Programming with Java*; Tata McGraw Hill

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Demonstrate object-oriented principles using Java Programming language.
CO2	Understand	Explain the importance of multithreading and client server programming in Java.
CO3	Analyse	Determine suitable data structures from Collection Framework for solving given problems.
CO4	Create	Develop robust and database centric applications using Java.
CO5	Apply	Implement file handling and file management in Java.
CO6	Apply	Illustrate basic Interactive application development using Java.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	1	1	1	3	-	3	2	-	2	2	-	2
CO2	2	2	1	2	2	-	3	1	-	2	1	-	2
CO3	2	3	3	2	3	-	2	1	-	-	3	-	2
CO4	3	3	3	3	2	-	3	3	-	3	3	-	2
CO5	2	3	2	3	3	-	2	3	-	2	3	-	2
CO6	2	2	2	2	2	-	1	2	-	3	3	-	2
Avg	2.3	2.3	2	2.16	2.5	-	2.3	2	-	2	2.5	0	2

MCA SEMESTER – II

SUBJECT : DATA STRUCTURES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course provides basic concepts, importance and applications of various data structures such as array, stack, queue, linked list, tree, and graph. Enables to implement various data structures efficiently. The subject enables examine working of various sorting and searching techniques. Provides awareness in algorithm analysis and dynamic memory management.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to Pointers, Arrays and Pointers, Passing an Array to a Function, Differences Between Array Name and Pointer, Pointers and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointers To an Array, Two-dimensional Arrays and Pointers, Passing Two dimensional Array to a Function. Introduction to Dynamic Memory Allocation, Dynamic Allocation of Arrays, Freeing Memory, Reallocating Memory Blocks, Memory Leak and Memory Corruption, Pointer to Constant, Constant Pointers.	10	CO1 CO2
[2]	Data Structures, Classification of Data Structures, Operations of Data Structures, Define Abstract Data Types. Introduction to Algorithms, Approaches of Designing an Algorithm, Control Structures used in Algorithms, Understanding Basics of Time Complexity, Introduction to Asymptotic Notation, Rate of Growth in Algorithm, Basics of Storage Management.	05	CO1 CO3
[3]	Introduction to Stack, Applications of Stack, Representation of Stack using Array, Implementation of Operations on Stack Using Array, Implementation of Applications of Stack. Introduction to Queue, Applications of Queue, Representation of Queue using Array, Implementation of Queue Operations, Understanding Circular Queue. Introduction to Priority Queue and its Operations, Introduction to Dqueue and its Operation.	12	CO1 CO2 CO3 CO5
[4]	Introduction to Singly Linked List, Representation of Singly Linked List using Array and Pointer, Implementing Operations on Singly Linked List – Insertion as a First Node, Head Node, Insertion as a Last Node, Insertion of a Node at Specific Location, Deletion of First Node, Deletion of Last Node, Deletion of a Desired Node, Searching for the Particular Element in List, Sorting the Linked List, Reversing the Linked List, Traversing a Linked List. Introduction to Doubly Linked List, Representation of Doubly Linked	14	CO1 CO2 CO3 CO4 CO5

	List, Implementing Operations of Doubly Linked List – Insertion as a First Node, Insertion as a Last Node, Insertion of a Node at Specific Location, Deletion of First Node, Deletion of Last Node, Deletion of a Desired Node, Searching for the Particular Element in Doubly Linked List, Sorting the Doubly Linked List, Traversing a Linked List. Introduction to Circular Linked List, Representation of Circular Linked List, Implementing Operation of Circular Linked List – Inserting and Deleting a Node in Circular Linked List, Traversing a Circular Linked List Implementing Stack and Queue Operations using Singly Linked List.		
[5]	Definition of Tree, Representation of Tree, Basic Terminology of Tree, Types of Tree. Binary Tree, Types of Binary Tree, Conversion of General Tree to a Binary Tree, Understanding and Implementing Binary Tree Traversal, Constructing a Binary Tree from Traversal Results, Storage Representation and Manipulation of Binary Tree, Applications of Tree. Binary Search Trees, Operations on Binary Search Trees – Searching for a Node in a Binary Search Tree, Inserting a New Node in a Binary Search Tree, Deleting a Node from a Binary Search Tree, Determining the Height of a Binary Search Tree, Determining the Number of Nodes, Finding the Smallest Node in a Binary Search Tree, Finding the Largest Node in a Binary Search Tree, Traversal and Search in Binary Search Tree, Implementation of Basic Operation in Binary Search Tree, Representation of AVL Tree, Understanding Insertion and Deletion in AVL Tree, Determining Height in an AVL Tree. Definition of Graph, Representation of Graphs, Types of Graph, Graph Traversal, Graph Traversal and Spanning Forest, Minimum Spanning Tree, Finding the Shortest Path.	14	CO1 CO2 CO3 CO4 CO5
[6]	Linear Search, Binary Search Sorting Methods, Internal and External Sorting, Bubble Sort, Quick Sort, Merge Sort, Insertion Sort.	05	CO1 CO2 CO3 CO4 CO5

C. TEXT BOOKS

1. Reema Thereja, *Data Structures Using C*; 2nd ed.; Oxford University Press.
2. R. B. Patel , *Expert Data Structures with C*

D. REFERENCE BOOKS

3. Sanjay Pahuja, *A Practical Approach to Data Structures and Algorithms*; New Age International Publishers
4. Y. Langsam, M. J. Augenstein, A. M. Tenenbaum, *Data structures using C and C++*
5. Yashvant Kanetkar, *Pointers in C*; BPB Publications.
6. Yashvant Kanetkar, *Data Structures Through C;* BPB Publications.
7. Jean-Paul Trembley and Paul G. Sorenson, *An Introduction to Data Structures with Applications*; 2nd ed.; Tata McGraw Hill Publications.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Create	Implement suitable data structure to solve given societal problems
CO2	Apply	Exercise dynamic memory management using C language.
CO3	Understand	Summarize data structures algorithms and its applications.
CO4	Apply	Illustrate various searching and sorting algorithms.
CO5	Create	Develop computing solutions for given problems using appropriate data structures.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	3	2	2	1	-	3	-	2	-	2	-	2
CO2	3	2	2	2	3	-	3	-	2	-	2	-	2
CO3	1	1	1	1	1	-	1	-	1	-	1	-	1
CO4	2	3	2	2	2	-	2	-	2	-	2	-	2
CO5	3	2	3	3	3	-	3	-	2	-	3	-	3
Avg	2.2	2.2	2	2	2	-	2.4	-	1.8	-	2	-	2

MCA SEMESTER – II
SUBJECT : PYTHON PROGRAMMING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course helps the learners build foundation in programming using Python. The course covers various Python standard libraries and object-oriented features. The course also covers working with Python modules, sequences, exception handling and interfacing databases.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction to Python Programming Environment, Writing and Executing Basic Python Program. Data types: Built-in Types, str, bytes, Literals, type() function. Operators: Arithmetic, Assignment, Relational, Logical, Boolean, Bitwise, Membership, Identity. Input & Output statements, Command line arguments. Control Statements: if, else, elif, while, for, break, continue, pass, assert, return.	06	CO1 CO2
[2]	List: create, update, delete elements, list methods, indexing and slicing. Tuple: create, basic operations, functions to process tuple. Dictionary: create, update, delete elements, dictionary methods.	08	CO1 CO2
[3]	Difference between Function and Method, Create and Use Function, Return Multiple Results from Function, Pass by Object Reference. Arguments: Positional, Keyword, Default, Variable length. Local and Global Variables, Global Keyword, Passing group of Elements to Function. Anonymous Functions: Using Lambdas with: filter(), map() and reduce()	10	CO1 CO2
[4]	Create Class and its Objects, Self variable, Constructor, Destructor, Instance methods, Class methods, Static methods. Inheritance: Constructors in Inheritance, Overriding Super Class Constructors and Methods, super(), Method Overloading and Overriding.	08	CO1 CO2
[5]	Types of Errors, Exceptions, Handling Exceptions, Types of Exceptions, Assert and Except Statements, User defined exceptions.	04	CO1 CO3
[6]	Introduction, Working with MySQLdb module, Establish connection, Create database and table, CRUD operations, Invoke stored procedure.	06	CO1 CO3
[7]	Introduction: single and multitasking, Difference between Process and Thread. Create Thread: Without Using a Class, Using a Thread Class. Thread Class Methods, Single Tasking Using a Thread, Multitasking Using Multiple Threads. Thread Synchronization, Communication between Threads.	06	CO1 CO3
[8]	numpy arrays: zeros(), ones(), reshape(), hstack(), vstack(), arange(), linspace(), logspace(), asarray(), dot(), matmul(), indexing and slicing.	06	CO1 CO2

	pandas: Work with Series and Dataframe: create, delete rows and columns, index and select data, handle missing data, methods and functions. Matplotlib: Plotting- bar chart, pie chart, area chart, line chart, histogram.		CO3
[9]	Django Introduction, Setup environment, Create project, Life Cycle, Admin Interface, Create Views, Models, Page Redirection, Process Form.	06	CO1 CO6

C. TEXT BOOKS

1. R Nageswara Rao. *Core Python Programming; 2nd Edition*; Dreamtech press

D. REFERENCE BOOKS

1. https://www/djangoproject.com
2. John V Guttag. *Introduction to Computation and Programming Using Python; 6th edition*; Prentice Hall of India
3. Sanjeev Jaiswal and Ratan Kumar. *Learning Django Web Development*; PACKT

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe role of Python language constructs
CO2	Apply	Implement object-oriented applications
CO3	Apply	Develop general purpose and scientific applications with or without backend database support
CO4	Apply	Plot diversified charts
CO5	Create	Create basic web applications

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3	2	2	-	2	-	2	1	2	1	2
CO2	3	3	2	2	3	-	2	-	2	3	2	3	2
CO3	2	1	1	2	3	-	2	-	2	1	2	2	2
CO4	2	2	2	2	2	-	2	-	2	3	2	2	2
CO5	2	2	2	2	2	-	2	-	2	2	2	2	2
Avg	2.4	2	2	2	2.4	-	2	-	2	2	2	2	2

MCA SEMESTER – II

SUBJECT : SEMINAR RESENTATION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
-	-	2	2	1	-	-	-	25	25

A. COURSE OVERVIEW

The course aims to develop learners' communication, presentation and report writing skills lifelong. It enables the learner strengthen and practice discussion abilities, develop internet research skills, increase vocabulary, improve reading and listening comprehension & build confidence for oral communicative purposes.

B. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Independently explore and identify a suitable technological topic.
CO2	Understand	Find relevant literature for a given technological topic individually and in a team.
CO3	Analyse	Perform detailed literature review on the identified topic to pursue lifelong learning.
CO4	Create	Summarise literature and Prepare detailed informative report individually and in a team based on the reviewed literature.
CO5	Create	Prepare an effective presentation.
CO6	Apply	Deliver presentation to the individuals and groups to practice lifelong in a professional environment.

C. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	-	-	2	2	3	-	1	2	2	-	2
CO2	3	2	-	-	2	2	3	-	2	2	2	-	2
CO3	2	3	-	-	2	2	2	-	2	2	2	-	2
CO4	2	2	-	-	2	2	2	-	2	2	2	-	2
CO5	2	2	-	-	2	2	3	-	2	2	2	-	2
CO6	1	1	-	-	2	2	3	-	3	2	2	-	2
Avg	2.16	2.0	-	-	2.0	2.0	2.66	-	2.0	2.0	2.0	-	2.0

MCA SEMESTER – II

SUBJECT : OPERATING SYSTEM

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

This course explains building blocks of operating system such as process management, memory management, deadlock management and disk scheduling. The course covers usage basic linux commands.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Basic Elements, Processor Registers, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory Operating System: Introduction, Objectives, Functions, Evolution, Major Achievements, Characteristics of Modern Operating System.	9	CO1
[2]	Process Concept, Process States, Process Control, Process Scheduling: Types and Al- gorithms : FCFS, Round Robin ,SPN, SRT , Introduction to Threads: Process and Thread,Thread Syncronaization,Types of Thread, Principles of Concurrency, Semaphores, Monitors, Reader/Writer Problem Deadlock: Introduction, Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection.	20	CO2 CO3
[3]	Memory Management Requirements, Memory Partitioning, Paging, Segmentation, Virtual Memory Terminology, Hardware and Control Structures : Locality and Virtual Memory, Virtual Memory, Paging,Page Table Structure,Inverted Page Table,TLB,Page size, Segmentation Operating System Software.:Introduction, Fetch Policy, Placement Policy, Replacement Policy and algorithms(LRU, Optimal, FIFO, CLOCK)	19	CO2 CO4
[4]	Disk Scheduling Concepts and Policies (FIFO,SSTF,SCAN,CSCAN), File Management Overview, File Organization and Access,	07	CO2
[5]	Linux Directory Structure Basic commands: who, whoami ,man, ps , pwd, echo Directory Handling Command: cd ,mkdir, rmdir File Handling Command: cat,cp,mv,rm, wc, chmod	05	CO5

C. TEXT BOOKS

1. William Stalling, *Operating Systems: Internals and Design Principles;* 6th ed.; Prentice Hall India
2. Sumitabha Das, *UNIX- Concepts and applications*; 4th ed.; TMH Publication

D. REFERENCE BOOKS

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Principles;* 9th ed.; Wiley-Indian
2. A. S. Tanenbaum, *Modern Operating Systems;* 4th ed.; PHI

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Express significance of the operating system and its various building blocks.
CO2	Analyze	Contrast various algorithms for process scheduling, memory management and disk scheduling.
CO3	Understand	Justify the importance of concurrency control and deadlock management.
CO4	Understand	Explain Importance of memory management concepts
CO5	Understand	Discuss usages of basic linux commads, file and directroy handling command

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	-	-	-	-	-	2	-	-	-	-	-	2
CO2	2	3	-	-	-	-	3	-	-	-	-	-	2
CO3	3	2	-	-	-	-	2	-	-	-	-	-	2
CO4	3	3	-	-	-	-	2	-	-	-	-	-	2
CO5	2	2	-	-	-	-	1	-	-	-	-	-	2
Avg	2.6	2.0			-	-	2	-	-	-	-	-	2

MCA SEMESTER – II

SUBJECT: SYSTEM ANALYSIS DESIGN AND MANAGEMENT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	125

A. COURSE OVERVIEW

The course covers various stages of information system development life cycle. It also emphasizes on analytical techniques to develop analysis and design solutions for business problems and user requirements. It enables the learners to understand essential concepts of Project Management and cost estimation.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Overview of Information System, Information Technology, Information System Components, Business Process Modeling – Business Information System, Characteristics of Information System, Types of Business Information System -Organizational Structure, Systems Development Techniques and Tools, Role of System Analyst.	05	CO1
[2]	Technical, Operational and Financial Feasibility, Request Approval, Project Selection Requirement and Methods, Steering Committee, Information System Group, Scope, Boundary and Objective of the Project Undertaken.	07	CO2
[3]	Structured English, Decision Tables, Methods of Performing Cost Benefit Analysis, System Logical and Physical Design, Selection of Hardware and Software, Criteria to Evaluate Hardware and Software.	05	CO4
[4]	Data Flow Analysis, Developing Logical Model Of the System Using Data Flow Diagram, Data Dictionary, HIPO Chart, Visual Table of Content, System Flow Chart, Data Structure Diagram.	08	CO4
[5]	System, Design, Operational, User, Time Chart, Budget Chart.	03	CO4 CO5
[6]	Planning, Equipment Installation, Program Developments, Design and Documentation of Software, Program and System Testing, Errors, File Conversions, User Training, Performance Evaluation of the System, Quality Assurance, Post-Implementation Review.	06	CO5
[7]	Project, Project Management, Relationships among Portfolio, Program, Project and Organizational Management, Relationship Between Project, Operations and Organizational Strategy, Business Value, Role and Responsibilities Of Project Manager.	08	CO3 CO6
[8]	Organizational Influences on Project Management, Project Stakeholders and Governance, Project Team, Project Life Cycle.	04	CO3 CO6
[9]	Common Project Management Process Interactions, Project Management Process Groups, Initiating, Planning, Executing, Monitoring and Controlling, Closing Process Group, Project Information, Role of the Knowledge Areas.	07	CO6
[10]	Process Metrics, Project metrics, Halstead's Software Science, Function Point(FP), Cyclomatic Complexity Measures; Software Project Estima-	07	CO2

	tion Models- Empirical, Putnam, COCOMO Estimating Size with Story Points, Velocity, Estimating Time: Ideal Days for Estimated Size, Techniques for Estimation: Estimates Shared, Estimation Scale, Derive Estimation, Planning Poker.		

C. TEXT BOOKS

1. Henry Lucas, *Analysis, Design and Implementation of an Information System*; McGraw Hill
2. James Senn, *Analysis and Design of an Information System*; McGraw Hill
3. Uma Gupta, *Management Information Systems, A Managerial Perspective*; Galgotia Public- ations Pvt Ltd
4. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*; 5th ed.

D. REFERENCE BOOKS

5. H. Lucas, *Information System Concept for Management*; McGraw Hill
6. Cleland and King, *System Analysis and Project Management*; McGraw Hill

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Explain the importance of structured approach of system analysis and design in software development.
CO2	Apply	Perform feasibility study for evaluating scope of the system and Practice software estimation for software project planning.
CO3	Understand	Understand the significance and practice to comply with ethics in system development.
CO4	Understand	Explain the structured approach of analysis and development.
CO5	Analyse	Prepare software analysis and design deliverables for specified requirements individually and in team.
CO6	Understand	Associate Project management principles and processes for lifelong software development practice.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	-	-	-	-	2	1	1	-	-	-	-
CO2	2	2	3	-	-	2	3	2	3	-	3	-	-
CO3	1	2	2	-	-	3	2	1	1	-	2	-	-
CO4	3	3	2	-	-	2	2	1	2	-	3	-	-
CO5	3	2	3	-	-	2	2	3	3	-	3	-	-
CO6	2	1	2	-	-	2	2	3	2	-	-	-	-
Avg	2.2	2.0	2.4	-	-	2.2	2.2	1.8	2.0	-	2.8	-	-

MCA SEMESTER – II

SUBJECT : ANALYSIS AND DESIGN OF ALGORITHMS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	125

A. COURSE OVERVIEW

The course provides important algorithmic design paradigms and methods of analysis. It will enable learners carry out analysis of various algorithms for mainly time and space complexity. It will make learners familiarize with specific algorithms for a number of important computational problems like sorting, searching, graphs etc. and introduce the concept of NP-complete problems.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Fundamentals of Mathematics: Role of Algorithms in Computing, Mathematics for Algorithmic Sets, Data Structures: Array, Stack and Queue, Pointers, Linked List, Graph, Tree, Associative Table	05	CO2
[2]	The Efficient Algorithm, Average, Best and Worst Case Analysis, Elementary Operation, Asymptotic Notations, A Notation for "The Order Of", Analysing Control Structures: Loop Statements, Recursive Calls, Correctness of Algorithms, Sorting Algorithms and Analysis: Bubble Sort, Selection Sort, Amortized Analysis.	10	CO1 CO2
[3]	Introduction, Recurrence and Different Methods to Solve Recurrence, Multiplying Large Integers Problem, Problem Solving using Divide and Conquer Algorithm - Binary Search, Max- Min Problem, Matrix Multiplication.	09	CO3
[4]	Types of Graphs: Undirected, Unidirectional, Bidirectional Graphs, Traversing Graphs, Graph Search: Depth First Search and Breadth First Search.	05	CO3 CO4
[5]	Greedy Algorithm: Introduction and Characteristics, Spanning Tree, Minimum Spanning Tree: Kruskal's Algorithm, Prim's Algorithm, Shortest Path Algorithm.	09	CO3 CO4
[6]	Introduction, The Optimality Principle, Problem Solving using Dynamic Programming: All Points Shortest Path, Matrix Chain Multiplication, Longest Common Subsequence, Knapsack Problem.	10	CO4
[7]	Back Tracking: General Strategy, N-Queen's Problem, Traveling Salesman Problem.	06	CO4
[8]	Basic Concepts: Non-Deterministic Algorithms, The Classes NP Hard and NP complete.	06	CO4 CO5

C. TEXT BOOKS

1. Thomas Cormen, Charles Leiserson, Ronald Rivest, Clifford Stein, *Introduction to Algorithms* ; 3rd ed.; PHI
2. Gilles Brassard, Paul Bratley, *Fundamentals of Algorithmics*; PHI
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, *Computer Algorithms*; Computer Science Press

