



**RAMAIAH**  
*Institute of Technology*

# **CURRICULUM**

**for the Batch 2022 – 2024**

**DEPARTMENT OF  
MASTER OF COMPUTER APPLICATIONS**

**2022 – 2024 BATCH MCA**

**RAMAIAH INSTITUTE OF TECHNOLOGY**  
(Autonomous Institute, Affiliated to VTU)  
Bangalore – 560054.

## About the Institute

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with 'A<sup>+</sup> grade by NAAC in March 2021 for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is also been conferred autonomous status for Ph.D program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 65% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

**As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 67<sup>th</sup> rank among 1249 top Engineering Institutions & 17<sup>th</sup> Rank for School of Architecture in India for the year 2022 and is 1<sup>st</sup> amongst the Engineering Colleges affiliated to VTU, Karnataka.**

## **About the Department**

The Department of Master of Computer Applications was established in 1997 with the objective of producing high quality professionals to meet the demands of the emerging field of Computer Applications. The department got academic autonomy in the year 2007 and is accredited by NBA. The department is recognized as a Research Centre under Visvesvaraya Technological University in 2012.

## **VISION OF THE INSTITUTE**

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio- economic needs

## **MISSION OF THE INSTITUTE**

**MSRIT shall meet the global socio-economic needs through**

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

## **QUALITY POLICY**

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

## **Vision of the Department**

To be a nationally prominent and internationally recognized department in academics and research activities with the aim of developing competitive software professionals to serve the society and ever changing industry.

## **Mission of the Department**

- To enable the students to be knowledgeable and creative through state-of-the-art curriculum and innovative teaching methodologies
- To provide training programs that bridges the gap between academia and industry to produce competitive software professionals
- To inculcate ethical values in the students enabling them to become socially committed professionals
- To enhance the research quality and productivity, by providing required facilities

### **Program Educational Objectives (PEOs):**

**PEO1:** Excel in professional career in the field of Computer Applications and contribute to research and development activities.

**PEO2:** Provide software solutions that are socially acceptable and adapt emerging technologies and tools.

**PEO3:** Exhibit ethical and communication skills and engage in lifelong learning.

### **Program Outcomes (POs):**

1. **Computational Knowledge:** Apply knowledge of mathematics, computing principles and domain knowledge appropriately to develop a conceptual model from defined problems and requirements.
2. **Problem Analysis:** Identify, formulate problem definition, analyze the literature of the domain and provide solutions using mathematics and computing.

3. **Design & Development of Solutions:** Design, develop and assess a software system, process, component, or program that meets specified needs with appropriate consideration for societal concerns.
4. **Conduct Investigation of Complex Computing Problem:** Use research-based knowledge to analyse, interpret the data and synthesize information to provide valid conclusions.
5. **Modern Tools Usage:** Create, select, and use modern tools and technologies necessary for computing practices.
6. **Professional Ethics:** Adopt professional ethics, principles of professional computing practices, cyber regulations, and responsibilities.
7. **Lifelong Learning:** Recognize the need and engage in independent learning for continual development as a computing professional.
8. **Project management and Finance:** Demonstrate the management principles for managing projects as an individual, as a member, and as a leader in a team in multidisciplinary environments.
9. **Communication Efficacy:** Communicate effectively about computing activities by being able to write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
10. **Societal and Environmental Concern:** Assess the local and global impact of software solutions on individuals, organizations, and society.
11. **Individual and Team work:** Perform effectively as an individual and as a member or leader in diverse teams and multidisciplinary environments.
12. **Innovation and Entrepreneurship:** Recognize and pursue the opportunities with innovative ideas to succeed as an employee or entrepreneur.

### Curriculum Course Credits Distribution

Semester	Mathematics (MTH)	Management (MGT)	Humanities & Social Sciences (HSS)	Professional Courses		Project Work / Internship (PW /IN)	Seminar (SEM)	Ability Enhancement Course	Total credits in a Semester
				Core (Hard core, Soft core, Lab) (PC-C)	Electives (PC-E)				
<b>First</b>	4		2	18					24
<b>Second</b>				16	9				25
<b>Third</b>		3		15	6	2			26
<b>Fourth</b>						22	2	1	25
<b>Total</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>49</b>	<b>15</b>	<b>24</b>	<b>2</b>	<b>1</b>	<b>100</b>

## SCHEME FOR 2022-2024 BATCH

### I SEMESTER

	Course Code	Course Name	Credits*			
			L	T	P	Total
1.	MCA11	Programming with Python	3	0	1	4
2.	MCA12	Computational Mathematics	3	1	0	4
3.	MCA13	Computer Organization	3	0	0	3
4.	MCA14	Operating Systems	3	0	1	4
5.	MCA15	Data Structures	3	0	1	4
6.	MCA16	Professional Communication and Ethics	1	1	0	2
7.	MCA17 <sup>#</sup>	Web Programming	0	1	2	3
8.	MCABC <sup>##</sup>	Bridge Course	0	0	0	0
<b>Total</b>			<b>16</b>	<b>3</b>	<b>5</b>	<b>24</b>

### II SEMESTER

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCA21	Programming in Java		3	0	1	4
2.	MCA22	Design and Analysis of Algorithms	MCA15	3	0	1	4
3.	MCA23	Database Systems		3	0	1	4
4.	MCA24	Computer Networks		3	0	1	4
5.	MCAE1-	Elective I					3
6.	MCAE2-	Elective II					3
7.	MCAE3-	Elective III					3
<b>Total</b>							<b>25</b>

### III SEMESTER

S. No	Course Code	Course Name	Pre-requisite Courses	Credits*			
				L	T	P	Total
1.	MCA31	Software Engineering and Agile Methodologies		3	1	0	4
2.	MCA32	Artificial Intelligence and Machine Learning	MCA11 MCA12	3	0	1	4
3.	MCA33	Information Security		3	0	1	4
4.	MCA34	Cloud Computing <sup>#</sup>	MCA14 MCA24	0	1	2	3
5.	MCAE4-	Elective IV					3
6.	MCAE5-	Elective V					3
7.	MCAE6-	Elective VI					3
8.	MCAP1	Mini Project					2
9.	MCASA	Societal Activity					0
<b>Total</b>							<b>26</b>

### IV SEMESTER

S. No	Course Code	Course Name	Credits*			
			L	T	P	Total
1.	MCA41	Project Work				20
2.	MCAS1	Seminar				2
3.	MCAIN	Industry Internship				2
4.	MCAAEC	Ability Enhancement Course				1
<b>Total</b>						<b>25</b>



### ELECTIVE I

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCAE11 <sup>#</sup>	Full Stack Development	MCA17	0	1	2	3
2.	MCAE12 <sup>#</sup>	ASP.Net with C#	MCA17	0	1	2	3
3.	MCAE13 <sup>#</sup>	User Interface and User Experience Design	MCA17	0	1	2	3
4.	MCAE14 <sup>#</sup>	Computer Graphics and Animation		0	1	2	3
5.	MCAE15 <sup>#</sup>	Power BI		0	1	2	3

### ELECTIVE II

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCAE21	Digital Forensics		2	0	1	3
2.	MCAE22	UNIX Systems Programming	MCA14	2	0	1	3
3.	MCAE23	Operations Research		2	1	0	3
4.	MCAE24	Social Network Analysis		2	0	1	3
5.	MCAE25	Augmented and Virtual Reality		2	0	1	3

### ELECTIVE III

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCAE31 <sup>#</sup>	Programming IoT	MCA11	0	1	2	3
2.	MCAE32 <sup>#</sup>	Introduction to Spring Boot and Microservices		0	1	2	3
3.	MCAE33 <sup>#</sup>	Go Programming		0	1	2	3
4.	MCAE34 <sup>#</sup>	Web Programming with PHP and AJAX	MCA17	0	1	2	3
5.	MCAE35	Secure Coding in C and C++		2	0	1	3

### ELECTIVE IV

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCAE41	Ethical Hacking and Penetration Testing		2	0	1	3
2.	MCAE42	Digital Marketing		3	0	0	3
3.	MCAE43 <sup>#</sup>	Software Testing	MCA11	0	1	2	3
4.	MCAE44 <sup>#</sup>	Big Data Analytics	MCA23	0	1	2	3
5.	MCAE45	Blockchain Technology		2	0	1	3

### ELECTIVE V

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCAE51 <sup>#</sup>	Web Component Development with J2EE	MCA21	0	1	2	3
2.	MCAE52 <sup>#</sup>	Mobile Application Development	MCA21	0	1	2	3
3.	MCAE53	Object Oriented Modeling and Design		2	0	1	3
4.	MCAE54 <sup>#</sup>	DevOps		0	1	2	3
5.	MCAE55	Edge Computing		3	0	0	3

### ELECTIVE VI

S. No	Course Code	Course Name	Pre-requisite Course(s)	Credits*			
				L	T	P	Total
1.	MCAE61	Software Project Management		3	0	0	3
2.	MCAE62	Management and Entrepreneurship		3	0	0	3
3.	MCAE63	Design Thinking		3	0	0	3
4.	MCAE64	Enterprise Resource Planning		3	0	0	3
5.	MCAE65	Management Information Systems		3	0	0	3

**<sup>#</sup> Semester End Examination will be conducted for Laboratory**

**<sup>##</sup> Audit Course. Only for Non-BCA students**

**\* L: Lecture**

**T: Tutorial**

**P: Practical**

# **I SEMESTER**

<b>PROGRAMMING WITH PYTHON</b>	
<b>Subject Code: MCA11</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### Unit 1

#### **Introduction to Python**

**Python Basics:** Data Types, Operators, Input/Output Statements, Creating Python Programs.

**Python Flow Control statements:** Decision making statements, Indentation, Conditionals, loops, break, continue, and pass statements.

**Core Data Structures:** Strings, Lists, Tuples, and Dictionaries.

### Unit 2

**Python Functions:** Defining functions, DOC strings, Function parameters: default, keyword required and variable length arguments, key-word only parameters, local and global variables, pass by reference versus value, Recursion.

**Functional Programming:** Mapping, Filtering and Reduction, Lambda Functions, List Comprehensions.

### Unit 3

**Object Oriented Programming:** Definition and defining a class, Constructor, Destructor, self and del keywords, Access to Attributes and Methods, getattr, setattr and hasattr attributes, Data Attributes and Class Attributes, Data Hiding, Inheritance, Static Members.

**Regular Expressions:** Defining Regular Expressions and String Processing

### Unit 4

**Working with Arrays:** Arrays, NumPy

**File I/O:** File object attributes, Read and Write into the file, Rename and Delete a File.

**Exceptions Handling:** Handling Exceptions, Built-in Exceptions and User defined Exceptions.

### Unit 5

**Working with Django:** Rendering Templates into HTML and Other Formats, Understanding Models, Views, and Templates, Separating the Layers (MVC) - Models, Views, Templates, Overall Django Architecture, Defining and Using Models, Templates and Form Processing, Setting up the Database, Using a Database Server, Using SQLite, Creating the Tables.

### Laboratory

- Programs that supplement the theory concepts are to be implemented.

#### **References:**

1. Timothy A. Budd: Exploring Python, Tata McGraw-Hill, 2011.
2. Ascher, Lutz: Learning Python, 4<sup>th</sup> Edition, O'Reilly, 2009.

3. Jeff Forcier, Paul Bissex, Wesley Chun: Python Web Development with Django, Addison-Wesley (e-book), 2008.
4. Wesley J Chun: Core Python Applications Programming, Pearson Education, 3<sup>rd</sup> Edition, 2013.
5. <https://www.tutorialspoint.com/python/>

**Course Outcomes (COs):**

1. Apply the basic and core data structures of Python programming. (PO-1, PO-2, PO-3, PO-5, PO-9)
2. Develop modular programs using functions. (PO-1, PO-2, PO-3, PO-5, PO-9)
3. Implement object-oriented concepts and regular expressions. (PO-1, PO-2, PO-3, PO-5, PO-9)
4. Demonstrate arrays, files and exception handling. (PO-1, PO-2, PO-3, PO-5, PO-9)
5. Create web applications using Django framework. (PO-1, PO-2, PO-3, PO-5, PO-9)

<b>COMPUTATIONAL MATHEMATICS</b>	
<b>Subject Code: MCA12</b>	<b>Credits: 3:1:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28T</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Fundamentals of Logic:** Basic Connectives and Truth Tables, Logic Equivalence - the laws of Logic, Logical Implications, Rules of Inference, The use of Quantifiers.