D. REFERENCE BOOKS

4. Prabhakar Gupta, Vineet Agarwal, Manish Varshney, *Design and Analysis of Algorithms*; PHI
5. Parag Dave, Himanshu Dave, *Design and Analysis of Algorithms*; 2nd ed.; Pearson Education

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe importance of efficient algorithm design, algorithm complexity and asymptotic notations
CO2	Analyse	Estimate complexity of given algorithm.
CO3	Analyse	Identify an appropriate algorithmic approach for solving a given problem.
CO4	Understand	Demonstrate various graph based searching and traversal techniques.
CO5	Understand	Understand basic concepts of P, NP and NP-complete problems.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	2	3	-	-	2	-	-	-	2	-	2
CO2	1	2	3	2	-	-	2	-	-	-	2	-	2
CO3	2	2	3	3	-	-	2	-	-	-	2	-	2
CO4	2	2	2	2	-	-	2	-	-	-	2	-	2
CO5	1	2	-	-	-	-	2	-	-	-	2	-	2
Avg	2	2	2	2	-	-	2	-	-	-	2	-	2

MCA SEMESTER – II

SUBJECT : RESEARCH METHODOLOGY

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	125

A. COURSE OVERVIEW

The purpose of this course is to let the learners understand methodology, processes and criteria for good research. The course covers various aspects of defining research problem and its design. Various methods about designing samples and data collection also are covered. The course also includes statistical data analysis techniques and aspects of writing basic research report.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Meaning of Research, Objective, Motivation, Types, Approaches, Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.	10	CO1
[2]	Introduction to Research Problem, Selecting the Problem, Necessity of Defining the Problem, Meaning of Research Design, Need for Research Design, Future of a Good Design, Important Concepts Relating to Research Design, Different Research Design, Basic Principals of Experimental Designs.	12	CO1
[3]	Census and sample survey, Implications of a Sample Design, Steps in sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of sample Designs, How to Select a Random Sample. Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.	12	CO1 CO2 CO3
[4]	Processing Operation, Types of Analysis, Statistics in Research, Measure of Central Tendency, Measure of Dispersion, Measure of Asymmetry, Measure of Relationship, Basic Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association of Attributes, Other Measures.	14	CO4
[5]	Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Significance of Report Writing, Deferent Steps in Writing Report. Layout of the Research Report, Types of Report, Oral Presentation, Mechanics of Writing a Research Report, Precautions for	12	CO5

	Writing a Research Report.		

C. TEXT BOOKS

1. C. R. Kothari, *Research Methodology Methods and Techniques; 2nd ed.; New Age International Publishers*

D. REFERENCE BOOKS

2. Ranjit Kumar, *Research Methodology a step-by-step guide for beginners; 3rd ed.; Sage Publications*
3. D. K. Bhattacharyya, *Research Methodology; Excel Books Publication.*
4. B.L. Garg, Renu Kavdia, Sulochana Agrawal and U.K. Agrawal**,** *An Introduction to Research Methodology;* RBSA PUBLISHERS.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand significance and general characteristics of research design
CO2	Apply	Contrast sampling design techniques
CO3	Understand	Differentiate data collection methods
CO4	Apply	Apply relevant basic statistical methods required for a given research design
CO5	Apply	Express data interpretation techniques and report writing

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	-	2	-	-	2	2	-	2	-	2	3	-
CO2	2	-	3	-	-	2	2	-	2	-	2	2	-
CO3	2	-	2	-	-	2	2	-	2	-	2	-	-
CO4	2	-	3	-	-	2	2	-	2	-	2	2	-
CO5	2	-	-	-	-	2	2	-	2	-	2	3	-
Avg	2.2	-	2	-	-	2	2.2	-	2	-	2	2	-

MCA Semester - III

MCA SEMESTER – III
SUBJECT: ADVANCED WEB DEVELOPMENT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course enables learners to build dynamic web applications using AJAX, jQuery and ReactJS. It covers basic aspects of developing server side programs using Node.JS.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction, Adding JQuery Code to HTML Page, JavaScript Vs JQuery, The Document Object Model, $() Function, CSS Selectors, Custom Selectors, DOM Traversal, Accessing DOM Elements, Page Load Events, Simple Events, Compound Events, Event Object, Remove Event Handler, Simulating User Interaction.	7	CO1 CO2 CO3
[2]	Inline CSS Modification, Basic Hide & Show, Effects & Speed, Custom Animations, Simultaneous Versus Queued Effects, Attribute Manipulation, DOM Tree Manipulation, Copying Elements, Content Getter & Setters. Loading Data on Demand using AJAX, Data Formats, Passing Data to Server, Deliver Content based on Ajax Requests, Introduction to Error Handling and Events in AJAX.	7	CO1 CO2 CO3
[3]	Introduction, The MVC architectural pattern, Installing and configuring MongoDB, Installing Node.js, Installing npm packages Introduction, Node programming basics, Buffers, Events and Event Emitters, Streams, Working with Files, HTTP Client and Servers, Non HTTP Network Clients and servers, Working with Child Processes, Worker Threads Introduction, Routing in ExpressJS, Route methods, Route handlers, Chainable route methods, Modular route handlers, middleware functions, configurable middleware functions, router-level middleware functions, error-handler middleware functions, Using ExpressJS' built-in middleware function for serving static assets, Parsing the HTTP request body, Compressing HTTP responses, Using an HTTP request logger Managing and creating virtual domains, Securing an ExpressJS web application with Helmet, Using template engines, Debugging your ExpressJS web application	12	CO1 CO2 CO3 CO5
[4]	Introduction, CRUD operations using ExpressJS' route methods, CRUD operations with Mongoose, Using Mongoose query builders, defining document instance methods, Defining static model methods, Writing middleware functions for Mongoose, Document middleware functions, Query middleware functions, Model middleware functions, Writing custom validators for Mongoose's schemas, Building a RESTful API to manage users with ExpressJS and Mongoose	11	CO1 CO2 CO3 CO5

	Real-Time Communication with Socket.IO and ExpressJS, Understanding Node.js events, Understanding Socket.IO events, The Socket.IO server events, Socket.IO client events, Working with Socket.IO namespaces, io.Manager, Defining and joining Socket.IO rooms, Writing middleware for Socket.IO, Integrating Socket.IO with ExpressJS, Using ExpressJS middleware in Socket.IO.		
[5]	Introduction to React, React elements and React components Composing components, Stateful components and life cycle methods, Working with React.PureComponent, JSX, Styling Components, State and Props, Working with Multiple Components, event handlers, Conditional rendering of components, Rendering lists, Working with forms and inputs, Understanding refs and how to use them, Understanding React portals, Catching errors with error boundary components, Type checking properties with PropTypes, Component Lifecycle phases and hooks, Routing in React, Fetch Data from APIs, Introduction to React with Redux, Creating Frontend with react JS	11	CO1 CO2 CO3 CO4

C. TEXT BOOKS

1. Eddy Wilson IriarteKoroliova. *MERN Quick Start Guide*; Packt Publication.
2. StoyanStefnov. *React Up & Running*; O'Reilly Publications.
3. Jonathan Chaffer, Karl Swedberg. *Learning JQuery; 3rd Editio*n; Packt Publication.
4. *React in Action*, Manning Publication

D. REFERENCE BOOKS

1. Pedro Teixeira. "*Professional Node.Js: Building Javascript Based Scalable Software*", Wiley Publication.
2. Caio Ribeiro Pereira. "*Building APIs with Node.js*", Apress Publication
3. David Flanagan. "*JavaScript The Definitive Guide*", O'Reilly Publications
4. Basarat Ali Syed. "*Beginning Node.js*", Apress Publication.
5. Carlos Santana Roldán. "*React Cookbook*", Packt Publication

E. WEB REFERENCES

1. React, NodeJS, Express & MongoDB - The MERN Fullstack Guide - Udemy
   by MaximilianSchwarzmüller, Manuel Lorenz
   https://www.udemy.com/course/react-nodejs-express-mongodb-the-mern-fullstack-guide/
2. Meta - React Basics - Coursera
   by Meta Staff
   https://www.coursera.org/learn/react-basics?specialization=meta-front-end-developer
3. Meta - Advanced React - Coursera
   by Meta Staff
   https://www.coursera.org/learn/advanced-react?specialization=meta-front-end-developer
4. https://react.dev/reference/react
5. https://nodejs.org/en/docs
6. https://expressjs.com/

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe role of JQuery, AJAX, React Js,Styling and Node JS in dynamic web development
CO2	Apply	Implement dynamic web pages with event handling and HTML manipulation using JQuery, Styling and AJAX.
CO3	Create	Create Webpages with Standard User Interface Using Client Side Scripting Libraries
CO4	Apply	Design interactive web pages using ReactJS
CO5	Apply	Develop server side web application using Node JS

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	1	1	-	1	-	1	-	-	-	1	-	2
CO2	3	2	2	1	2	1	2	-	1	1	2	-	2
CO3	3	3	3	3	3	2	3	-	2	2	3	-	1
CO4	2	2	2	2	3	1	2	-	2	1	2	-	1
CO5	2	2	2	2	3	1	2	-	2	1	2	-	1
Avg	2.2	2	2	1.6	2.4	1	2	-	1.4	1	2	-	1.4