### **Unit 2**

**Set Theory:** Sets and Subsets, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams

**Relations and Functions:** Cartesian Products and Relations, Functions: Plain and One-to-One, Onto Functions, The Pigeonhole Principle, Function Composition and Inverse Functions, Properties of Relations, Computer Recognition: Zero-One Matrices and Directed Graphs.

### **Unit 3**

**Graph Theory:** Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree: Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles, Graph Coloring and Chromatic Polynomials

### **Unit 4**

**Probability:** A First word on Probability, The Axioms on Probability, Conditional Probability: Independence

**Descriptive Statistics:** Measures of Central Tendency, Measures of Dispersion, Moments, Skewness and Kurtosis

### **Unit 5**

**Distributions and Test of Significance:** Theoretical Distributions Overview-Uniform, Binomial, Poisson, Normal; Theory of Test of Significance, Small Sample Tests

#### **Text Books:**

1. Ralph P Grimaldi, B V Ramana: Discrete and Combinatorial Mathematics, An Applied Introduction, 5<sup>th</sup> Edition, Pearson Education, 2007.
2. N G Das: Statistical Methods, McGraw Hill Education (India) Private Limited, 2009. (5.1,5.2,5.11,5.12,5.14,5.15,5.17 to 5.19, 6.1 to 6.5, 6.7, 7.1,7.3,7.7,7.8, 12.1,12.2,12.4 to 12.6,12.11 to 12.13, 14,6, 14.8)

**Course Outcomes (COs):**

1. Apply the notion of mathematical logic and proof and be able to apply them in problem solving
2. Solve Problems which involve discrete data structure such as relations and functions and its associated properties.
3. Evaluate the given problem by applying the concepts of graph theory. (PO-1, PO-2)
4. Apply probability for uncertainty and examine the data characteristics. (PO-1, PO-2, PO-4)
5. Analyze various data distributions using hypothesis testing. (PO-1, PO-2, PO-4)



<b>COMPUTER ORGANIZATION</b>	
<b>Subject Code: MCA13</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Binary Systems:** Digital Systems, Binary Numbers, Number Base Conversion, Octal and Hexadecimal Numbers, Complements, Signed Binary Numbers, Binary Codes.

**Boolean Algebra and Logic Gates:** Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic gates

### **Unit 2**

**Basic Structure of Computers:** Basic Operational Concepts, Bus Structures, Performance: Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.

**Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instructions & Instruction Sequencing, Addressing Modes, Assembly Language.

### **Unit 3**

**Input/output organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access.

**Memory:** Some Basics concepts, Semiconductors RAM Memories, Read-Only Memories, Cache Memories-Mapping Functions.

### **Unit 4**

**Arithmetic Unit:** Addition & Subtraction of Signed Numbers, Design of Fast adders, Floating – Point Numbers and Operations.

**Basic Processing Unit:** Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization.

### **Unit 5**

**Control Signals:** Hard-Wired Control, Micro Programmed Control.

**Embedded Systems and Large Computer Systems:** Examples of Embedded Systems, Processor chips for embedded applications, Simple Microcontroller.

#### **Text Books:**

1. M. Morris Mano: Digital Logic and Computer Design, 4th Edition, Pearson Education, 2008. Chapters: 1.1 to 1.6, 2.1 to 2.4, 2.7.
2. Carl Hamacher, Z Varnesic and S Zaky: Computer Organization, 5<sup>th</sup> Edition, McGraw Hill, 2002.

Chapters: 1.3, 1.4, 1.5, 1.6.1, 1.6.2, 1.6.4, 1.6.7,2.2,2.3,2.4,2.5,2.6.1,2.6.2, 4.1, 4.2.1, 4.2.2,4.2.3 4.4, 5.1, 5.2.1,5.2.2, 5.3, 5.5.1, 6.1, 6.2, 6.7, 7.1, 7.2, 7.3, 7.4, 7.5.1, 7.5.2,7.5.3,9.1,9.2,9.3

**Course Outcomes (COs):**

1. Apply number system conversion and Boolean algebra. (PO-1, PO-2, PO-3)
2. Explain the structure of computers and concept of programs as sequences of machine instructions. (PO-1, PO-2, PO-3)
3. Discuss the organization of input/output devices and design of memory systems. (PO-1, PO-2)
4. Illustrate advanced Arithmetic operations and execution of instructions. (PO-1, PO-2, PO-3)
5. Describe the concepts of control signals and embedded system architecture. (PO-1, PO-2, PO-3)

<b>OPERATING SYSTEMS</b>	
<b>Subject Code: MCA14</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

#### **Introduction to Operating Systems, System Structure**

What operating systems do, Operating System Operations, Computing Environments, Operating System Services, System Calls, Types of System Calls, System Programs, Operating System Structure, System Boot

### **Unit 2**

**Process Concept:** Process Concept, Process Scheduling, Interprocess Communication

**Process Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms

**Synchronization:** Background, The Critical Section Problem, Mutex Locks, Semaphores, Classic Problems of Synchronization: Readers-Writers Problem, Dining Philosopher's Problem using Semaphores

### **Unit 3**

**Deadlocks:** Deadlocks: System model, Deadlock Characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock

### **Unit 4**

**Memory Management Strategies:** Basic Hardware, Swapping, Contiguous Memory Allocation, Segmentation, Paging,

**Virtual Memory Management:** Background, Demand Paging, Page Replacement

### **Unit 5**

**File System:** File concept, Access methods, Directory overview

**Implementing File System:** Allocation methods, Free Space Management

**Mass Storage Structures:** Overview of Mass Storage Structure, Disk Scheduling, Disk Management, Swap Space Management

### **Laboratory**

#### **Unix Laboratory covering the following topics:**

- General Purpose Utilities: man, cal, date, echo, printf, bc, script, who, uname, tty
- File and Directory Handling commands: cat, cp, rm, mv, file, wc, pwd, cd, mkdir, rmdir, File Permissions, Hard Links, Symbolic Links
- Understanding the Shell: Wild cards, Escaping, Quoting, Redirection, Pipes, tee, Command Substitution, Shell Variables
- Simple Filters: pr, head, tail, cut, paste, sort, uniq, tr
- Filters using Regular Expressions: grep, sed

- The Process: Process status, Process Creation, Running and Killing Processes, at, batch, cron
- Simple Shell scripts

### **Text Books:**

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating Systems Principles, 9<sup>th</sup> Edition, Wiley – India, 2018.  
Chapters: 1.1, 1.5, 1.11, 2.1, 2.3, 2.4, 2.5, 2.10, 3.1, 3.2, 3.4, 5.1, 5.2, 5.3, 6.1, 6.2, 6.5, 6.6.1, 6.6.2, 6.6.3, 6.7.2, 6.7.3, 7, 8.1.1, 8.2, 8.3, 8.4, 8.5.1, 8.5.2, 9.1, 9.2.1, 9.4.1, 9.4.2, 9.4.3, 9.4.4, 10.1.1, 10.1.2, 10.1.3, 10.2, 10.3.2, 11.4.1, 11.4.2, 11.4.3, 11.5, 12.1, 12.4, 12.5, 12.6
2. Sumitabha Das: UNIX Concepts and Applications, 4<sup>th</sup> Edition, Tata McGraw Hill, 2017.

### **Reference Books:**

1. D M Dhamdhare: Operating Systems – A Concept Based Approach, 3<sup>rd</sup> Edition, Tata McGraw – Hill, 2017.
2. Harvey M Deital: Operating Systems, 3<sup>rd</sup> Edition, Addison Wesley, 1990.

### **Course outcomes (COs):**

1. Explain the elements and various functionalities of the operating system using different utilities in Unix (PO-1, PO-2, PO-3, PO-5, PO-9)
2. Apply the techniques of process management and demonstrate process synchronization (PO-1, PO-2, PO-3, PO-5, PO-9)
3. Demonstrate deadlock handling and process control. (PO-1, PO-2, PO-3, PO-5, PO-9)
4. Demonstrate various memory allocation strategies, virtual memory techniques (PO-1, PO-2, PO-3)
5. Explain the physical and logical structure of the storage media and illustrate various algorithms for storage management (PO-1, PO-2, PO-3, PO-5, PO-9)

<b>DATA STRUCTURES</b>	
<b>Subject Code: MCA15</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Introduction to Data Structures:** Need of Data Structure, Basic Concepts, Types

**Recursion:** Recursive definition and processes, Example on recursion: Factorial, Fibonacci numbers, Towers of Hanoi problem

**Stack:** Introduction to Stacks, Operations on a Stack, Applications of Stacks: infix to postfix, evaluation of a postfix expression

### **Unit 2**

**Queues:** Introduction to Queues, Array Representation of Queues, Types of Queues: Circular Queues, Deques, Priority Queues.

**Linked list:** Introduction, Singly Linked Lists, Doubly Linked List, Circular Linked Lists.

### **Unit 3**

**Trees:** Basic Tree Concepts, Binary Tree - Traversals, Expression Tree,

**Binary Search Tree:** Binary Search Trees – Basic Concepts, Operations, Threaded Trees

### **Unit 4**

**Advanced concepts in Trees:** AVL Search trees - Basic concepts, implementations, Heaps - Basic Concepts, implementation.

### **Unit 5**

**Multi-way trees:** Multi-way trees, B-trees – Basic Concepts, Implementation, Simplified B-Trees: 2-3 tree, 2-3-4 tree

**Graphs:** Basic concepts, operations - traversals, storage structures, graph algorithms.

### **Laboratory**

- Students shall implement programs that supplement the theory concepts

#### **Text Books:**

1. Richard F Gilberg and Behrouz A Forouzan: Data Structures - A Pseudocode Approach with C, Cengage Learning, 6<sup>th</sup> Indian Reprint, 2009.
2. Yedidyah Langsam and Moshe J. Augenstein and Aaron M Tenenbaum: Data Structures using C and C++ by, 2<sup>nd</sup> Edition, Pearson Education Asia, 2004.

#### **Reference Books:**

1. Reema Thareja: Data Structures Using C, 2<sup>nd</sup> Edition, Oxford University Press, 2018.

**Course Outcomes (COs):**

1. Apply the concepts of recursion and stack for real world problems. (PO-1, PO-2, PO-3, PO-5, PO-9)
2. Implement the queue and list for real world applications. (PO-1, PO-2, PO-3, PO-5, PO-9)
3. Demonstrate the usage and operation of binary search trees. (PO-1, PO-2, PO-3, PO-5, PO-9)
4. Demonstrate the operations of AVL tree and heap. (PO-1, PO-2, PO-3, PO-5, PO-9)
5. Exhibit the construction of Multi way Trees and traversal of graphs. (PO-1, PO-3, PO-5, PO-9)

<b>PROFESSIONAL COMMUNICATION AND ETHICS</b>	
<b>Subject Code: MCA16</b>	<b>Credits: 1:1:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 14L 28T</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Formal Presentations:** Introduction, Planning, Outlining and Structuring, Nuances of Delivery, Guidelines for Effective Delivery, Visual Aids in Presentations

### **Unit 2**

**Group Communication:** Introduction, Use of Body Language in Group Communication, GD as part of a Selection

**Email:** Introduction, Letter Writing, Email

**Research Papers:** Research Papers

### **Unit 3**

**Interviews:** Introduction, Objectives of Interviews, Types of Interviews

**Resumes:** Resume, biodata and curriculum vitae, Resume Design

### **Unit 4**

**An Overview of Ethics:** What Is Ethics? Ethics in the Business World

**Intellectual Property:** What Is Intellectual Property? Copyrights, Patents, Trade Secrets, Key Intellectual Property Issues

### **Unit 5**

**Ethics of IT Organizations:** Key Ethical Issues for Organizations, Contingent Workers, Outsourcing, Whistle-Blowing

#### **Text Books:**

1. Meenakshi Raman and Sangeeta Sharma: Technical Communication-Principles and Practices, 3<sup>rd</sup> Edition, Oxford University Press, 2015.
2. George Reynolds: Ethics in Information Technology, 5<sup>th</sup> Edition, Cengage, 2015.