MCA SEMESTER – III
SUBJECT: MOBILE APPLICATION DEVELOPMENT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course is intended to make learners capable of developing applications for mobile devices. It will enable learners to design and develop data centric applications on android platform.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	The Evolution of Mobile Application Development, Different Ecosystems: Apple, Google, Microsoft, Problems with Ecosystem-Based Applications, Web Sites and Web Views for Mobile Devices, Hybrid Mobile Applications, Front-End and Back-End Development, Introduction to Testing Mobile Applications, Native Vs. Hybrid Mobile Applications.	2	CO1
[2]	An Android Platform, Android SDK Features, Which Devices Android Runs on, Android For Mobile Development, Comparison of Android with other Platform, Android Development Framework, Android Software Stack, Android Application Architecture Installation and Updation of Android SDK, Guidelines for app Deployment Android Development Tools: AVD Manager, Android SDK Manager, Emulator, Dalvik Debug Monitor Service, Debug Bridge, Hierarchy View and Lint Tool, Monkey and Monkey Runner.	3	CO1
[3]	Building Blocks of Android Application, Application Manifest File, Manifest Editor, Creation of Resources file, Use of Resources, Android Application Lifecycle, Application's Priority and Its Process States, Skeleton Application classOverride Application Lifecycle Events Android Activities: Create Activities, Activity Lifecycle, Activity Stacks, Activity States, Monitor Activity State Changes, Android Activity Classes Introduction to an Intent, Starting of Activities, sub Activities and Services using Implicit and Explicit Intents.	4	CO1
[4]	Fundamental Android UI Design, Assigning UI To Activities, Layout Classes, Defining Layouts, Linear Layout, Relative Layout, Grid Layout, Constraint Layout Fragment Layout: Fragment LifeCycle, Fragment Specific LifeCycle Events, Fragment States, Create New Fragment, Add Fragments to Activities, Fragment Transaction, Interfacing Between Fragments and Activities, Fragment Without User Interfaces, Android Fragment Classes.	5	*CO2*
[5]	Toolbox Controls, Creating and Modifying Views, Creating Compound Controls, Custom Views, Handling User Interaction Events, Custom Controls, Customizing Array Adapter and Simple Cursor Adapter.	10	*CO2*
[6]	Introduction to SQLite Database, Content Values and Cursors,	6	CO5

	Work with SQLite Databases: Create and Open Database without Sqlite Open Helper, CRUD Operations Content Provider : URI Address, Content Provider Transaction, Add, Delete and Update Content, Access Files from a Content Provider, Introduction to Native Android Content Providers.		CO3
[7]	Broadcast Receiver: Introduction to Pending Intent, Broadcasting Events with Intents, Introduction to Intent Filters and Broadcast Receiver Saving Simple Application Data, Shared Preferences:Introduction, Saved Application UI State, Files Create, Save and Retrieve Shared Preferences, Persisting the Application Instance State File System : Create File, Create Directory, Read and Write Files	4	*CO4* CO3
[8]	Location Based Service:Introduction, Emulator with Location Based Services, selecting a Location Provider, Find Current Location Hardware Support Phone States Telephone Manager: Introduction ,Using Intent Receiver to Monitor Incoming Calls, Initiating Phone Calls, Replacing Native Dialer, Send SMS using Implicit Intent, Send SMS Using SMS Manager, Accessing Telephony Properties and MMS Using Intents, Listening For Incoming SMS.	4	CO4
[9]	Services: Creating and Controlling Services, Binding Services to Activities, Using AsyncTask to Run Asynchronous Tasks, Intent Service, Creating, Setting, and Cancel Alarms, Set Repeating Alarms Introducing the Action Bar, Customizing the Action Bar, Introducing the Android Menu System, Creating a Menu, Specifying Action Bar Actions, Menu Item Options, Defining Menu Hierarchies in XML, Introducing Submenus, Update Menu Items Dynamically, Context Menus and Popup Menus Notification Service:Introducing the Notification Manager, Creating Notifications, Using the Notification Text, Sounds, Lights, and Vibrations, Using the Notification Builder. Notification with Pending Intent	4	CO4
[10]	Media Player Service:Introduction, Prepare Audio and Video for Playback, Control Media Player Playback, Manage Media Playback Output, Respond to the Volume Controls, Respond to the Media Playback Controls, Record Sound with Audio Record, Play Sound with Audio Track. Camera Service: Using Intents to Take Pictures, Control Camera Properties, Camera Settings and Image Parameters, Auto Focus, Focus Areas, and Metering Areas, Taking a Picture and Store.	3	CO4
[11]	Securing application components, Protecting components with custom permissions Protecting content provider paths Defending against the SQL-injection attacks Application signature verification (anti-tamper) Tamper protection by detecting the installer, emulator, and debug flag Removing all log messages with ProGuard Web service types, Consuming web services, Reading and sending data	3	CO2 CO5

C. TEXT BOOKS

1. Mahesh Panhale. Beginning Hybrid Mobile Application Development; Apress
2. Reto Meier. Professional Android 4 Application Development; Wrox (Willey) Publication
3. Keith Makan , Scott Alexander-Bown. Android Security Cookbook; PACKT Publication

D. REFERENCE BOOKS

1. Lauren Dercey & Shane Conder. Android Wireless Application Development Vol-I Android Essential; 3rd ed.; Pearson
2. W.Frank Ableson, Robi Sen, Chris King, C. Enrique Ortiz. Android in action; 3rd ed.;, Dreamtech Press

E. WEB REFERENCES

1. https://developer.android.com/reference/android/widget

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe mobile application environment, android development framework and android application structure.
CO2	Create	Develop secure mobile applications using android user interface by using layouts and controls
CO3	Apply	Demonstrate methods for storing and retrieving data form files, shared preferences and central repository in mobile application.
CO4	Apply	Illustrate use of service, broadcast receiver, telephony manager, location manager, menus, notifications, media player and camera service in android application.
CO5	Create	Create data centric and web based mobile application.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	-	-	-	-	-	2	-	-	-	-	-	2
CO2	3	3	3	3	3	2	2	-	1	2	2	-	2
CO3	2	2	3	1	3	1	2	-	1	-	3	-	1
CO4	2	2	3	1	3	2	2	-	1	1	2	-	1
CO5	2	3	3	3	3	2	2	-	2	2	3	-	1
Avg	2	2	2.4	1.6	2.4	1.2	2	-	1.0	1.0	2	-	1.4

MCA SEMESTER –III
SUBJECT: CYBER SECURITY

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

The course aims to provide understanding of cyber security, cybercrimes and cyber laws. It covers various Data security and security policies along with security compliance, management and governance.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Overview of Cyber security Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.	08	CO1
[2]	Cyber crimes Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber- squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons - cyber grooming, child pornography, cyber stalking, Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.	12	CO1 CO2
	Tools and Methods Used in Cybercrime Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.	06	CO3
[3]	Cyber Law Cybercrime and legal landscape around the world, IT Act, 2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.	06	CO1 CO4

[4]	Data Privacy and Data Security Defining data, meta-data, big data, non- personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR), 2016 Personal Information Protection and Electronic Documents Act (PIPEDA). Social media- data privacy and security issues.	10	CO4
[5]	Cyber Security Management, Compliance and Governance Cyber security Plan- cyber security policy, cyber crises management plan, Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	06	CO5

C. TEXT BOOKS

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
6. Auditing IT Infrastructures for Compliance by Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe cyber security and cybercrimes.
CO2	Understand	Summarise various types of security threats.
CO3	Understand	Describe various tools and methods used for cyber attacks.
CO4	Apply	Identify appropriate laws and policies for prescribed crime scenario.
CO5	Understand	Discuss cyber-security risks assessment, audit and compliance.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	-	-	-	2	2	-	-	1	-	-	2
CO2	2	2	3	-	-	2	2	-	-	2	-	-	2
CO3	2	2	2	-	-	2	2	-	-	2	-	-	2
CO4	2	2	3	-	-	3	2	-	-	3	-	-	2
CO5	2	2	2	-	-	3	2	-	-	2	-	-	2
Avg	2	2	2	-	-	2.4	2	-	-	2	-	-	2

MCA SEMESTER –III
SUBJECT: NETWORK SECURITY

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

The course aims to provide understanding of computer system and network security issues, challenges and solutions. It also emphases on security issues with emerging technologies.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security, Standards	04	CO1
[2]	Symmetric Encryption and Message Confidentiality Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Random and Pseudorandom Numbers, Stream Ciphers and RC4 Public-Key Cryptography and Message Authentication Approaches to Message Authentication, Secure Hash Functions, Message Authentication Codes, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures	12	CO1 CO2 CO4
[3]	Key Distribution and User Authentication Symmetric Key Distribution Using Symmetric Encryption, Kerberos, Key Distribution Using Asymmetric Encryption, X.509 Certificates, Public-Key Infrastructure Transport-Level Security Introduction, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Transport Layer Security, HTTPS, Secure Shell (SSH): Transport Layer Protocol and Connection Protocol.	12	CO2 CO4
[4]	Wireless Network Security IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Overview of Wireless Application Protocol and Wireless Transport Layer Security, WAP End-to-End Security Electronic Mail Security Pretty Good Privacy, S/MIME IP Security IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations	10	CO3
[5]	System Security Intruders: Intruders, Intrusion Detection, Password Management Malicious Software: Types of Malicious Software: Backdoor Logic Bomb Trojan Horses Mobile Code Multiple-Threat Malware	06	CO1 CO5

	Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations		
[6]	Security of Emerging Technologies Security of Big Data Analytics, Security of Cloud Computing, Overview of Security of Internet of Things (IoT), Security of Blockchain	04	CO2

C. TEXT BOOKS

1. Network Security Essentials – Applications and Standards by William Stallings, 4th Edition, PHI.
2. Network Security and Cryptography by Sarhan Musa, Mercury Learning and Information

D. REFERENCE BOOK

1. Cryptography and Network Security by Atul Kahate, McGraw Hill.
2. Cryptography and Network Security: Principles and Practice by William Stalling, 3rd ed., Prentice Hall

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand vulnerabilities in computer networks.
CO2	Apply	Demonstrate techniques to defend against attacks on computer networks and emerging technologies.
CO3	Understand	Explain security standards for computer systems and networks.
CO4	Apply	Demonstrate use of various Cryptographic techniques for secure communication.
CO5	Understand	Explain standards and protocols for Wireless networks, Email and IP security.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	1	1	-	2	3	-	-	2	-	-	2
CO2	3	2	2	1	-	2	2	-	-	2	-	-	2
CO3	2	2	2	1	-	2	2	-	-	2	-	-	2
CO4	3	2	3	1	-	2	3	-	-	2	-	-	2
CO5	2	2	2	1	-	2	2	-	-	2	-	-	2
Avg	2.4	2	2	1	-	2	2.4	-	-	2	-	-	2

MCA SEMESTER –III
SUBJECT: BLOCKCHAIN TECHNOLOGY

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	-	4	4	60	40	-	-	100

A. COURSE OVERVIEW

The course aims to provide understanding of building blocks of Blockchain technology, security challenges, limitations and applications. The course also covers the functional &operational aspects of cryptocurrency ecosystem.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Fundamentals of Blockchain Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Consensus Mechanism: Decentralization and Distribution, Types of Blockchain, Consensus Protocol Cryptocurrency – Bitcoin, Altcoin and Token Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrency, Cryptocurrency Usage Introduction to Cryptography History, Overview: Cryptographic Hash Functions, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency Example.	08	CO1 CO2
[2]	Public Blockchain System Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain: Need for Bitcoin and Its Value, Common Terminologies, Bitcoin Mining, Proof-of-work and Hashcash in Bitcoin, Ethereum Blockchain	08	CO1 CO4
[3]	Private Blockchain System Key Characteristics and Need of Private Blockchain, Private Blockchain Example, Private Blockchain and Open Source, E-commerce Site Example, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain	08	CO1 CO4
[4]	Smart Contracts Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry	04	CO4
[5]	Consortium Blockchain Introduction, Key Characteristics of Consortium Blockchain, Why We Need Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda Initial Coin Offering Introduction, Blockchain Fundraising Method, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms	07	CO1 CO3

[6]	Security in Blockchain Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Majority Attack, Deterministic Transactions, Inherent Security Attributes of Blockchain (CIAR), Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp)	06	CO4
[7]	Applications of Blockchain Blockchain in Banking and Finance, Education, Healthcare, Supply Chain and in IoT Limitations and Challenges of Blockchain Introduction, Blockchain Implementation – Limitations, Blockchain Implementation – Challenges Case Studies Case Studies - Banking and Financial Services, Healthcare	07	CO5

C. TEXT BOOKS

1. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, University Press.
2. Bitcoin and Cryptocurrency Technologies Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University Press.