#### **Course Outcomes (COs):**

1. Demonstrate the skills of presentation. (PO-6, PO-9, PO-11)
2. Demonstrate the skills of email writing, research paper and group discussion etiquettes. (PO-6, PO-9, PO-11)
3. Apply the skills of writing resumes and attending interview. (PO-6, PO-9, PO-11)
4. Adapt ethical practices in day to day life and profession and explain the legal process of acquiring an Intellectual Property Rights. (PO-6, PO-9, PO-10, PO-11)
5. Demonstrate the ethics of IT organizations etiquettes. (PO-6, PO-9, PO-10, PO-11)

<b>WEB PROGRAMMING</b>	
<b>Subject Code: MCA17</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Topics to be covered in Tutorial**

- Introduction to HTML5, Basic HTML Tags
- HTML Forms, Graphics and Media
- Designing HTML pages using CSS
- Basics of XML and DTD
- Introduction to JavaScript, JavaScript variables, operators
- Conditional and loop statements in JavaScript
- Functions and Arrays in JavaScript
- Event Handling and Document Object model in JavaScript
- Handling strings and working with window object
- New Features in ES6, Introduction to JSON
- Introduction to Bootstrap
- Developing web pages using Bootstrap

### **Laboratory**

- Programs supplementing the concepts covered in tutorial.
- Students are expected to build a website using HTML5, Bootstrap and JavaScript.

### **Reference Books:**

1. KOGENT Learning Solutions Inc.: HTML5BLACK BOOK, Dream tech Press, 2011.
2. Robert W. Sebesta: Programming the World Wide Web, 4<sup>th</sup> Edition, Pearson Education, 2008.
3. BOOTSTRAP Responsive Web Development by Tutorials Point.

### **Course Outcomes (COs):**

1. Develop web pages using HTML5, CSS and XML. (PO-1,2,3,5)
2. Develop interactive web pages using JavaScript. (PO-1,2,3,5)
3. Develop web pages using Bootstrap framework. (PO-1,2,3,5,7,9,12)



<b>BRIDGE COURSE</b>	
<b>Subject Code: MCABC</b>	<b>Credits: 0:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### Unit 1

**Introduction:** Introduction, Structure of C/C++ Program, comments, keywords and identifiers, constants, data types, variables, variable declaration and initialization, reference variables defining symbolic constants, const keyword.

**Operators and Expressions:** Arithmetic, relational, logical, assignment, increment and decrement, conditional, bitwise, comma, shorthand operators, scope resolution operator, arithmetic/relational expressions.

**Managing Input and Output Operations:** Formatted input and output functions: scanf() and printf(), cin and cout statements.

### Unit 2

**Decision Making and Branching:** Decision making with if statement, simple if, if..else , nesting of if..else, the else..if ladder, the switch, the ?: operator, the break statement, Sample C/C++ programs.

**Decision Making and Looping:** The while, do..while, for loops, nested loops, the continue.

### Unit 3

**Arrays:** Introduction, one dimensional and two-dimensional arrays, declaration and initialization of arrays, reading, writing and manipulation of above types of arrays, programming examples. Sample C and C++ programs.

**Functions:** Introduction, types of functions, Function declaration, function definition, function calls, parameter passing techniques, category of functions, function with default arguments. Function overloading, inline function.

### Unit 4

**Structures:** Defining a structure, declaring structure variables, accessing structure members.

**Classes and Objects:** Introduction to classes, objects, Difference between structure and classes. Member Function definition, function overloading, Inline functions, Static class members, Returning objects, Array of objects. Friend functions.

#### **Constructors and destructors**

Introduction, default constructors, parameterized constructors, copy constructors, Destructors, overloading constructors.

### Unit 5

**Inheritance:** Introduction, Base class access control, inheritance and protected members, types of Inheritances, constructors, destructors, passing arguments to base class constructor, granting access, virtual base classes.

**Pointers and Dynamic Memory Allocation:** Introduction to pointers, declaring and initialization pointer variables, accessing a variable through its pointer, example programs. Dynamic Memory Allocation using new and delete operators.

**Exception Handling:** Exception handling fundamentals, catching all exceptions.

### **Laboratory**

- Students shall implement programs which supplement the theory concepts (Platform Linux; GCC Compiler)

### **Text Books:**

1. Balagurusamy: Programming in ANSI C, 6<sup>th</sup> Edition, Tata McGraw Hill, 2010.
2. Herbert Schildt: The Complete Reference C++, 4<sup>th</sup> Edition, Tata McGraw Hill, 2003.
3. E Balagurusamy: Object Oriented Programming with C++, 6<sup>th</sup> Edition, Tata McGraw Hill Publishing Company Limited. NEW DELHI.

### **Reference Books:**

1. V Rajaraman: Computer Programming in C, Prentice Hall India, 2000.
2. Herbert Schildt: C The Complete Reference, 4<sup>th</sup> Edition, Tata McGraw Hill, 2000.
3. Stanley B.Lippmann, JoseeLajore: C++ Primer, 4<sup>th</sup> Edition, Addison Wesley, 2005.
4. Bjarne Stroustrup: The C++ Programming Language, Pearson Education, 2000.

### **Course Outcomes (COs):**

1. Develop C and C++ programs using basic constructs. (PO-1, PO-2, PO-3, PO-5, PO-9)
2. Determine the suitable control statements and implement the solution. (PO-1, PO-2, PO-3, PO-5)
3. Implement operations on arrays and develop user defined functions. (PO-1, PO-2, PO-3, PO-5)
4. Apply concepts of structures, classes, objects and constructor to solve problem. (PO-1, PO-2, PO-3, PO-5)
5. Develop classes by applying suitable type of inheritance, demonstrate dynamic memory allocation using pointers, new and delete. (PO-1, PO-2, PO-3, PO-5).

## **II SEMESTER**

<b>PROGRAMMING IN JAVA</b>	
<b>Subject Code: MCA21</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### Unit 1

**Introducing Classes:** Introduction to Java, Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage, The finalize() Method, Exploring the String Class, Using Command-Line Arguments, Varargs, Scanner class.

**Inheritance:** Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class.

### Unit 2

**Packages and Interfaces:** Packages, Access Protection, An Access Example Importing Packages, Interfaces, Default Interface methods.

**Exception Handling:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions Using try and catch, multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses.

### Unit 3

**Multithreaded Programming:** The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive( ) and join( ), Thread Priorities, Synchronization, Inter-thread Communication, Suspending, Resuming, and Stopping Threads, Obtaining thread state, Using Multithreading

**Enumeration and Autoboxing:** Enumeration, Type Wrappers, Autoboxing.

**Generics:** What are Generics?, A Simple Generics Example, A Generics Class with two Type Parameters, The General Form of a Generic Class.

### Unit 4

**The Collections Framework:** Collections Overview, The Collection Interfaces, The List Interface, The ArrayList Class, The LinkedList Class.

**Networking:** Networking Basics, Client server communication using TCP and UDP.

**Lambda Expressions:** Introducing Lambda Expressions, Block Lambda Expression.

### Unit 5

**Event Handling:** Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, The event class, The Key event, Class Sources of Events, Event Listener Interfaces, Using the Delegation Event Model, Adapter Classes, Inner Classes.

**JavaFX:** Introducing JavaFX GUI programming, Exploring JavaFX controls.

## **Laboratory**

- Programs that supplement the theory concepts are to be implemented.

## **Text Books:**

1. Herbert Schildt: The Complete Reference JAVA, 9<sup>th</sup> Edition, TATA McGraw HILL, 2014. Chapters: 2, 6, 7, 8, 9, 10, 11, 12, 14, 15, 18, 22, 24, 34, 35

## **Reference Books:**

1. Paul Deitel and Harvey Deitel: Java How to Program, 9<sup>th</sup> Edition, PHI, 2012.
2. Y.Daniel Liang: Introduction to JAVA Programming, 6<sup>th</sup> Edition, Pearson Education, 2006
3. Cay S Horstmann, Gary Cornell: Core Java 2 volume 1 and volume 2, 7<sup>th</sup> Edition, Pearson Education, 2005.

## **Course Outcomes (COs):**

1. Develop programs using the OOP concepts and basic constructs in Java for a given problem. (PO-1, PO-2, PO-3, PO-5)
2. Exemplify the usage of Packages, Interfaces and Exceptions for OO Programming. (PO-1, PO-2, PO-3, PO-5)
3. Apply Generics, Multithreading, Enumerations, and Auto boxing Concepts to develop robust programs. (PO-1, PO-2, PO-3, PO-5)
4. Implement the concepts of Networking, and analyze the usage of collection framework and lambda expression. (PO-1, PO-2, PO-3, PO-5)
5. Develop User Interfaces using JavaFX with Event Handling for Dynamic Applications. (PO-1, PO-2, PO-3, PO-5)

<b>DESIGN AND ANALYSIS OF ALGORITHMS</b>	
<b>Subject Code: MCA22</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: MCA15</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Introduction:** Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Basics of data Structures.

**Fundamentals of the Analysis of Algorithm Efficiency:** Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non recursive algorithms, Examples.

### **Unit 2**

**Brute Force:** Selection Sort, String Matching, Exhaustive Search.

**Divide-and-Conquer:** Merge sort, Quick sort, Binary Search, Multiplication of large integers.

**Principles of Parallel Algorithm Design:** Preliminaries-Decomposition, tasks, and Dependency graphs, Granularity, Concurrency and Task-Interaction, Decomposition Techniques.

### **Unit 3**

**Decrease-and-Conquer:** Insertion Sort, Depth First and Breadth First Search, Topological sorting, Algorithms for Generating Combinatorial Objects.

**Transform-and-Conquer:** Presorting, Heaps and Heap Sort.

### **Unit 4**

**Space and Time Tradeoffs:** Sorting by Counting, Input Enhancement in String Matching, Hashing.

**Dynamic Programming:** Warshall's and Floyd's Algorithms.

**Greedy Technique:** Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees.

### **Unit 5**

**Backtracking:** n-queens problem, Hamiltonian Circuit Problem, Subset-Sum Problem, General Remarks.

**Branch-and-Bound:** Knapsack problem, Traveling Salesman Problem.

**P, NP-Completeness and Approximation Algorithms:** Introduction, P and NP Problems, NP-complete problems, Approximation algorithms for the traveling salesman problem, Approximation algorithms for Knapsack problem.

### **Laboratory**

- Programs that supplement the theory concepts are to be implemented.

**Text Books:**

1. Anany Levitin: Introduction to the Design and Analysis of Algorithms, 2nd Edition, Pearson Education, 2009.  
Chapters 1.1-1.4, 2.1-2.4, 3.1, 3.2, 3.4, 4.1-4.3, 4.5, 5.1-5.4, 6.1, 6.4, 7.1-7.3, 8.2, 9.1-9.4, 11.3, 12.1-12.3
2. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, 2nd Edition, Pearson Education, 2003.  
Chapters 3.1.1, 3.1.2, 3.2

**References:**

1. Horowitz E., Sahani S., Rajasekharan S.: Fundamentals of Computer Algorithms, 2<sup>nd</sup> Edition, Universities Press, 2007.
2. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein: Introduction to Algorithms, 3<sup>rd</sup> Edition, PHI, 2010.

**Course Outcomes (COs):**

1. Derive the time complexity of algorithms in terms of asymptotic notations. (PO-1, PO-2, PO-4, PO-5, PO-9)
2. Apply the brute force, divide and conquer and parallel algorithm approaches for designing algorithm and determining the order of growth. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-9)
3. Implement the decrease and conquer and transform and conquer approach for designing and determining the order of growth of algorithms. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-9)
4. Demonstrate the design techniques dynamic programming and greedy technique to solve problems and determine the time complexity. Describe the space and time tradeoffs for algorithms. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-9)
5. Apply the branch and bound and backtracking approach for solving problem and describe the concepts of NP-hard problem. (PO-1, PO-2, PO-3, PO-4)

<b>DATABASE SYSTEMS</b>	
<b>Subject Code: MCA23</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Introduction:** Introduction, Database Architecture

**Relational Model:** Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update operations, Transactions, and Dealing with Constraint Violations

**SQL:** SQL Data Definition and Data Types; Specifying constraints in SQL, Schema Modification

### **Unit 2**

**SQL:** Basic Retrieval Queries in SQL; INSERT, DELETE and UPDATE statements in SQL; Additional features of SQL, Complex Queries

**PL/SQL:** Introduction to PL/SQL, Procedures and Functions, Triggers

### **Unit 3**

**Entity-Relationship Model:** Using High-Level Conceptual Data Models for Database Design, Entity Types, Entity Sets, Attributes and Keys; Relationship Types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams

**Database Design:** Functional Dependencies; Normal Forms Based on Primary Keys.

### **Unit 4**

#### **Advanced Databases**

**Object Oriented Databases:** Object Database Concepts

**Distributed Databases:** Distributed Database Concepts, Types of Distributed Database Systems, Distributed Database Architectures, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design

**Big Data:** Introduction to big data, NoSQL Databases and their Benefits - MongoDB, CouchDB, HBase, Cassandra DB, InfiniteGraph

### **Unit 5**

**MongoDB:** Introduction: Features, Database, Collection, Documents, Data Types CRUD

Operations: Create, Read, Update, Delete, Bulk Write Aggregation: Aggregation Pipeline, Map-Reduce, Single Purpose Aggregation Operations

### **Laboratory**

- Programs that supplement the theory concepts are to be implemented.