D. REFERENCE BOOKS

1. Blockchain Applications: A Hands-on Approach by Bahga, Arshdeep, and Vijay Madisetti, VPT
2. Antonopoulos, Andreas M, Mastering Bitcoin: Programming the open Blockchain, O'Reilly Media, Inc
3. 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming' by Josh Thompson,

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Justify need of Blockchain and its building blocks in the context of information security
CO2	Understand	Explain the working of Cryptocurrency. Explain significance and role of Cryptocurrency.
CO3	Understand	Describe Hyperledger Platform, Ripple, and Corda.
CO4	Apply	Demonstrate the use of smart contract with various platforms.
CO5	Understand	Discuss applications, limitations and challenges in Blockchain.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	-	1	-	2	2	-	-	2	-	-	2
CO2	3	2	-	1	-	2	2	-	-	2	-	-	2
CO3	2	2	-	1	-	2	2	-	-	2	-	-	2
CO4	2	2	-	1	-	2	2	-	-	2	-	-	2
CO5	2	2	-	1	-	2	2	-	-	2	-	-	2
Avg	2.4	2	-	1	-	2	2	-	-	2	-	-	2

MCA SEMESTER – III
SUBJECT: ADVANCED DATABASE MANAGEMENT SYSTEM

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course provides hands-on experience of Document based and Graph based databases with MongoDB and Neo4j respectively. The course includes implementations of semi structured database using XML. The course covers parallel and distributed database principles, and relational operations & transaction techniques. The course enables exercise query optimization for relational database.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	NoSQL Overview Introduction to NoSQL, Characteristics and it's Applications, Challenges, NoSQL Approach, Different Storage Types, Comparing the NoSQL Models, Advantages and Drawbacks. Dos and Don'ts for Transactional, Computational and Web-scale Applications	02	CO1
[2]	MongoDB Database JSON Structure, Introduction, Installation, Running MongoDB, Create Collection, Reference Information in Document, Create _id Field, Insert Data : Navigate Collections and Documents, Insert Data into Collection View Data : Use of Dot Operators, Work with Conditional Operators, Search Match in Array, Search for Multiple Expression in a Document, Retrieve Document with Slice, Filtering Result Based on size, Regular Expressions for Search Data, Use of Sort, Limit and Skip Functions, Group Data and use Aggregation Functions. Update Data : Update Single and Multiple Data, Append Values in Documents, Append and Remove elements in Array, Remove Single Data and Multiple Data, Modify Documents Automatically, Rename a Collection. Delete Document and Collection, Create and Drop Index. Timeseries Data: Create Timeseries Collection, CRUD operations on Timeseries Data Geospatial Data: Create Geospatial objects in Documents, Queries on data: geoWithin, Near, nearSphere, geoIntersects, Aggregation functions	06	CO1
[3]	Graph Database Introduction to Graph, Graph Database and Graph Compute Engine, Power of Graph Database, Relationship and Graph Database ,Neo4j Property, Graph Data Model, Environment Setup, Neo4j Building Blocks, Query Operations On Graph Database: Introduction to Cypher, Create Node, Create Relationship, Remove Node, Remove Relationships, Set	06	CO2

	the Properties, Filtering Using Where clause, MATCH Clause, RETURN Clause, Updating Data with FOREACH Clause, String and Aggregation Functions on Graph Database, ORDERBY, SKIP and LIMIT Clause, Query Chaining using WITH Clause. Create Index, Database References		
[4]	Parallel Database Introduction, Partitioning Techniques, Comparison of Partitioning Techniques, Handling Skew, Interquery Parallelism, Intraquery Parallelism Intraoperation Parallelism: Parallel Sort, Range Partitioning Sort, Parallel External Sort Merge, Parallel Join, Partition Join, Partitioned Parallel Hash Join, Cost of Parallel Evaluation of Operations Interoperation Parallelism: Pipelined Parallelism, Independent Parallelism. Distributed Database Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions. Commit Protocols: Two Phase Commit, Three Phase Commit Concurrency Control in Distributed Database: Locking Protocols, Timestamping, Replication with Consistency, Deadlock Handling Availability (Failure handling) of Database: Majority based Approach, Site Reintegration, Coordinator Selection, Heterogeneous Distributed Database: Unified View of Data, Overview of Transaction Management	15	CO3
[5]	Query Processing Overview, Measure of Query Cost, Selection Operation: Selection Using File Scan and indices, Selection for Comparison, Complex Selection, Merge Sort, Cost Analysis of Merge Sort, Join Operations : Nested Loop Join, Merge Join, Hash Join. Evaluation of Expressions Query Optimization Overview, Transformation of Relational Expression : Overview, Equivalence Rules, Join Ordering, Statistics of Expression Result: Selection Size Estimation, Complex Selection Size Estimation, Join Size Estimation, Estimation of Number of Distinct Values Choice of Evaluation Plan: Cost Based Optimization with Equivalence Rule	16	CO4
[6]	Working with XML Data Introduction, Structure of XML Data, XML Schema, Query on XML : XPATH, FLOWR Expressions: For, Let, Where, Order by, and Return statements Joins , Nested Query ,Sort Data , Functions and Types	03	CO5

C. TEXT BOOKS

1. Gaurav Vaish. Getting Started with NoSQL ; Packt Publishing
2. Devid Hovs, Peter Membrey, Eleco Plugge. MongoDB Basics; Apress Publication
3. Ian Robinson, Jim Webber, Emil Eifrem. Graph Databases 2nd ed; O'Reilly Publication
4. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, Database System Concepts ; 6th ed ; McGraw Hill Publication

D. REFERENCE BOOKS

1. Cyrus Dasadia, Amol Nayak.MongoDB CookBook;2nd ed; Packt Publishing
2. Dr Jim Webber, Rik Van Bruggen. Graph Database Dummies; Wiley Publication

E. WEB REFERENCES

1. https://neo4j.com/docs/
2. https://www.mongodb.com/docs/manual/

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Implement Document based NoSQL using MongoDB
CO2	Apply	Construct graph database and perform CRUD operations
CO3	Understand	Describe significance of query processing and query optimization techniques on relational database.
CO4	Understand	Describe Parallel and Distributed Database principles, operations & transaction techniques.
CO5	Apply	Implement semi structured database and exercise CRUD operations.

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	3	2	3	1	2	-	2	3	2	-	1
CO2	2	2	3	2	3	1	2	-	2	3	2	-	1
CO3	3	3	2	3	1	1	2	-	1	1	-	-	1
CO4	3	-	-	-	-	1	2	-	1	-	-	-	2
CO5	2	3	3	3	3	1	2	-	2	3	2	-	1
Avg	2.2	2	2.2	2	2	1.0	2	-	1.6	2	1.2	-	1.2

MCA SEMESTER – III
SUBJECT: WEB DEVELOPMENT WITH PHP

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course covers knowledge necessary for designing and developing dynamic, object oriented, database-driven and MVC based web applications using PHP. The course makes learners enable to develop web applications with Laravel framework.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	A Brief Introduction to Apache, MySQL and PHP , Configure Apache, MySQL and PHP, PHP Structure and Syntax, Create PHP Program Using HTML	04	CO1
[2]	PHP Files, Variables, DataTypes, Strings, Arrays, Operators, Conditional statements, Loops, Built in Functions for Array, String, Date and Time and Datatypes, Function Declaration, Function Arguments, Return Statement, Types of Errors, Error handling. Working with HTML Forms: Handling input, Passing Input to PHP , Validation at Server side, Reading and Writing Files, Uploading and Downloading Files, FileSystem Functions , Handle Cookies, Sessions Management	10	CO1 CO2
[3]	Classes and Objects, Properties, Methods, Constructors, PropertiesandMethodsVisibility,Encapsulation,Namespaces,Autoloading Classes, Inheritance, Overriding Methods, Abstract Classes, Interfaces, Polymorphism, Handling Exceptions, Anonymous Functions, Magic Methods, Clone of Objects	12	CO3
[4]	Connecting to the Database using PHP Data Objects, Implement CRUD operations, Prepared Statements MVC: The MVC Pattern, Understand Composer, Manage Dependencies, Add Metadata, Work with Requests Object, Filter Parameters from Requests, The Router Class, URL Matching with Regular Expression, Controller Class, Model Class, View Class, Map Routes to Controllers and Views, Implementation of MVC Application	10	CO4
[5]	The Purpose of Frameworks, The Main Parts of a Framework, Other Features of Frameworks, Complete and Robust Frameworks, Lightweight and Flexible Frameworks Popular Frameworks: Symfony, Zend , Laravel Laravel Framework: Composer, Laravel Homestead, File Structure, Routing, Controller Class, View and Blade, Environment for Database, Database Migration, Eloquent Model Class, Model View and Controller Workflow, CRUD Application, Work with Sessions and Cookies.	12	CO5

C. TEXT BOOKS

1. Antonio Lopez, Learning PHP 7; 2016 Packt Publishing
2. Sanjib Sinha, Beginning Laravel; Apress

D. REFERENCE BOOKS

1. Atkinson Leon, Suraski Zeev, Core PHP Programming; Pearson Publication
2. Robin Nixon, Learning PHP, MySQL & JavaScript; 4th ed.; O'Reilly Publication.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Illustrate basic building blocks of PHP.
CO2	Apply	Develop session enabled and data persistent web application.
CO3	Apply	Demonstrate robust object-oriented programs.
CO4	Create	Develop data centric multitier web applications.
CO5	Apply	Summarize different PHP frameworks and implements CRUD operations in Laravel framework.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	1	-	2	-	2	-	1	-	-	-	2
CO2	2	2	2	2	2	1	2	-	2	-	1	-	1
CO3	2	1	2	2	2	1	2	-	2	1	3	-	2
CO4	2	2	3	3	3	2	2	-	3	2	2	-	1
CO5	2	2	2	2	3	1	3	-	2	2	3	-	1
Avg	2	2	2	1.8	2.4	1.0	2.2	-	2	1.0	2	-	1.4

MCA SEMESTER – III
SUBJECT: CLOUD COMPUTING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course makes learners understand virtualization concepts and ecosystem of cloud computing. The course covers key services of public cloud for deploying applications on the cloud platform. It enables learner to set up applications in container environment. The course covers fundamentals of OpenStack platform. It also introduces source code version controlling and hosting on GitHub cloud platform

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Cloud Computing Introduction Define Cloud Computing, Cloud Types, Characteristics of Cloud Computing, The Role of Open Standards, Benefits of Cloud Computing, Cloud Architecture, Cloud Computing Service Models (IaaS, SaaS, PaaS, IDaaS, CaaS). Edge Computing: Introduction, Benefits and working mechanism.	7	CO1
[2]	Git and Github Version Control Fundamentals, What is Git?, Installing Git, Initialize Repository, Import Project, Ignore Files, Add New File, Changes into Existing file, Add Partial Changes, Remove Files, Rename Files, Unstage File, Make Commit, Discard Last Commit, Undo Commit, Fetch and Merge Changes, Make a New Branch, Merge a Branch,Sync Local Branch with Remote Branch Introduction to GitHub, setting up Personal Account, Create and Manage Access to Repository, Pull from GitHub, Push to GitHub, Create Branch on GitHub, Manage Branches, Create GitHub Pages	5	CO2
[3]	Virtualization Introduction to Virtualization Technologies, Understand Hypervisors, Virtual Machine Types, Oracle VirtualBox, Create Virtual Machines on Hypervisor, KVM	3	CO1
[4]	AWS Services AWS Components and Services Elastic Compute Cloud (EC2) Service: Understand the types of EC2, Create and Deploy Application on EC2 instances Storage Services: Simple Storage Service(S3): Create Buckets, Deploy Static websites on S3, Version Control service of S3, Access S3 buckets from EC2 Instance. Elastic Block Storage (EBS), Database Services: Different Database Services of AWS, Relational Database Service (RDS), Create database on RDS and Connect with EC2 Application, Create Unstructured Database and Connect with	13	CO3

	EC2Application Serverless Computing Service: Introduction to Lambda Service, Lambda Features, Demonstration of Lambda Services Identity and Access Management Service: Trust and Boundaries of IAM, Why IAM, IAM Challenges, Setup Users, Roles, Permissions, Policies with IAM Service		
[5]	Containerization Introduction to Docker Container, Advantage of Container over Virtual Machine, Create Docker Image and Container, Publish Docker Image on Public Repository, Overview of Container Orchestration, Docker Swarm: Introduction, Docker Swarm Architecture Kubernetes: Introduction, Kubernetes Architecture, Container Orchestration with Kubernetes	16	CO4
[6]	OpenStack Introduction, OpenStack Components: Keystone - OpenStack Identity Service, Nova- OpenStack Compute, Swift- OpenStack Object Storage.	2	CO5
[7]	Security Measures in Cloud Environment Infrastructure Security at Network Level: Ensure Integrity, Ensure Access Control, Network Level Mitigation Infrastructure Security at Host Level: SaaS and PaaS Host Security, Virtualization software Security, Virtual Server Security Infrastructure Security at Application Level: Application Security Threats, End User Security, PaaS Application Security	2	CO5

C. TEXT BOOKS

1. Barrie Sosinsky, Cloud Computing Bible; Wiley Publishing Inc.
2. Kevin Jackson, Cody Bunch, Egle Sigler, OpenStack Cloud Computing Cookbook; 3rd ed.; Packt Publishing
3. Ian Miell, Aidan Hobson Sayers, Docker in Practice; 2nd ed.; Manning
4. Tim Mather, Subra Kumaraswamy, Shahed Latif. Cloud Security and Privacy; O'Reilly Publication
5. Richard E Silverman. Git Pocket Guide; O'Reilly Publication

D. REFERENCE BOOKS

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Cloud Computing Concepts Technology and Architecture; Prentice Hall
2. Anthony Velte, Tony Velte, Robert Elsenpeter, Cloud Computing A Practical Approach; McGrawHill
3. Nigel Poulton, Docker Deep Dives; 4th ed.;

E. WEB REFERENCES

1. https://docs.aws.amazon.com
2. https://docs.github.com
3. https://git-scm.com/docs
4. https://help.ubuntu.com/community/KVM

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe cloud computing ecosystem and virtualization
CO2	Apply	Demonstrate the use of Git and GitHub repository
CO3	Apply	Develop and deploy cloud based applications on public clouds using various cloud services.
CO4	Apply	Build container images for given platform specific and programming language libraries.
CO5	Understand	Describe Openstack components, architecture and security measures

G. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	1	1	1	-	2	-	1	-	-	-	-
CO2	3	1	1	2	3	1	3	-	3	1	2	-	-
CO3	3	3	3	3	3	2	3	-	3	2	3	-	-
CO4	3	3	3	3	3	2	3	-	3	2	3	-	-
CO5	1	2	-	1	-	2	2	-	1	-	-	-	-
Avg	2.6	2	2	2.2	2	1.4	2.6	-	2.2	1.0	1.6	-	-

MCA SEMESTER – III
SUBJECT: ARTIFICIAL INTELLIGENCE

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course makes understand significance of existing AI methods and algorithms in various domains of computer science and applications. It helps the learner understand available approaches for performing different searching approaches such as - state space search, heuristic search and randomized search. The learner will also learn techniques for finding graph-based optimal paths, problem decomposition and game playing.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction, History significance and applications of Artificial Intelligence.	2	CO1
[2]	State space search Generate and Test, Depth First Search, Breadth First Search, Comparison of BFS and DFS, Depth Bounded DFS, Depth First Iterative Deepening (DFID).	8	CO1 CO2
[3]	Informed (Heuristic) Search Heuristic Functions, Best First Search, Hill Climbing, Local Maxima, Solution Space Search, Variable Neighborhood Descent. Randomized Search and Emergent Systems Iterated Hill Climbing, Simulated Annealing, Genetic Algorithms, Travelling Salesman problem, Emergent Systems, Ant Colony Optimization.	10	CO1 CO2 CO3
[4]	Finding Optimal Paths Brute Force, Branch and Bound, Dijkstra's Algorithm, A* Algorithm, Admissibility of A*, Iterative Deepening A*(IDA*), Recursive Best First Search (RBFS). Adversarial Search Techniques (Game Playing) MINIMAX Algorithm, Alpha-Beta Pruning, SSS*.	10	CO1 CO3
[5]	Planning and Constraint Satisfaction The STRIPS Domains, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning, Graph Plan, Constraint Satisfaction Problems, N-Queens Problem.	8	CO1 CO4
[6]	Logic and Inferences Propositional Logic, Resolution Method in Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward Chaining.	6	CO1 CO4
[7]	Knowledge Based Reasoning Agents, Facets of Knowledge, Memory, Declarative Knowledge	4	CO1 CO4

C. TEXT BOOKS

1. A First Course in Artificial Intelligence, Deepak Khemani, McGraw Hill
2. Artificial Intelligence, 3rd edition, Elaine Rich and Kevin Knight, McGraw Hill

D. REFERENCE BOOKS

1. Artificial Intelligence with Python, Alberto Artasanchez and Prateek Joshi, Packt Publishing
2. Artificial Intelligence: A Modern Approach", 3rd Edition, Stuart Russell and Peter Norvig, Prentice Hall

E. WEB REFERENCES

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Justify role and working of artificial intelligence and its building blocks
CO2	Apply	Implement various search algorithms in context of artificial intelligence
CO3	Apply	Explain role and functions of various techniques for searching, and finding optimal paths
CO4	Understand	Explain methods for planning, constraint satisfaction, inferencing and knowledge-based reasoning

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	1	-	1	-	1	-	-	1	1	-	2
CO2	2	1	1	3	1	-	1	-	-	1	1	-	2
CO3	2	2	2	1	1	-	1	-	-	1	1	-	2
CO4	2	2	2	-	1	-	1	-	-	1	1	-	2
Avg	2	1.75	1.5	1	1	-	1	-	-	1	1	-	2

MCA SEMESTER – III
SUBJECT: INTERNET OF THINGS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course makes understand role of IoT systems and building blocks therein. It helps learn basic methodology of designing and developing simple IoT systems incorporation with diversified sensors and micro-controller boards such as Raspberry Pi & Arduino.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Internet of Things Introduction, Architecture, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and Deployment Templates. Domain Specific IoTs Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Healthcare & Lifestyle. IoT and M2M Machine to Machine, Difference between IoT and M2M, Software Defined Networking, Network Function Virtualization. IoT Protocols IoT access technologies, Physical & MAC layers, Routing over low power and lossy networks, Constrained nodes and networks, Application transport methods, IoT protocols, CoAP.	10	CO1
[2]	IoT Platforms Design Methodology Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development. IoT on cloud Role of IoT in cloud, Solution framework for IoT applications-Implementation of Device integration, Data acquisition and integration, Device data storage - Unstructured data storage on cloud/local server, Authentication, authorization of devices.	8	CO3
[3]	IoT Physical Devices & Endpoints Basic Building Blocks of an IoT Device, Raspberry Pi board and its interfaces. Programming Raspberry Pi Controlling LED, Interfacing LED and Switch, Interfacing sensors, Communicating with sensors. IoT Sensors Overview of various sensor types, actuators, Micro electro mechanical systems, smart objects & trends therein, Wireless Sensor Networks and	10	CO2 CO4

	protocols		
[4]	Programming Arduino Board Arduino board and its interfaces, Developing Home Weather System using Arduino Board. Getting input from sensors Detection of - movement, light and motion Measurement of – distance, vibration, sound, temperature.	10	CO2 CO4
[5]	Case studies Case studies on IoT - Agriculture, Healthcare, Transportation, Home automation, and smart city.	10	CO2 CO4