#### **Text Book:**

1. Ramez Elmasri and Shamkanth B Navathe: Fundamentals of Database Systems, 6<sup>th</sup> Edition, Pearson Education, 2011.  
Chapters: 1.1, 1.4, 2.1, 2.2, 2.4.1, 3, 4, 5.1, 7.1 to 7.7, 7.9, 11.1, 15.1 to 15.3, 25.1 to 25.4



2. Kristina Chodorow: MongoDB: The Definitive Guide: Powerful and Scalable Data Storage, 3<sup>rd</sup> Edition, O'Reilly, 2020.

**Web Links:**

1. <http://plsql-tutorial.com>
2. <http://k.web.umkc.edu/kumarv/cs471/oracle-arch.htm>
3. <https://docs.mongodb.com/>

**Reference Books:**

1. Abraham Silberschatz, Henry F Korth and S Sudarshan: Data base System Concepts, 6<sup>th</sup> Edition, Mc-Graw Hill, 2011.
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3<sup>rd</sup> Edition, McGraw-Hill, 2003.
3. C.J. Date, A. Kannan, S. Swamynatham: An Introduction to Database Systems, 8<sup>th</sup> Edition, Pearson education, 2006.

**Course Outcomes (COs):**

1. Describe the basic architecture of the database management system and database schema with constraints. (PO-1, PO-3, PO-5, PO-9)
2. Execute SQL queries to access data and implement triggers, PL/SQL procedures and functions. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-9, PO-11)
3. Design ER model and relational database schema for real world application. (PO-1, PO-2, PO-3, PO-7, PO-9, PO-11, PO-12)
4. Explain different databases and Compare the significance of different NoSQL databases. (PO-1,PO-3)
5. Perform mongodb crude operations and aggregation. (PO- 1, PO-2, PO-3, PO-5, PO-7, PO-9, PO-11, PO-12)

<b>COMPUTER NETWORKS</b>	
<b>Subject Code: MCA24</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Computer Networks and the Internet:** What Is the Internet? The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and Their Service Models.

### **Unit 2**

**Application Layer:** Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, DNS—The Internet’s Directory Service, Peer-to-Peer Applications.

### **Unit 3**

**Transport Layer:** Introduction and Transport-Layer Services, Multiplexing and De-multiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection-Oriented Transport: TCP.

### **Unit 4**

**Transport Layer:** Principles of Congestion Control, TCP Congestion Control.

**The Network Layer:** Introduction, Virtual Circuit and Datagram Networks, What’s Inside a Router? The Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing Algorithms.

### **Unit 5**

**The Network Layer:** Routing in the Internet Broadcast and Multicast Routing.

**The Link Layer and Local Area Networks:** Link Layer: Introduction and Services, Error-Detection and Correction Techniques, Multiple Access Protocols, Link- Layer Addressing.

### **Laboratory**

- Exercises to supplement the concepts using existing tools

### **Text Books:**

1. James F. Kurose, Keith W. Ross: Computer Networking: A Top-Down Approach, 5<sup>th</sup> Edition, Addison-Wesley, 2012.  
Chapters: 1.1 – 1.5, 2.1 - 2.6, 3, 4.1- 4.7, 5.1 - 5.4

### **Reference Books:**

1. Behrouz A. Forouzan: Data Communications and Networking, 4<sup>th</sup> Edition, Tata McGraw-Hill, 2006.
2. Alberto Leon-Garcia and Indra Widjaja: Communication Networks-Fundamental Concepts and Key architectures, 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2004.

3. William Stallings: Data and Computer Communication, 8<sup>th</sup> Edition, Pearson Education, 2007.
4. Larry L. Peterson and Bruce S. David: Computer Networks – A Systems Approach, 4<sup>th</sup> Edition, Elsevier, 2007.
5. Wayne Tomasi: Introduction to Data Communications and Networking, Pearson Education, 2005.
6. Nader F. Mir: Computer and Communication Networks, Pearson Education, 2007.

**Course Outcomes (COs):**

1. Describe basic terminologies used for computer networking. (PO-1, PO-2, PO-3, PO-5)
2. Demonstrate application layer protocols used for Process to Process Communication and illustrate using packet tracer and wireshark. (PO-1, PO-2, PO-3, PO-5, PO-9)
3. Describe the transport layer protocols and illustrate using wire shark. (PO-1, PO-2, PO-3, PO-5, PO-9)
4. Familiarize with network layer protocols and simulate using packet tracer. (PO-1, PO-2, PO-3, PO-5, PO-9)
5. Explain link-layer functionalities. (PO-1, PO-2, PO-3, PO-5)

# **ELECTIVE I**

<b>FULL STACK WEB DEVELOPMENT</b>	
<b>Subject Code: MCAE11</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA17</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Concepts to be covered in Tutorial**

1. Introduction to ReactJS, Express JS and Node.js.
2. React features, components, keys, lists, refs.
3. React CSS, Adding Bootstrap for React, React Props Validation.
4. React forms, events, React Conditional Rendering.
5. Node.js First Application, REPL Terminal, Package Manager(NPM).
6. Node.js Callbacks, Even Loop, Event Emitter.
7. Node.js Buffers, Streams and File System.
8. Express JS Routing, HTTP Methods.
9. Express JS URL Building, Templating, Static Files.
10. Express JS Cookies, Sessions and Authentication.
11. Connecting MongoDB, insert documents, update/delete documents, Query Database.

### **Laboratory**

- Programs supplementing the concepts covered in Tutorial.
- Building of small applications using above Frameworks

### **References**

1. Mean Web Development Second Edition, PACKT
2. <http://www.tutorialpoint.com/reactjs/>
3. <http://www.tutorialpoint.com/nodejs/>
4. <http://www.tutorialpoint.com/expressjs/>

### **Course Outcomes (COs):**

1. Demonstrate and Develop simple programs using ReactJS. (PO-1,2,3,5,6,9)
2. Demonstrate and Develop simple programs using Express JS. (PO-1,2,3,5,6,9)
3. Demonstrate and Develop simple programs using Node JS. (PO-1,2,3,5,6,9)

<b>ASP.NET WITH C#</b>	
<b>Subject Code: MCAE12</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA17</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Concepts to be covered in Tutorial**

1. Introduction to C#, Classes.
2. Concepts of ASP.NET Framework, and Applications
3. Working with Standard, List, Rich and Validation Controls.
4. Building Data Access Components with ADO.NET
5. Working with GridView, Repeater, Data list and Navigation Controls.
6. Concepts of LINQ to SQL.
7. Designing websites with Master pages.
8. Maintaining applications states in ASP .NET

### **Exercises for Laboratory:**

- Creating ASP.NET Applications
- Demonstrate the use of Standard and list controls
- Demonstrate the use of Rich and validation controls
- Design and develop an application to connect to a Database with ADO.NET and display using GridView.
- Design and develop an application to connect to a Database with ADO.NET and display using Repeaters.
- Design and develop an application to connect to a Database with ADO.NET and display using DataList Controls.
- Design and Develop an Application using Navigation controls.
- Demonstrate and Data Access with LINQ to SQL.
- Design and Develop an application to demonstrate the concepts of Master pages
- Demonstrate Applications state using cookies
- Demonstrate Applications state using sessions.

### **References:**

1. Herbert Schildt: Complete Reference C# 4.0, Tata McGraw Hill, 2010.
2. .NET 4.5 Programming (6-in-1), Black Book, Kogent Learning Solutions Inc., Wiley-Dream Tech Press.
3. Paul Deitel and Harvey Deitel: C# 2010 for Programmers, 4th Edition, Pearson Education.
4. Andrew Troelsen: Pro C# 5.0 and the .NET 4.5 Framework, 6th Edition, Apress.
5. Bart De Smet: C# 4.0 Unleashed, Pearson Education- SAMS Series.

**Course Outcomes (COs):**

1. Develop Interactive Web Applications using various Controls. (PO-2, PO-3, PO-5, PO-6, PO-8, PO-10, PO-11, PO-12)
2. Demonstrate the use of ADO.NET for Web Applications. (PO-2, PO-3, PO-5, PO-6, PO-8, PO-10, PO-11, PO-12)
3. Exhibit skills to use technologies like master pages and LINQ to develop highly responsive web applications (PO-2, PO-3, PO-5, PO-6, PO-8, PO-10, PO-11, PO-12)

<b>USER INTERFACE AND USER EXPERIENCE DESIGN</b>	
<b>Subject Code: MCAE13</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA17</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Topics to be covered in Tutorial**

- Usability of Interactive Systems
- Guidelines, Principles, and Theories
- Managing Design Processes
- Direct Manipulation and Virtual Environments
- Collaboration and Social Media Participation
- Balancing Function and Fashion
- UX- What is UX Designs? Why is UX so important? Full stack design, UX Design Process, Discovery and Planning, The UX Strategy, UX Research. UX analysis
- User Behavior Basics and User Research
- Designing Behavior.
- UI Design and Implementation

### **Laboratory**

Students have to design the User Interface components based on the theory concepts and Design Website template and Navigation using: Adobe Photoshop and Adobe Image Ready, Microsoft Visio, Paint.NET etc.

**CASE Tools:** Introduction to Adobe Photoshop, Adobe Image Ready, Paint.NET, Microsoft Visio, etc.

### **List of Projects (Domain)**

- Interface for online shopping website
- Mall Map
- e learning web site
- Tele-shopping
- Video/ Audio on demand web site
- Online banking
- ATM interface
- Automatic vending machine for Drinks
- Travel reservation system
- Booking of movie tickets
- Route finder
- Railway enquiry
- Students' Kiosk for institute's information
- Interface for waiter for billing (table wise etc.)
- Online buying of books.



- Online trading on Stock market
- Web site for buying Car
- University web site
- Week end holidays
- Pass port application tracking system
- Zoo information kiosk
- Museum Information Center
- Help desk for Hotel
- Hospital Management
- Servicing center for Automobile
- Patients information storage
- Website for Tuition class
- Catering Service (on-line chef)
- Marriage burro
- Placement agency
- Event management
- Web site for Device drivers and service center
- Just Dial type web site
- Website for promotions of new construction projects.

**Text Book:**

1. Shneiderman Plaisant Cohen Jacobs: Designing the User Interface, 5<sup>th</sup> Edition, Pearson Education, 2010.
2. Elvis Canziba: Hands-On UX Design for Developers: Design, prototype, and implement compelling user experiences from scratch. Packt Publishing, 2018.

**Course Outcomes (COs):**

1. Design the Usability of Interactive systems. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7)
2. Develop the design process of Direct manipulation and Collaboration systems. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7)
3. Develop the UI of particular domain. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-12)

<b>COMPUTER GRAPHICS AND ANIMATION</b>	
<b>Subject Code: MCAE14</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites:</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### Concepts to be covered in Tutorial

1. **Computer Graphics Basics:** Computer Graphics and Its Types, Application of Computer graphics, Basic functions used for Graphics.
2. **Output Primitives and Attributes of Output Primitives:** Output Primitive Points and Lines, Line Drawing Algorithms, Circle Generating Algorithms, Scan-Line Polygon Fill Algorithm
3. **2D Transformations:** Basic Transformations, Matrix Representation and Homogeneous Coordinates, Composite Transformations, Reflection and Shearing.
4. **3D Transformations:** Three-Dimensional Scaling, Three-Dimensional Shearing, Rotation, Reflection and Translation.
5. **Viewing and Clipping:** The viewing Pipeline, Clipping Operations, Point Clipping, Line Clipping, Polygon Clipping, Text Clipping, Exterior Clipping
6. **Computer Animation:** Introduction to animation techniques and concepts. Simple Key-framed Animation
7. **Lighting & Shading:** Rendering Shading Surfaces Rigid bodies and constraints Expressions
8. **Motion capture based animation:** Inertial Motion Capture Body Suit System, Shaders, Material Palettes and Rendering

### Exercises for Laboratory:

- Programs Supplementing the concepts covered in Tutorial
- Students are expected to build an application using Graphics and Animation.