C. TEXT BOOKS

1. Internet of Things – A Hands on Approach, Arshdeep Bahga, Vijay Madisetti, Universities Press
2. Programming the Raspberry Pi: Getting Started with Python, Dr. Simon Monk, McGraw Hill Publication
3. Internet of Things: Architecture and Design, Raj Kamal, McGraw Hill

D. REFERENCE BOOKS

1. Arduino Cookbook, Michael Margolis, O'Reilly
2. Mastering Internet of Things, Peter Waher, Packt
3. Internet of Things, Jeeva Jose, Khanna book publishing
4. The Internet of Things – Do it yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black, Donald Norris, McGraw Hill

E. WEB REFERENCES

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Describe role and building blocks of IoT technology.
CO2	Understand	Explain role and functioning of IoT sensors and microcontroller boards.
CO3	Apply	Prepare relevant design for specific requirements of basic IoT based application.
CO4	Apply	Build basic IoT based applications using appropriate microcontroller and sensor technology.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	1	-	2	1	2	1	-	1	1	1	2
CO2	2	1	1	2	2	1	2	1	-	1	1	1	1
CO3	2	3	3	2	2	1	1	1	-	1	1	1	2
CO4	2	2	3	2	2	1	2	1	-	1	1	1	2
Avg	2	2	2	1.5	2	1	1.75	1	-	1	1	1	1.75

MCA SEMESTER – III
SUBJECT: ASP.NET PROGRAMMING WITH C#

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course introduces development of console applications and windows form applications using C# programming language. Learners will be able to develop multi-tier data centric web applications using ASP.NET technology with C#.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	The Evolution of Web Development: Active Server Page (ASP).NET, Server-Side and Client Side Programming, The .NET Framework: CLR, The .NET Class Library, Features of Visual Studio .NET.	4	CO1 CO3
[2]	Variables, Data Types, Flow Control, Enumeration, Arrays, Namespaces, Main() Method, Compiling C# File, Console I/O, Comments, Rules for Identifiers, Class Members, Inheritance: Types, Implementation, Abstract Class, Sealed Class, Modifiers, Interfaces Operators, Type Safety, Comparing Objects for Equality, User-Define Casts Advanced C#: Indexers, Properties, Generics and Collections, Files,Memory Management, Feeing Unmanaged Resources, Unsafe Code, String Class, Error and Exception Handling, Delegates and Events.	8	CO2 CO3
[3]	Creating Windows Form Applications, Control Class, Size and Location, Appearance, User Interaction, Windows Functionality, Class Hierarchy Standard Controls and Components: Button, Checkbox, Combobox, Listbox, Datetimepicker, Error Provider, Help Provider, Image List, Label, Listview, Panel, Picturebox, Progressbar, Radio Button, Textbox, Richtaxtbox, Splitter, Statusbar, Tabcontrol, Tabpages, Menu, Toolbar, Form Class.	8	CO3
[4]	Creating Website Using Visual Studio, Designing A Web Page, Anatomy of Webform, Writing Code, Debugging, Anatomy of ASP.NET Application, Introduction of Server Controls, Page Class, Configuring ASP.NET Application, Basic Web Control Classes, Web Control Tags, Webcontrol Base Class, The Default Button, List Controls, Web Control Events, Autopostback, Page Life Cycle, Validation Controls, Calendar and Adrotator Control State Management: View State, Transferring Information between Pages, Cookies, Session State, Configure Session, Application State, Comparison of State Management Options.	8	CO2 CO5
[5]	Configure Database, Basic SQL in Visual Studio, Data Provider Model, Direct Data Access, Disconnected Data Access, Data Binding: Single Value Databind, Repeated Value Data Bind, Working with Data Source Controls, Gridview, Details View, Form View.	6	CO2 CO5

[6]	XML Basics, Attributes, Comments, XML Display and Transform XML Web Controls, Introduction to AJAX, Script Manager, Update Panel, Progressbar, Timer.	4	CO2 CO4 CO5
[7]	History of MVC, Principles, MVC Pattern Flow, Advantages of MVC, Webforms and MVC in ASP.NET, Programming Model, Main Elements, Relation between ASP.NET, ASP.Net Webforms and ASP.NET MVC, Implementation of MVC in ASP.NET, ASP.NET MVC Project, Examining the Solution Structure, Test Projects, Demonstration of MVC in ASP.NET.	6	CO2 CO5
[8]	Introduction, WCF vs. ASP.NET Web API, Scenarios, Security, RESTful Service, Identification of Resources, Manipulation of Resources, Self-Descriptive Messages, Hypermedia, Implementing and Consuming an ASP.NET Web API.	4	CO5

C. TEXT BOOKS

1. Robinson, Nagel, Watson, Glynn, Skinner, Evjen, *Professional C#;* 3rd ed.; Wrox –Wiley Publication
2. Matthew Macdonald, *Beginning ASP.NET 4.5 In C#;* APRESS
3. Chiaretta&Nayyeri, *Beginning ASP.NET MVC 1.0;* Wrox –Wiley Publication
4. BadrinarayananLakshmiraghavan,*Pro ASP.NET Web API Security Securing ASP.NET Web API;* Apress

D. REFERENCE BOOKS

1. Evjen, *Professional ASP.NET 4 In C# And VB;* Wrox –Wiley Publication
2. Matthew Macdonald, *Professional ASP.NET 3.5 In C# 2008;* APRESS

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand .NET Framework Architecture and Features
CO2	Apply	Develop Database Driven MultiTier ASP.Net Web Applications
CO3	Create	Develop Windows Applications using C# Language and .NET Framework Controls
CO4	Apply	Demonstrate use of Ajax Controls, Xml And Xml Schema Definition in .NET Applications
CO5	Create	Develop MVC based application and implement Web API

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	-	1	1	-	1	2	-	1	1	-	-	2
CO2	3	3	3	2	3	1	2	-	2	1	2	-	2
CO3	3	2	3	3	3	1	3	-	1	1	2	-	2
CO4	1	2	1	2	3	1	2	-	1	1	1	-	2
CO5	2	3	3	3	3	1	3	-	2	1	2	-	2
Avg	2.2	2	2.2	2.2	2.4	1	2.4	-	1.4	1	1.4	-	2

MCA SEMESTER – III
SUBJECT: ADVANCED JAVA PROGRAMMING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course provides the knowledge necessary to understand J2EE architecture and develop dynamic web pages using java servlets and java server pages. It enables learners to develop data centric Web Application using Hibernate. Learners will be able develop RESTful web services using Java. It will enable the students to build applications using Spring and Spring Boot Framework.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction to J2EE Platform, Challenges and Requirements for Enterprise Application Development, Introduction to Enterprise Architecture Styles, J2EE Container Architectures, J2EE Server and Containers, J2EE Architecture, Introduction to Web Containers.	2	CO1
[2]	Introduction to Java Servlet, Servlet Lifecycle, Servlet Implementations, Servlet Configuration, Servlet Exceptions, Requests & Responses, Servlet Session Tracking, Servlet Context Introduction to Events and Event Handling [Context Level Events and Session Level Events]	8	CO1 CO2
[3]	Introduction, JSP Directives, Scripting Elements, Introduction to Java Beans, Standard JSP Actions, JSP Implicit Objects, Scopes, Expression Language, Developing MVC Application Using Servlets, JSP and POJO Beans.	8	CO1 CO2
[4]	Define REST, Restful Architecture, Restful Clients, Accessing Restful Services, Restful Web Service Design, Introduction to Annotations, Web Service Architecture, Implementation with JAX-RS based implementation, Securing Web Services	8	CO1 CO2 CO4
[5]	Understanding Persistence and Paradigm Mismatch, Introduction to Object-Relational Mapping, Java Hibernate, Hibernate Architecture, Hibernate Object Life Cycle, Hibernate Configuration File and Mapping Files, Working with Hibernate Objects, Session Operations, Hibernate Strategies, Mapping of Relations, Introduction to Fetching Strategies, Querying Using HQL.	8	CO1 CO2 CO3
[6]	Introduction to Spring, Spring Framework Architecture and Modules, Exploring Bean, Bean Wiring and Autowiring, Dependency Injection, Inversion of Control (IoC), Aspect-Oriented Programming, Managing Transactions, Form Tag Library, Web MVC Framework, JDBC with spring and DAO support, Implementation using Web MVC Framework. Sample data driven application using Spring MVC.	8	CO1 CO5
[7]	Introduction to Spring Boot - Spring Boot Features, Creating Simple Spring Boot Application, Application Configuration, Autoconfiguration Report, Actuators, Adding Database Access, REST API with Spring	6	CO1 CO5

	Boot		

C. TEXT BOOKS

1. SubrahmanyamAllamaraju, Cedric Buest, Daniel O'Connor Et Al. "*Professional Java Server Programming J2EE 1.3 Edition* ", Apress Publications.
2. Jose Sandoval. "*Restful Java Web Services*", Packt Publication.
3. Christian Bauer, Gavin King. "*Hibernate in Action*", Manning Publications.
4. Mark Heckler. *"Spring Boot: Up and Running*", O'Reilly Publications.
5. Dinesh Rajput. "*Mastering Spring Boot 2.0*" ,Packt Publications

D. REFERENCE BOOKS

1. "*Java Server Programming Java EE7 (J2EE1.7) Black Book*" by Kogent Learning Solutions Inc. ,Dreamtech Press
2. Rod Johnson, JuergenHoeller, AlefArendsen, Thomas Risberg, Colin Sampaleanu. "*Professional Java Development with the Spring Framework*", Wiley Publications
3. Craig Walls, Ryan Breidnbach. "*Spring in Action*" 3rd Edition, Manning Publications.
4. Craig Walls. "*Spring Boot in Action*", Manning Publications.

E. WEB REFERENCES

1. API Documentation (http://www.springsource.org/spring-framework#documentation).
2. https://docs.spring.io/spring-boot/docs/current/reference/html/

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand Various Components and Building Blocks in Enterprise JAVA Technology
CO2	Create	Develop & Deploy Database Driven Multi Tier Enterprise Applications
CO3	Apply	Map Classes and Object Association to Relational Database with Hibernate
CO4	Apply	Demonstrate RESTful API using Java's JAX-RS specifications
CO5	Apply	Implement multi-tier applications using Spring and Spring Boot framework

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	1	2	1	1	-	2	-	1	-	-	-	2
CO2	3	3	3	3	3	2	3	-	2	2	3	-	1
CO3	2	2	2	1	2	1	2	-	1	1	1	-	2
CO4	2	2	2	2	2	1	3	-	2	1	2	-	1
CO5	2	2	3	2	3	1	2	-	2	1	2	-	1
Avg	2	2	2.4	1.8	2.2	1	2.4	-	1.6	1	1.6	-	1.4

MCA SEMESTER – III
SUBJECT: APPLIED MACHINE LEARNING

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

The course helps develop practical machine learning skills. The course covers basics of various machine learning concepts and methods along with practical aspects using relevant case studies and programming assignments.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	**Machine Learning** Introduction and need of machine learning, Supervised and unsupervised machine learning, Types of machine learning algorithms, Choosing appropriate algorithm, Steps for developing a machine learning Application. Introduction to tools and libraries for machine learning. **Working with Data** Data preprocessing, normalization, sampling, resampling, Exploratory data analysis.	8	CO1 CO3
[2]	**Classification** Concept and applications of classification-based machine learning techniques Naïve Bayes classification: Significance, Bayesian Decision Theory, Naïve Bayes Classification, Gaussian and Bernoulli distribution, Estimating Accuracy and Model Evaluation. Decision Tree: Significance, Building and splitting decision tree, Decision forest. K-Nearest Neighbour: Significance, Distance measurement, Classification with K-Nearest-Neighbour. Support Vector Machine: Significance, hyperplane, support vectors, margin, kernel, hinge loss, Classification with SVM, Case study.	14	CO1 CO2 CO3 CO4
[3]	**Regression** Concept and applications of regression-based machine learning techniques Simple Linear Regression: Introduction, Finding best fitting line using Least – Gradient descent and normal equation method, Multilinear regression, Polynomial regression, Evaluating regression models. Tree Regression: Building tree with continuous and discrete features, Using CART for Regression. Logistic Regression: Introduction, Classification with logistic regression and sigmoid function, hyperparameter tuning, loss function, Case study.	8	CO1 CO2 CO3 CO4
[4]	**Clustering** Concept and applications of clustering techniques, K-Mean Clustering,	6	CO1 CO2

	K-Medoid clustering. Association Rule Mining: Introduction, Apriori algorithm, Case study.		CO3 CO4
[5]	**Neural Networks** Introduction, Biological neuron and biological neural networks, Perceptron, Single-layer Neural Network, Activation function, Multilayer Neural perceptron and networks, Back-Propagation neural networks.	8	CO5
[6]	**Principal Component Analysis** Need and steps for PCA, Features Transformation, PCA using Python.	4	CO5

C. TEXT BOOKS

1. Machine Learning, Anuradha Srinivasaraghavan and Vincy Joseph, Wiley India.
2. Python Machine Learning, Sebastian Raschka, Packt Publication
3. Machine Learning in Action, Peter Harrington, Dreamtech Press

D. REFERENCE BOOKS

1. Machine Learning, Tom M Mitchell, McGraw Hill
2. Machine Learning, Amit Kumar Das, Saikat Dutt and Subramanian Chandramouli, Pearson
3. Elements of Artificial Neural Networks, Kishan Mehrotra, Chilukuri Mohan and Sanjay Ranka, Penram international
4. Statistics for Research, George Argyrous, Sage publications

E. WEB REFERENCES

F. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Justify need, challenges & lifecycle of machine learning systems.
CO2	Understand	Describe role and working of various machine learning techniques.
CO3	Apply	Perform data preprocessing operations, dimensionality reduction and exploratory analysis on given dataset.
CO4	Apply	Develop prediction models for given machine learning problem and evaluate performance of the resultant model.
CO5	Understand	Explain significance and working of neural networks.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	1	1	1	1		1		1	1	1		1
CO2	2	2	2	2	2		2		2	1	1		1
CO3	3	3	3	3	3		2		3	1	2		2
CO4	3	3	3	3	3		2		3	2	2		3
CO5	2	2	2	2	2		1		1	2	1		2
Avg	2.2	2.2	2.2	2.2	2.2		1.6		2	1.4	1.4		1.8

MCA SEMESTER – III
SUBJECT: BIG DATA ANALYTICS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
4	-	2	6	5	60	40	25	25	150

A. COURSE OVERVIEW

This course gives an overview of technologies used for Big Data storage, retrieval and its processing. It covers working with Apache Hadoop, Map Reduce, programming tools PIG, SPARK& HIVE in Hadoop ecosystem.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	Cos
[1]	Introduction Big Data and Its Importance, Big Data Characteristics, Types of Big Data, Traditional Verses Big Data Approach, Big Data Applications, Analysis Mode, Big Data Stack.	4	CO1
[2]	Hadoop Introduction to Hadoop, Core Hadoop Components, Overview of Hadoop Ecosystem, Physical Architecture, Hadoop Limitations (Book 1), Comparing SQL Data Bases and Hadoop Starting Hadoop: The building blocks of Hadoop: NameNode, DataNode, Secondary NameNode, JobTracker, TaskTracker. Set up SSH for Hadoop cluster, Running Hadoop using different modes. Components of Hadoop: Basic File Commands, Parallel Copying with distcp, Reading and Writing to HDFS programmatically. HDFS: HDFS concepts, The Command line Interface, Hadoop Filesystems, The Java Interface, and Data Flow: Anatomy of File Read, Anatomy of File Write.	8	CO1 CO2 CO3
[3]	MapReduce Anatomy of Map Reduce Program: Hadoop Data Types, Mapper, Reducer, Partitioner- Redirecting Output from Mapper, Combiner - Local Reduce, Word Counting Example with Predefined Mapper and Reducer Class. MapReduce and the new software Stack Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization, Grouping by Key, Coping with Node Failures. Map Reduce Patterns Count, Min, Max, Average, Top N, Filter, Distinct, Sorting, Joins Algorithms Using Map Reduce: Matrix Multiplication, Relational Operators (Selection, Projection, Union, and Intersection), Computing Natural Join, Grouping and Aggregation.	8	CO2 CO3
[4]	NoSQL Database: HBase, Overview of NoSQL HBase HBasics, Introduction to Zookeeper **service**, HBase: Concepts, Clients, Example, Differentiate: Hbase and RDBMS.	5	CO4
[5]	Apache Sqoop	5	CO4

	Getting Sqoop, Sqoop Connectors, A Sample Import, Working with Imported Data, Imported Data and Hive, A Sample Export.		
[6]	Apache Hive Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.	6	CO5
[7]	Apache Pig Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.	6	CO5
[8]	Apache Spark Installing Spark, Example, Resilient Distributed Databases, Shared Variables, Anatomy of Spark Job Run, Executers and Cluster Managers.	6	CO5

C. TEXT BOOKS

1. Arshdeep Bahga & Madisetti, *Big Data Science and Analytics - A Hands On Approach;*
2. Tom White,,*Hadoop: The Definitive Guide;* 4th ed.; O'Reilly Media
3. Chuck Lam , Manning, *Hadoop in Action*
4. Radha Shankarmani, M Vijayalakshmi , *Big Data Analytics;* 2nd ed.; Wiley

D. REFERENCE BOOKS

1. Venkat Ankam, *Big Data Analytics;* Packt Publishing Ltd.,
2. Seema Acharya, Subhashini Chhellappan, *Big Data and Analytics;* Wiley
3. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, and Marcia Kaufman, *Big Data for Dummies*
4. EMC Education Services, *Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data;* Wiley

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Explain the fundamentals and applications of Big Data Analytics.
CO2	Understand	Describe role of Hadoop ecosystem.
CO3	Apply	Demonstrate data storage and access in Distributed File System.
CO4	Apply	Store voluminous data using Hbase and Sqoop.
CO5	Apply	Design solutions for Big Data Analytics problem using Hive, Pig and Spark to solve data intensive problems.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	1	2	1	-	1	2	-	1	1	1	-	3
CO2	2	1	2	1	1	1	2	-	1	1	1	-	3
CO3	2	2	2	2	3	1	2	-	2	1	2	-	2
CO4	2	3	3	2	3	1	2	-	2	1	3	-	1
CO5	2	3	3	3	3	1	2	-	2	1	3	-	1
Avg	2	2	2.4	1.8	2	1	2	-	1.6	1	2	-	2

MCA Semester - IV

MCA SEMESTER –IV
SUBJECT: PROJECT

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
-	-	40	40	20	-	-	300	400	700

A. COURSE OVERVIEW

The purpose of this course is to let the learners gain wholistic insight and practicum experience by building required technological solutions in the domain of Computer Science & Applications at industry/research organization. The learners will be expected to demonstrate and sharpen various skills in the domain of - existing & contemporary computer science & applications, communication; time bound requirement analysis, solution design & development and report writing - individually and in team. Upon successful course completion, the learner will be required to submit a project report/dissertation about the work performed.

B. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Analyze	Critically formulate problem statement and analyze its requirements for given software/research problem
CO2	Apply	Professionally communicate the project/research deliverables.
CO3	Create	Prepare software/research design and project timeline for the given requirements in context of current practices
CO4	Apply	Practice project development life cycle ethically individually and in team
CO5	Create	Develop robust software/research solutions using appropriate tools, technologies and methodologies
CO6	Apply	Evaluate quality & performance of software/research outcomes

C. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	1	3	3	2	2	2	3	3	3	2	2
CO2	2	2	3	1	2	1	2	3	3	2	3	2	2
CO3	3	3	3	3	3	2	3	2	3	3	3	2	2
CO4	2	1	2	2	2	3	3	3	1	2	3	2	2
CO5	3	2	3	3	3	2	3	2	2	3	3	2	2
CO6	2	1	2	3	2	3	2	1	2	2	3	2	2
Avg	2.5	2	2.3	2.5	2.5	2.1	2.5	2.1	2.3	2.5	3	2	2