### References:

1. Edward Angel: Interactive Computer Graphics - A Top-Down Approach using OpenGL, 5<sup>th</sup> Edition, Pearson Education, 2014.
2. Hearn and Baker: Computer Graphics with OpenGL, 3<sup>rd</sup> Edition, Pearson 2009.
3. Malay K Pakhira: Computer Graphics Multimedia and Animation, 2<sup>nd</sup> Edition, PHI, 2010.

### Course Outcomes (COs):

1. Develop programs using the concepts of Computer Graphics. (PO-1, PO-2, PO-3, PO-5)
2. Develop programs using the concepts of Animation. (PO-1, PO-2, PO-3, PO-5)
3. Develop an application using features of Graphics and Animation. (PO-1, PO-2, PO-5, PO-8, PO-9, PO-10)

<b>POWER BI</b>	
<b>Subject Code: MCAE15</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites:</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### Concepts to be covered in Tutorial

- Introduction to Power BI and difference between Power BI and Excel
- Understanding the Power BI Desktop Basics and preparing the project template
- Understanding Data Preparation/Cleaning and Cleansing
- Data Preparation in the Power Query Editor
- The Star Schema
- Data Transformation in the Power Query Editor
- The Data Model: Working with Relationships and DAX (Data Analysis Expressions)
- Creating Visuals in Report View

### Laboratory

- Get to know the different tools of the Power BI universe and learn how to use them
- Understanding Power BI Desktop and its components
- Learning how to use the Query Editor to connect Power BI to various source types, how to work on the Data Model and understand the difference between those two steps
- Learning how to filter and format data, how pivoting and unpivoting works
- Illustrating the different views of the Data Model
- Demonstrating how to create calculated columns and measures
- Understanding how to build relationships between different tables
- Demonstrating how to create a report with different interactive visualization types?
- Learning how to use Power BI Pro to create dashboards and to share and publish your results

### Reference Books: -

1. Power Pivot and Power BI: The Excel User's Guide to DAX Power Query, Power BI & Power Pivot by Rob Collie and Avi Singh, Holy Macro! Books, PO Box 541731 Merritt Island FL 32954 USA
2. Beginning DAX with Power BI: The SQL Pro Guide to better Business Intelligence by Philips Seamark, Apress Publications.

### Course Outcomes

1. Analyze data from different data sources and create their own datasets. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-9, PO-12)
2. Illustrate the different tools of the Power BI universe and know how the different tools work together. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-8, PO-9, PO-11)
3. Build Power BI applications. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-8, PO-9, PO-11)

## **ELECTIVE II**

<b>DIGITAL FORENSICS</b>	
<b>Subject Code: MCAE21</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites:</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### Unit 1

**Understanding Cyber Crimes, Indian IT Act 2008, and its amendments, Computer Forensic and Investigations as a Profession:** Understanding Computer Forensics.

**Understanding Computer Investigations:** Preparing a Computer Investigation, Taking a Systematic Approach, Procedures for Corporate High-Tech Investigations, Understanding Data Recovery Workstations and Software.

### Unit 2

**Working with Windows and DOS Systems:** Understanding File Systems, Exploring Microsoft File Structures, Examining NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, Understanding Virtual Machines.

**Macintosh and Linux Boot Processes and File Systems:** Understanding the Macintosh File Structure and Boot Process, Examining UNIX and Linux Disk Structures and Boot Processes, Understanding Other Disk Structures.

### Unit 3

**Current Computer Forensics Tools:** Evaluating Computer Forensic Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software.

**Data Acquisition:** Understanding Storage Formats for Digital Evidence, Determining the best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Using Remote Network Acquisition Tools, and Using Other Forensic Acquisition Tools.

### Unit 4

**Computer Forensics Analysis and Validation:** Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisitions.

**Recovering Graphics Files:** Recognizing a Graphics File, Understanding Data Compression, Locating and Recovering Graphics Files, Identifying Unknown File Formats, Understanding Copyright Issues with Graphics.

### Unit 5

**Network Forensics:** Network Forensic Overview, Performing Live Acquisitions, Developing Standard Procedures for Network Forensics, Using Network Tools. **E-mail Investigations:** Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools.

*\*Assignment Based on Case Study*

## **Laboratory**

- Lab exercises using forensic software and case study.

### **Textbooks:**

1. Nelson, Phillips, Frank, Enfinger and Steuart: Computer Forensics and Investigations, Cengage Learning, 2008.  
Chapters: 1, 2, 4, 6, 7, 8, 9, 10, 11, 12

### **Reference Books:**

1. Marjie T. Britz: Computer Forensics and Cyber Crime - An Introduction, 2<sup>nd</sup> Edition, Pearson Education, 2012.
2. Pawan Duggal: Cyber Law- An exhaustive section wise Commentary on The Information Act along with Rules, Regulations, Policies, Notifications etc., Universal Law Publishing Co. Pvt. Ltd., 2014.
3. Harish Chander: Cyber Laws and IT Protection, PHI, 2012.

### **Course Outcomes (COs):**

1. Recall the Indian IT Act 2008, its amendments and describe various types of computer crime and its investigation techniques. (PO-6, PO-10)
2. Describe the file system and process handling concept of MS-DOS, Windows, and Macintosh and Linux operating system. (PO-3, PO-5, PO-10)
3. Analyze and validate evidences using forensic tools. (PO-4, PO-5, PO-6, PO-9, PO-10)
4. Extract, analyze hidden information from graphics, images and other files using forensic tools. (PO-4, PO-5, PO-9, PO-10)
5. Apply network forensic tools for network forensic, email investigation and live data forensic analysis. (PO-4, PO-5, PO-9, PO-10)

<b>UNIX SYSTEMS PROGRAMMING</b>	
<b>Subject Code: MCAE22</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites: MCA14</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

#### **Introduction**

**UNIX and ANSI Standards:** The ANSI C Standard, The POSIX Standards, POSIX feature test macros, Limits Checking at Compile Time and at Run Time. The POSIX APIs, API Common Characteristics.

**UNIX Files:** File Types, The UNIX and POSIX File System, The UNIX and POSIX File Attributes, UNIX Kernel Support for Files, Relationship of C Stream Pointers and File Descriptors, Hard and Symbolic Links.

### **Unit 2**

**UNIX File APIs:** General File APIs (open, read, write, close, link, unlink, chmod, lseek, fcntl, access), File and Record Locking, Directory File APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs.

### **Unit 3**

**UNIX Processes:** The Environment of a UNIX Process: Introduction, main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions.

**Process Control:** Introduction, Process Identifiers, fork, vfork, Zombie Process, wait, waitpid, Race Conditions, exec Functions.

### **Unit 5**

**Process Relationships:** Introduction, Terminal Logins, Network Logins, Process Groups, Sessions, Controlling Terminal, tegetpgrp, tcsetpgrp, and tegetsid Functions, Job Control.

**Signals:** Introduction, The UNIX Kernel Support for Signals, signal (), signal sets, Signal Mask, sigaction, Kill, Alarm.

### **Unit 5**

**Daemon Processes:** Introduction, Daemon Characteristics, daemon Coding Rules, Error Logging,

**Interprocess Communication:** Introduction, Pipes, popen, pclose Functions; Coprocesses; FIFOs; Stream Pipes, Introduction to sockets, socket descriptors and connection establishment.

### **Laboratory**

- Programs that supplement the theory concepts are to be implemented.

**Text Books:**

1. Terrence Chan: UNIX System Programming Using C++, PHI, 1999.  
Chapters: 1, 5, 6, 7, 8, 9
2. W. Richard Stevens, Stephen A. Rago: Advanced Programming in the UNIX Environment, 2<sup>nd</sup> Edition, Pearson Education, 2005.  
Chapters: 7, 8, 9, 13, 15

**Reference Books:**

1. Marc J. Rochkind: Advanced UNIX Programming, 2<sup>nd</sup> Edition, Pearson Education, 2005.
2. Maurice J. Bach: The Design of the UNIX Operating System, Pearson Education, 1987.
3. Uresh Vahalia: UNIX Internals: The New Frontiers, Pearson Education, 2001.

**Course Outcomes (COs):**

1. Describe UNIX file system, UNIX/POSIX standards and POSIX API's. (PO-1, PO-2, PO-4, PO-5)
2. Implement API's required to perform various file operations on different file types. (PO-1, PO-2, PO-3, PO-5, PO-9)
3. Implement API's required to create, run and control processes. (PO-1, PO-2, PO-3, PO-5, PO-9)
4. Describe API's required for process relationships and signals. (PO-1, PO-2, PO-3, PO-5, PO-9)
5. Describe various methods for handling daemon process and inter-process communication. (PO-1, PO-2, PO-4, PO-5)



<b>OPERATIONS RESEARCH</b>	
<b>Subject Code: MCAE23</b>	<b>Credits: 2:1:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28L 28T</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**What is Operations Research?** Operations Research Models, Solving the OR models, Queuing & Simulation models, Art of Modelling, Phases of OR Study

**Modelling with Linear Programming:** Two variable LP model, Graphical LP solution, Formulation of LP problems.

### **Unit 2**

**The Simplex Method:** LP model in equation form, Transition from graphical to algebraic solution, The Simplex method.

**Artificial starting solution -M Method, Two-Phase Method, Special cases in simplex method.**

### **Unit 3**

**Duality and Dual Simplex Method:** Definition of Dual Problem, Primal-Dual Relationships

**Game theory:** Introduction to Game Theory, the formulation of two persons, Zero sum games, solving simple Zero sum games, Games with mixed strategies.

### **Unit 4**

**Transportation model and its Variants:** Definition of the Transportation Model, Mathematical formation of Transportation problem, The Transportation Algorithm: Determination of the starting solution, Iterative computations of the Transportation Algorithm, The assignment model - The Hungarian Method.

### **Unit 5**

**PERT and CPM:** Network representation, Critical Path Method (CPM) Computations, Construction of the Time Schedule, PERT calculations.

#### **Text Books:**

1. Operations Research: An Introduction, Hamdy A Taha, 8<sup>th</sup> Edition, Pearson Education, 2011.  
Chapters: 1.1-1.6, 2.1, 2.2, 2.3.1, 2.3.3, 2.3.4 (Single-Period Production Model), 2.3.6, 3.1-3.5, 3.6.1, 4.1, 4.2, 4.3, 4.4.1, 5.1, 5.3.1, 5.3.2, 5.4.1, 6.1- 6.3.2, 6.4.1, 6.4.2, 6.5.1-6.5.3, 6.5.5, 13.4 (Solution of Mixed Strategy Games using Graphical Method Only)

#### **Reference Books:**

1. S D Sharma: Operations Research, 15<sup>th</sup> Edition, KedarNath Ram Nath, Meerut, Delhi, 2005.
2. Fredrick S. Hiller, Gerald J Lieberman: Introduction to Operations Research, 9th Edition, McGraw Hill, India, 2008.

**Course Outcomes (COs):**

1. Formulate linear programming problems (LPP) and solve two-variable LPP graphically. (PO-1, PO-2, PO-4)
2. Solve LP problems using simplex methods. (PO-1, PO-2, PO-4)
3. Derive dual from a given primal problem and solve the LP problem using dual simplex method. Formulate and solve simple games to resolve competitive situations. (PO-1, PO-2, PO-4)
4. Develop transportation and assignment models and solve the models to obtain optimum solution. (PO-1, PO-2, PO-4)
5. Apply PERT and CPM techniques for project management. (PO-1, PO-2, PO-4)

<b>SOCIAL NETWORK ANALYSIS</b>	
<b>Subject Code: MCAE24</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Networks and Society:** Social Network Analysis, Applications, Graph Preliminaries, Three Levels of Social Network Analysis, Graph Visualization Tools

**Network Measures:** Network Basics – Degree and Degree Distribution, Paths

### **Unit 2**

**Network Measures:** Network Basics – Clustering Coefficient, Connected Components, Node Centrality, Assortativity, Transitivity and Reciprocity, Similarity, Degeneracy

### **Unit 3**

**Link Analysis:** Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis Algorithms, PageRank, SimRank

**Link Prediction:** Applications of Link Prediction, Temporal Changes in a Network, Problem Definition, Evaluating Link Prediction Methods

### **Unit 4**

**Community Structure in Networks:** Applications of Community Detection, Types of Communities, Community Detection Methods, Disjoint Community Detection - Node-centric Community Detection, Modularity and Community Detection, Overlapping Community Detection - Clique Percolation, Link Partition, Community Detection vs Community Search, Evaluation of Community Detection Methods.

### **Unit 5**

**Anomaly Detection in Networks:** Outliers and versus Network-based Anomalies, Challenges, Anomaly Detection in Static Networks, Anomaly Detection in Dynamic Networks – Preliminaries, Feature-based Approaches, Decomposition-based Approaches, Window-based Approaches

**Graph Representation Learning:** Machine Learning Pipelines, Intuition behind Representation Learning, Benefits of Representation Learning, Criterion for Graph Representation Learning, Graph Representation Learning pipeline

### **Laboratory**

The students have to work on simulated and publicly available real datasets. The project(s) will require students to develop a complete end-to-end solution requiring preprocessing, design of the graph algorithms, training and validation, testing and evaluation with quantitative performance comparisons.

**Text Books:**

1. Tanmoy Chakraborty: Social Network Analysis, Wiley, 2021.

Chapters: 1.1 - 1.5, 1.7, 2.1 – 2.6, 4.1 – 4.5, 4.8, 5.1 – 5.3, 5.4.1, 5.4.2, 5.5.1, 5.5.2, 5.7, 5.8, 6.1 – 6.4, 8.1 – 8.3, 8.4.1, 8.4.2, 8.4.3, 8.4.5, 9.1 – 9.5

**References:**

1. Stanley Wasserman, Katherine Faust: Social Network Analysis: Methods and Applications, Cambridge University Press, 1994.
2. Charu C Aggarwal: Social Network Data Analytics, Springer, 2011.

**Course Outcomes (COs):**

1. Relate the physical society with the online social network and explain how one shapes the other. (PO-1, PO-2, PO-6, PO-10)
2. Apply network measures to real-world networks. (PO-1, PO-2)
3. Analyze the edges in the network using link analysis algorithms and link prediction methods. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10, PO-11, PO-12)
4. Formulate the community structures in networks and evaluate the community detection methods. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-9, PO-10, PO-11, PO-12)
5. Design algorithms for efficient and cost-effective anomaly detection and discuss the advantages and limitations of existing graph representation learning approaches. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-9, PO-10, PO-11, PO-12)

## AUGMENTED AND VIRTUAL REALITY

**Subject Code: MCAE25**

**Credits: 2:0:1**

**Pre requisites: Nil**

**Contact Hours: 28L 28P**

**Course Coordinator:**

### Unit 1

**Introduction:** Definition of VR, modern experiences, historical perspective. Virtual Reality Applications.

**Birds-eye view:** Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics.

### Unit 2

**Geometry of Virtual Worlds:** Geometric models, Changing Position and orientation, Axis-Angle representation of rotation, Chaining the transformation.

**Tracking:** Tracking 2D orientation, Tracking 3D orientation, Tracking Position and orientation

### Unit 3

**Getting started with Blender:** An introduction to Blender. Features of Blender Layout workspace, Sculpt Workspace, Modeling Workspace, Animation Workspace. Introduction to Unity, working with objects, Working with Scripts First Person Controller, Third Person Controller

### Unit 4

**Introduction to Augmented Reality:** Definition and scope, A brief history of augmented reality, Examples, Related fields.

**Displays:** Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display model, Visual Displays

### Unit 5

**Evaluating VR Systems and Experiences:** Perceptual Training, Recommendations for developers, Comfort and VR sickness, Experiments on Human subjects.

**Software Architectures:** AR Application Requirements, Software Engineering Requirements

### Laboratory

- Students shall implement programs which supplement the theory concepts

#### **Text Books:**

1. Steven M. LaValle: Virtual Reality, 2017 Available for downloading at <http://vr.cs.uiuc.edu/>.
2. Dieter Schmalstieg and Tobias Höllerer: Augmented Reality Principles and Practice, Addison-Wesley, 2016.

**Reference Books:**

1. Tony Parisi: Learning Virtual Reality, Developing Immersive Experiences and Applications for Desktop, Web and Mobile, 1st Edition, O'Reilly Media, Inc., 2015.
2. Paul Mealy: Virtual & Augmented Reality. Wiley publications 2018

**Course Outcomes (COs):**

1. Explain the concepts of Virtual Reality and its Applications. (PO-1, PO-2, PO-3)
2. Demonstrate a virtual environment to captivate its experiences. (PO-1, PO-2, PO-3, PO-5, PO-10)
3. Apply the tools for Virtual Reality. (PO-1, PO-2, PO-3, PO-5, PO-6, PO-10)
4. Create scenarios using Augmented and Virtual Reality. (PO-1, PO-2, PO-3, PO-5, PO-6, PO-10)
5. Analyze the fundamental issues of virtual reality. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-10)

## **ELECTIVE III**

<b>PROGRAMMING IoT</b>	
<b>Subject Code: MCAE31</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA11</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Concepts to be covered in Tutorial**

- Introduction to Internet of Things (IoT)
- IoT enabling technologies and IoT levels
- Python Programming with Raspberry Pi
- Working with Arduino
- Working with Sensors on Raspberry Pi and Arduino
- Case study on Home Intrusion Detection
- Introducing Cloud platform for IoT
- Introduction to IoT with Machine Learning

### **Laboratory**

- Familiarity with Raspberry Pi
- Exploring the different components of Raspberry pi
- Setting up of the board and booting the board
- Practice sessions on Python
- Working with different sensors on Raspberry Pi
- Simple application development using Raspberry Pi and Python
- Familiarity with Arduino
- Exploring the different components of Arduino
- Setting up of the board and booting the board
- Working with different sensors on Arduino
- Working with Cloud platform.
- Working with simple IoT applications using Machine Learning
- Project work.

### **References:**

1. Arshdeep Bahga, Vijay Madisetti: Internet of Things: A Hands on Approach, Universities Press, 2015
2. Simon Monk: Programming the Raspberry Pi: Getting Started with Python, McGrawHill, 2nd Ed, 2015
3. Simon Monk: Raspberry Pi Cookbook, May 2016, O'Reilly
4. [www.raspberrypi.org](http://www.raspberrypi.org)
5. <http://forefront.io/a/beginners-guide-to-arduino/>
6. <https://www.arduino.cc/en/Tutorial/HomePage>



**Course Outcomes (COs):**

1. Configure and set up the Raspberry Pi board for a given application. (PO-1, PO-2, PO-3, PO-5)
2. Configure and set up the Arduino board for a given application. (PO-1, PO-2, PO-3, PO-5)
3. Building IoT applications using Cloud and Machine Learning. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)

<b>INTRODUCTION TO SPRING BOOT AND MICROSERVICES</b>	
<b>Subject Code: MCAE32</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

**Topics to be covered in Tutorial:**

- Introduction to JDBC
- CRUD operations using JDBC
- Selecting data using Row Mapper
- The Basic Spring Boot Application
- Annotations in REST and Endpoints
- Introduction to BEAN
- Using BEAN concept to create a container object
- Starting with Micro Services
- Micro Service Architecture
- Preparing the Environment
- Introduction to Spring Boot for Micro Services
- Getting started with Micro Service
- Eureka Cloud Server implementation
- Building Micro Services with Spring Boot

**Laboratory**

- Programs supplement the tutorial concepts will be based on the latest version of Java and Spring Boot

**Reference Books:**

1. Moises Macero: Learn Microservices with Spring Boot: A Practical Approach to RESTful Services using RabbitMQ, Eureka, Ribbon, Zuul and Cucumber, 1st Edition, APress, 2017.
2. Chris Richardson: Microservices Patterns with Examples in Java, 1st Edition, Manning Publications Co., 2019.
3. Sourabh Sharma: Mastering Microservices with Java 9, 2nd Edition, Packt Publishing Ltd., 2017.

**Course Outcomes (COs):**

1. Implement the basic programming constructs of spring boot application. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11)
2. Implement Microservices using spring boot application. (PO-1, PO-2, PO-3, PO-5, PO-6)
3. Develop the real-world and general-purpose applications using Microservices and spring boot. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11, PO-12)

<b>GO PROGRAMMING</b>	
<b>Subject Code: MCAE33</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

**Topics to be Covered in Tutorial:**

- Go Programming language fundamentals
- Core Go Language Concepts
- Explore Functions in Go
- Object-based Programming in Go
- Defining methods
- Go Interfaces
- Go Embedded Types
- The Go approach to error handling
- Go routines and Channels
- Concurrency management with shared data
- Go Packages and the Go Tool
- Go Test tool
- Go and Relational Databases
- Create a RESTful service using Go

**Laboratory**

- Programs supplement the tutorial concepts will be based on the latest Go release.

**Reference Books:**

1. Alan Donovan and Brian Kernighan: Go Programming Language, Addison-Wesley, 2015.
2. Agus Kurniawan: Go Programming by Example, Addison-Wesley, 2015.
3. Caleb Doxsey: Introducing Go. O'Reilly Media, Inc., 2016.
4. Katherine Cox-Buday: Concurrency in Go, O'Reilly Media, Inc., 2017.

**Web References:**

1. <https://golang.org/>
2. <https://gobyexample.com/>

**Course Outcomes (COs):**

1. Implement the basic programming constructs of Go language. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11)
2. Apply the principles of concurrency programming using Go language. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11)
3. Develop the real-world and general-purpose applications using Go Language. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11, PO-12)

<b>WEB PROGRAMMING WITH PHP AND AJAX</b>	
<b>Subject Code: MCAE34</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA17</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Concepts to be covered in Tutorial**

1. Overview of PHP, WAMP, LAMP, Syntactic characteristics, Primitives, Variables and Operators
2. Controlling program flow, Arrays, Strings, Dates and Times in PHP
3. Using functions and classes
4. Working with HTML forms and php
5. PHP and MySQL
6. Working with Cookies, Sessions and Headers
7. Overview of AJAX and its applications, Creating a simple AJAX example, XMLHttpRequest Object, Server side programming
8. Sending data to server using GET and POST
9. Demonstration of handling multiple XMLHttpRequest Objects
10. Demonstration of accessing XML data

### **Laboratory**

- Programs that supplement the tutorial concepts are to be implemented.
- Mini Project to be developed by the students.

### **Reference Books:**

1. Vikram Vaswani: PHP: A Beginner's Guide, Tata McGraw-Hill, 2017.
2. Steven Holzner: Ajax: A Beginner's Guide, Tata McGraw-Hill, 2017.
3. James Mallison: Mastering PHP 7, Packt Publishing Limited, 2017.
4. Antonio Lopez: Learning PHP 7, Packt Publishing Limited, 2016.

### **Course Outcomes (COs):**

1. Implement various programming constructs of PHP. (PO-1, PO-2, PO-3, PO-5, PO-9)
2. Demonstrate the concept of AJAX. (PO-1, PO-2, PO-3, PO-5, PO-9)
3. Create web applications using PHP and AJAX. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-10, PO-11, PO-12)

<b>SECURE CODING IN C AND C++</b>	
<b>Subject Code: MCAE35</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Running with Scissors**, Gauging the Threat, Security Concepts, Development Platforms, **Strings**, Character Strings, Common String Manipulation Errors, String Vulnerabilities and Exploits, Mitigation Strategies for Strings, String-Handling Functions, Runtime Protection Strategies, Notable Vulnerabilities.

### **Unit 2**

**Pointer Subterfuge**, Data Locations, Function Pointers, Object Pointers, Modifying the Instruction Pointer, Global Offset Table, The .ctors Section, Virtual Pointers, The atexit() and on\_exit() Functions, The longjmp() Function, Exception Handling, Mitigation Strategies. **Dynamic Memory Management**, C Memory Management, Common C Memory Management Errors, C++ Dynamic Memory Management, Common C++ Memory Management Errors.

### **Unit 3**

Memory Managers, Doug Lea's Memory Allocator, Double-Free Vulnerabilities Mitigation Strategies, Notable Vulnerabilities. **Integer Security**, Introduction to Integer Security, Integer Data Types, Integer Conversions, Integer Operations,

### **Unit 4**

Integer Vulnerabilities, Mitigation Strategies. **Formatted Output**, Variadic Functions, Formatted Output Functions, Exploiting Formatted Output Functions, Stack Randomization, Mitigation Strategies, Notable Vulnerabilities.

### **Unit 5**

**File I/O**, File I/O Basics, File I/O Interfaces, Access Control, File Identification, Race Conditions, Mitigation Strategies, **Recommended Practices**, The Security Development Lifecycle, Security Training, Requirements Design, Implementation, Verification.

#### **Text Books:**

1. Robert C. Seacord: Secure Coding in C and C++, 2<sup>nd</sup> Edition, Pearson, 2013. (Chapter 1,2,3,4,5,6,8,9)

#### **References:**

1. SEI CERT Coding Standards.
2. Robert C. Seacord: CERT C Coding Standard, 2<sup>nd</sup> Edition, The: 98 Rules for Developing Safe, Reliable, and Secure Systems (SEI Series in Software Engineering), Addison-Wesley Professional, 2014.

3. John Viega, Malt Messier: Secure Programming Cookbook for C and C++, O'Reilly Media, 2003.

**Course Outcomes (COs):**

1. Identify the vulnerability associated with String Handling and Mitigation strategies. (PO-1, PO-2, PO-3, PO-5, PO-6)
2. Describe the threats associated with Runtime Memory Management and Pointers. (PO-1, PO-2, PO-3, PO-5, PO-6)
3. Apply the mitigation techniques for vulnerable memory management and data type's conversion. (PO-1, PO-2, PO-3, PO-5, PO-6)
4. Identify the vulnerability associated with Formatted Output and Concurrency. (PO-1, PO-2, PO-3, PO-5, PO-6)
5. Describe the vulnerability mitigation techniques for File I/O and recommended practices for security development lifecycle. (PO-1, PO-2, PO-3, PO-5, PO-6)

## **III SEMESTER**

<b>SOFTWARE ENGINEERING AND AGILE METHODOLOGIES</b>	
<b>Subject Code: MCA31</b>	<b>Credits: 3:1:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28T</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Socio-technical Systems:** Complex systems, System engineering, System procurement, System development, System operation,

**Dependability and Security:** Dependability properties, Availability and reliability, Safety, Security,

**Requirements Engineering:** Functional and Non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

### **Unit 2**

**System Modelling:** Context models, Interaction Models, Structural Models, Behavioral models, Model-driven engineering.

**Software Design and Development, Architectural Design:** Architectural design decisions, Architectural views, Architectural patterns, Application architectures.

### **Unit 3**

**Agile Methodologies – Introduction:** What is Agile? The history of Agile, The Agile Manifesto, Agile Principles. Why Agile? – Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility. How to Be Agile – Agile Methods, Don't Make your own Method, The Road to Mastery, Find a Mentor.

### **Unit 4**

**Overview of Extreme Programming:** XP Concepts

**Agile Design:** Symptoms of Poor Design, Principles, Smells and Principles, what is Agile Design? What Goes Wrong with Software? How did the Agile Developers Know What to Do? Keeping the Design as Good as It Can Be.

### **Unit 5**

**Agile Frameworks:** Dynamic system development method (DSDM), Agile Project Management, Kanban, Lean Software Development, Lean Start-up, Scaled Agile Framework (SAFe).

**Agile Development - Planning:** Initial Exploration, Release Planning, Iteration Planning, Task Planning, Iterating.

**Testing:** Test Driven Development (TDD), Acceptance tests, Exploratory testing.

### **Text Books:**

1. Ian Sommerville: Software Engineering, 9<sup>th</sup> Edition, Pearson Education Publications, 2013.
2. Robert C. Martin with contributions by James W. Newkirk and Robert S. Koss: Agile Software Development: Principles, Patterns, and Practices, Pearson Education.



3. Peter Measey and Radtac: Agile Foundations: Principles, Practices and frameworks, Viva Books Private Limited.

**Reference Books:**

1. Roger. S. Pressman: Software Engineering-A Practitioners Approach, 7<sup>th</sup> Edition, McGraw-Hill, 2010.
2. Shari Lawrence Pfleeger, Joanne M. Atlee: Software Engineering Theory and Practice, 4<sup>th</sup> Edition, Pearson Education, 2009.
3. Ali Behforooz, Frederick J. Hudson: Software Engineering Fundamentals, 1<sup>st</sup> Indian Edition, Oxford University Press, 2006.

**Course Outcomes (COs):**

1. Articulate the software engineering process by developing the software requirements documentation. (PO-2, PO-3, PO-5, PO-6, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)
2. Model and design solutions for a given real life problem.( PO-1, PO-2, PO-3, PO-5, PO-6, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)
3. Discuss the process of Agile Software Development. (PO-2, PO-3, PO-5, PO-6, PO-9, PO-12)
4. Identify the poor software design using agile methodology in the early stages. (PO-2, PO-3, PO-5, PO-6, PO-8, PO-9, PO-12)
5. Describe the Agile Framework, Agile Planning process, and the testing process. (PO-3, PO-4, PO-5, PO-6, PO-8, PO-9, PO-10, PO-11, PO-12)

<b>ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING</b>	
<b>Subject Code: MCA32</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: MCA11, MCA12</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Artificial Intelligence:** Overview of AI Techniques, Types of Knowledge, Knowledge Representation, Solving Problems by Searching, Problem Solving using State Space Search (Tic-Tac-Toe and water jug problem), Forward vs Backward Reasoning

### **Unit 2**

**Introduction to Machine Learning:** Types of Machine Learning, Applications of Machine Learning. Preparing to Model, Basic types of data in Machine Learning, Exploring structures of Data, Data quality and remediation

### **Unit 3**

**Regression:** Correlation, Simple Linear Regression, Model Validation using t-test, Overview of Multiple Linear Regression and Logistic Regression.

**Classification:** Bayes Theorem, Naïve Bayes classifier.

### **Unit 4**

**Classification:** Decision Tree, Building a Decision tree, Information gain of Decision tree, Support Vector Machines, Linear SVM

### **Unit 5**

**Clustering:** Partitioning Method – K-means, Hierarchical Method - Agglomerative Clustering

**Neural Networks:** Working of a Perceptron Model, Multilayer Network.

### **Laboratory**

- Implementation of techniques for AI and ML using Python

### **Text Books:**

1. Rich and Knight: Artificial Intelligence, Mc Graw Hill, 2nd Edition 1991.
2. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das: Machine Learning, 2019.
3. Pang-Ning Tan, Micheal Steinbach and Vipin Kumar: Introduction to Data Mining, second Edition, Pearson Education 2006.

### **Reference Books:**

1. Anuradha Srinivasaraghavan, Vinc y Joseph: Machine Learning, Wiley, 2019.
2. Tom Mitchell, Machine Learning: 1st Edition, McGraw- Hill, 1997.
3. Ethem Alpaydin: Introduction to Machine Learning, 2nd Edition, The MIT Press Cambridge, Massachusetts London, England, 2010.
4. Stuart Russel, and Peter Norvig, Artificial Intelligence: A Modern Approach by, 3rd Edition, Pearson Education, 2015.

**Course Outcomes (COs):**

1. Explain basic concepts of Artificial Intelligence. (PO-1, PO-2, PO-4)
2. Distinguish between types of learning and prepare the data for analysis. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10)
3. Develop Regression and Classification Models for any given problem. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10)
4. Classify the data using Decision Tree and SVM techniques. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10)
5. Group the data into clusters and design neural networks Models. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-9, PO-10)

<b>INFORMATION SECURITY</b>	
<b>Subject Code: MCA33</b>	<b>Credits: 3:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Introduction to Information Security:** What Is Security? Components of an Information System, Balancing Information Security and Access, Approaches to Information Security Implementation, The Security Systems Development Life Cycle, **The Need for Security:** Threats, Attacks, **Legal, Ethical, and Professional Issues in Information Security:** Ethics and Information Security, Codes of Ethics and Professional Organizations.

### **Unit 2**

**Risk Management:** Risk Identification, Risk Assessment, Risk Control Strategies, selecting a Risk Control Strategy, Quantitative Versus Qualitative Risk Control Practices, **Security Technology: Firewalls and VPNs,** Access Control, Firewalls, Protecting Remote Connections.

### **Unit 3**

**Security Technology: Intrusion Detection and Prevention Systems, and Other Security Tools,** Intrusion Detection and Prevention Systems, Honeypots, Honeynets, and Padded Cell Systems, Scanning and Analysis Tools, Biometric Access Controls **Implementing Information Security,** Information Security Project Management, Technical Aspects of Implementation, Nontechnical Aspects of Implementation.

### **Unit 4**

**Symmetric Ciphers:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography, **Block Ciphers and the Data Encryption Standard:** Block Cipher Principles, The Data Encryption Standard, The Strength of Des, **Advanced Encryption Standard,** Evaluation Criteria For AES, The AES Cipher.

### **Unit 5**

**Public-Key Encryption and Hash Functions, Public-Key Cryptography and RSA,** Principles of Public-Key Cryptosystems The RSA Algorithm, **Key Management; Other Public-Key Cryptosystems,** Key Management, Diffie-Hellman Key Exchange, **Message Authentication and Hash Functions,** Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs.

### **Laboratory**

- Exercises to supplement the concepts using existing tools.

### **Text Books:**

1. Michael E. Whitman, Herbert J. Mattord: Principles of Information Security, 4<sup>th</sup> Edition, Cengage Learning, 2012.

(Selected Portion from Chapters 1,2,3,4,5,6,7,9,10).

2. William Stallings: Cryptography and Network Security-Principles and Practices, 4<sup>th</sup> Edition, Prentice Hall.  
Chapters: 2.1 to 2.5, 3.1 to 3.3, 3.5, 5.1 to 5.2, 9.1 to 9.2, 10.1 to 10.2, 11.1 to 11.5.

**Reference Books:**

1. Behrouz A Forouzan: Cryptography and Network Security, 3<sup>rd</sup> Edition, Tata McGraw Hill, 2015.
2. R. Kelly Rainer, Casey G. Cegielski: Introduction to Information Systems, 4<sup>th</sup> Edition, Wiley India, 2015.
3. Mark Merkow, James Breithaupt: Information Security: Principles and Practices, Pearson Education, 2014.

**Course Outcomes (COs):**

1. Describe the basic concepts of information security, its need, legal, ethical and professional issues associated with it. (PO-1, PO-6)
2. Determine risks and its controlling mechanisms, and discuss the importance of firewalls and VPN in the context of network security. (PO-1, PO-5, PO-7, PO-10)
3. Discuss different security technologies and implementation of information security. (PO-1, PO-3, PO-5, PO-7, PO-10)
4. Apply symmetric key cryptography and encryption standards. (PO-1, PO-3, PO-5, PO-7, PO-10)
5. Explain public-key cryptography and hash functions. (PO-1, PO-3, PO-5, PO-7, PO-10)

<b>CLOUD COMPUTING</b>	
<b>Subject Code: MCA34</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA14, MCA24</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Concepts to be covered in Tutorial**

1. Introduction to Cloud Computing
2. Familiarity of different services provided by AWS
3. Setting of Private Cloud in AWS
4. Working with Amazon EC2, and S3 services
5. Working with AMI
6. Back up and Launch a new instance using Back-up
7. Elastic IPs and AWS Identity and Access Management(IAM)
8. Hosting Static Website and Hosting Applications in AWS
9. Working with AWS RDS: MySQL Workbench and Dynamo DB
10. Resource management in cloud: Load Balancer and Auto Scaling Group
11. AWS-Eclipse Integration with Elastic Beanstalk
12. Connect RDS and Java Applications
13. Data Analytics, Security

### **Laboratory**

- Familiarize the services by AWS
- Creating user login
- Creating Linux, Windows virtual machines instance using EC2
- Run simple applications on EC2 Instance
- Creating Storage using S3
- Create a Backup using Image and launch new instance using Backup image
- Creating an RDS Instance with MySQL Workbench and Dynamo DB
- Demonstrate Database application on AWS
- Upgrading and downgrading the infrastructure based on the requirement
- Demonstrate Load balancing using different instance of EC2
- Launch a web application.
- Demonstrate Identity and Access management.
- Demonstrate Elastic bean stack
- Demonstrate AWS dynamic web application.
- Demonstrate Data Analytics using Elastic Map Reduce (EMR)

### **References:**

1. Rajkumar Buyya, ChristaianVecchiola, S. ThamaraiSelvi, Master Cloud Computing, TMH Education, 2013.
2. Arshdeep Bahga, Vijay Madiseti, Cloud Computing: A Hands-on Approach, Universities Press, 2014.

3. [https://aws.amazon.com/training/intro\\_series/](https://aws.amazon.com/training/intro_series/)
4. <https://aws.amazon.com/getting-started/>
5. <https://aws.amazon.com/>
6. <https://aws.amazon.com/free/>
7. <https://blog.webspecia.com/cloud/iaas-paas-saas-explained-examples-comparison>
8. <http://aws.amazon.com/training/self-paced-labs/>
9. Instructor led AWS Training - <http://aws.amazon.com/training/>

**Course Outcomes (COs):**

1. Build private cloud and launch instances using AWS services. (PO-1, PO-2, PO-3, PO-5, PO-7)
2. Demonstrate database, EMR, Auto Scaling, Load Balancer and IAM services on AWS. (PO-1, PO-2, PO-3, PO-5, PO-7)
3. Develop AWS Dynamic Web Application and Migrate Applications on AWS. (PO-1, PO-2, PO-3, PO-5, PO-7)

## **ELECTIVE IV**



<b>ETHICAL HACKING AND PENETRATION TESTING</b>	
<b>Subject Code: MCAE41</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

Ethical hacking process, Hackers' behaviour and mind-set, Maintaining Anonymity, Hacking Methodology, Information Gathering, Active and Passive Sniffing, Preparation of Ethical Hacking and Penetration Test.

### **Unit 2**

Introduction to penetration testing tools in Kali Linux. Introduction to Metasploit: Metasploit framework, Metasploit Console, Payloads, Meterpreter, Introduction to Armitage, Installing and using Kali Linux Distribution.

### **Unit 3**

DoS attacks. Web server and application vulnerabilities, SQL injection attacks, Vulnerability Analysis and Reverse Engineering, Buffer overflow attacks. Client-side browser exploits, Exploiting Windows Access Control Model for Local Elevation Privilege.

### **Unit 4**

Social Engineering attacks and countermeasures. Password attacks, Privilege Escalation and Executing Applications, Network Infrastructure Vulnerabilities, IP spoofing, DNS spoofing, Wireless Hacking: Wireless footprint, Wireless scanning and enumeration, gaining access (hacking 802.11), WEP, WPA, WPA2.

### **Unit 5**

Exploiting vulnerabilities in Mobile Application, Malware Analysis and Reverse Engineering, The Ethical Hacking Deliverable, The Document, Overall Structure, Aligning Findings, Presentation Integration: Integrating the Results, Integration Summary, Mitigation, Defence Planning, Incident Management, Security Policy.

### **Laboratory**

- Exercises to supplement the concepts using existing tools

### **Reference Books:**

1. Georgia Weidman: Penetration Testing: A Hands-On Introduction to Hacking, No Starch Press, 2014.
2. David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni: Metasploit: The Penetration Tester's Guide, No Starch Press, 2011.
3. James S. Tiller: The Ethical Hack: A Framework for Business Value Penetration Testing, Auerbach Publications, CRC Press, 2004.

4. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, Gray Hat Hacking: The Ethical Hackers' Handbook, TMH Edition, 4<sup>th</sup> Edition, 2014.
5. Baloch, R.: Ethical Hacking and Penetration Testing Guide, CRC Press, 2015.
6. Davidoff, S. and Ham, J.: Network Forensics Tracking Hackers through Cyberspace, Prentice Hall, 2012.

**Course Outcomes (COs):**

1. Discuss the importance of penetration testing and security assessment. (PO-3, PO-5, PO-6, PO-9, PO-10)
2. Elaborate the core concepts related to vulnerabilities and their causes. (PO-3, PO-5, PO-10)
3. Explain ethics behind hacking and vulnerability disclosure. (PO-5, PO-6)
4. Identify the vulnerabilities related to computer system and networks using state of the art tools and technologies. (PO-3, PO-5, PO-10)
5. Plan the Mitigation and Defense against IT infrastructure. (PO-3, PO-5, PO-10)

<b>DIGITAL MARKETING</b>	
<b>Subject Code: MCAE42</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Introduction to Digital Marketing:** Evolution of Digital Marketing from traditional to modern era, Role of Internet; Current trends, Info-graphics, implications for business & society; Emergence of digital marketing as a tool; Drivers of the new marketing environment; Digital marketing strategy; P.O.E.M. framework, Digital landscape, Digital marketing plan, Digital marketing models.

### **Unit 2**

**Internet Marketing and Digital Marketing:** Mix – Internet Marketing, opportunities and challenges; Digital marketing framework; Digital Marketing mix, Impact of digital channels on IMC; Search Engine Advertising: - Pay for Search Advertisements, Ad Placement, Ad Ranks, Creating Ad Campaigns, Campaign Report Generation Display marketing: - Types of Display Ads - Buying Models - Programmable Digital Marketing - Analytical Tools - YouTube marketing.

### **Unit 3**

Introduction to SEO, SEM, Web Analytics, Mobile Marketing, Trends in Digital Advertising– - Introduction and need for SEO, How to use internet & search engines; search engine and its working pattern, On-page and off-page optimization, SEO Tactics - Introduction to SEM Web Analytics: - Google Analytics & Google AdWords; data collection for web analytics, multichannel attribution, Universal analytics, Tracking code Trends in digital advertising.

### **Unit 3**

**Social Media Marketing:** Role of Influencer Marketing, Tools & Plan– Introduction to social media platforms, penetration and characteristics; Building a successful social media marketing strategy

**Facebook Marketing:** Business through Facebook Marketing, Creating Advertising Campaigns, Adverts, Facebook Marketing Tools LinkedIn Marketing, Content Strategy, Analytics and Targeting Twitter Marketing Instagram and Snapchat: - Digital Marketing Strategies through Instagram and Snapchat Mobile Marketing.

### **Unit 4**

**Addressing Social Media Channels:** Introduction, Key terms and concepts, Traditional media vs Social media. Social media channels: Social networking. Content creation, Bookmarking and aggregating and Location & social media. Tracking social media campaigns. Social media marketing: Rules of engagement. Advantages and challenges. Social Media Strategy: Introduction, Key terms and concepts. Using social media to solve business challenges. Step-by-step guide to creating a social media strategy. Documents and processes. Dealing with opportunities and threats. Step-by-step guide for recovering from an online brand attack. Social media risks and challenges.

**Text Books:**

1. Seema Gupta: Digital Marketing, 1<sup>st</sup> Edition, Mc-Graw Hill, 2017.

**Reference Books:**

2. Ian Dodson: The Art of Digital Marketing, Wiley.
3. Puneet Singh Bhatia: Fundamentals of Digital Marketing, 1<sup>st</sup> Edition, Pearson, 2017.
4. Prof. Nitin C. Kamat, Mr.Chinmay Nitin Kamat: Digital Social Media Marketing, Himalaya Publishing House Pvt. Ltd.

**Course Outcomes (COs):**

1. Describe basic concepts of digital marketing. (PO-1)
2. Demonstrate electronic media usage in digital marketing. (PO-4, PO-5)
3. Demonstrate the importance of search engine in digital marketing. (PO-4, PO-5)
4. Discuss different social media marketing platforms and its importance in digital marketing. (PO-4, PO-5)
5. Determine business challenges that can be overcome by social media. (PO-4, PO-5)

<b>SOFTWARE TESTING</b>	
<b>Subject Code: MCAE43</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA11</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### Concepts to be covered in Tutorial

- Articulate the basics of Software Testing Life Cycle using Manual Testing implementations.
- Installation of Selenium IDE, Recording and running test cases using Selenium IDE, Selenium Commands
- Installation of Selenium Webdriver in Pycharm and basics of python programming
- Finding Elements by NAME, ID, CSS, XPATH, LINKTEXT. Understanding “By” class
- Working with Web Elements; Useful Methods and Properties; Wait Types.
- Construct the complete automation framework in selenium webdriver.
- Running Complete Test suites.

### Laboratory

- Students should demonstrate the working of manual testing, selenium IDE and should be able to test the given web page using selenium web driver and generate the necessary documents/ tables
- **Project:** A team of 1 or 2 students must take up a Web Application and generate the necessary documents/tables using Manual Testing, Selenium IDE, Selenium Web Drivers and should run the complete test suite.

### Text Books:

1. Selenium with Python: A Beginners’ Guide, Pallavi R Sharma, BPB Publications.
2. David Burns: Selenium 2 Testing Tools: Beginner’s Guide, Packt Publishing, 2012.

### Course Outcomes (COs):

1. Explain the basics of the testing process and demonstrate the process of manual testing. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-9, PO-11, PO-12)
2. Demonstrate the basics of working with Selenium IDE. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-9, PO-11, PO-12)
3. Demonstrate the basics of working with Selenium Web Driver. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-9, PO-11, PO-12)

<b>BIG DATA ANALYTICS</b>	
<b>Subject Code: MCAE44</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA23</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### Topics to be covered in Tutorial:

- Big Data Fundamentals
- Hadoop Distributed File System and Hadoop Architecture.
- Moving the Data into Hadoop and Moving the Data out from Hadoop.
- MapReduce and HDFS.
- Reading and Writing the files in HDFS.
- Hive Overview and Working with Hive.
- Pig Overview and Working with Pig.
- Flume Overview and Moving the Data from Web Server into Hadoop.
- Introduction to Apache Spark: Features of Apache Spark, Apache Spark Architecture, Spark Applications.
- Apache Spark Components, Different Data Sources and Formats in Spark.
- Resilient Distributed Dataset (RDD): Introduction of RDD, Features of RDD in Spark, RDD operations.
- Spark RDD operations: RDD Transformation.
- RDD Action.
- Building and Deploying Spark Application

### Laboratory

- Programs supplement the tutorial concepts will be based on the latest version of Apache Hadoop and Ecosystems

### Reference Books:

1. Tom White: Hadoop The Definitive Guide, Fourth Edition, 4th edition, O'Reilly Media, 2015.
2. Edward Capriolo, Dean Wampler, and Jason Rutherglen: Programming Hive, 1st edition, O'Reilly Media, 2012.
3. Alan Gates: Jason Ostrander: Programming Pig, 1st edition, O'Reilly Media, 2011.
4. Lars George: HBase The Definitive Guide, 1st edition, O'Reilly Media, 2011

### Course Outcomes (COs):

1. Describe the Hadoop development framework and demonstrate the Hadoop shell commands. (PO-1, PO-2, PO-3, PO-5)
2. Develop MapReduce programs in Java, SQL queries using Hive and PIG Latin. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7)
3. Implement Apache Spark in Resilient Distributed Data to manage data. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-9, PO-11, PO-12)

<b>BLOCKCHAIN TECHNOLOGY</b>	
<b>Subject Code: MCAE45</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### **Unit 1**

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block Chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree.

### **Unit 2**

Bitcoin and Blockchain: Payments and double spending, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake.

### **Unit 3**

Permissioned Blockchain: Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain- Distributed consensus in closed environment, Byzantine general problem.

### **Unit 4**

Byzantine fault tolerant system, BFT over Asynchronous systems. Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric and Solidity.

### **Unit 5**

Enterprise application of Block chain: Know Your Customer (KYC), Food Security, Identity on Blockchain, Case studies.

### **Reference Books:**

1. Melanie Swan: Block Chain: Blueprint for a New Economy, O'Reilly, 2015.
2. Josh Thompsons: Block Chain: The Block Chain for Beginners - Guide to Blockchain Technology and Leveraging Block Chain Programming, CreateSpace Independent Publishing Platform, 2017.
3. Daniel Drescher: Block Chain Basics, 1<sup>st</sup> Edition, Apress, 2017.
4. Anshul Kaushik: Block Chain and Crypto Currencies, Khanna Publishing House, Delhi, 2019.
5. Imran Bashir: Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Packt Publishing, 2018.

6. Ritesh Modi: Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain, Packt Publishing, 2018.
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna: Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer, Packt Publishing, 2018.

**Course Outcomes (COs):**

1. Explain the fundamental concepts of Blockchain technology. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-12)
2. Explain the concept of crypto currencies and consensus algorithms. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-12)
3. Describe different types of Blockchain and smart contract. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-12)
4. Develop Blockchain based applications using Hyperledger Fabric. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-12)
5. Integrate ideas from various domains and implement them using Blockchain technology. (PO-1, PO-2, PO-3, PO-5, PO-9, PO-12)



# **ELECTIVE V**

<b>WEB COMPONENT DEVELOPMENT WITH J2EE</b>	
<b>Subject Code: MCAE51</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA21</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

**Topics to be covered in Tutorial:**

- Introduction to J2EE
- JDBC
  - Statement objects
  - Callable statement
  - Prepared statement
- Servlets
  - Servlet Context
  - Servlet Config
  - Request Dispatcher
  - Send Redirect
  - Cookies
  - Session Tracking
  - Filter API
- Java Server Pages(JSP)
  - Components of a JSP
  - Declaratives, Directives, (Page, Include, Taglib)
  - Implicit Objects, JSTL
  - JSP Standard Actions
- Introduction to Java Beans
  - A Bean Example, JSP with Java Beans
- Introduction to Springs
  - Spring with Eclipse
  - Crating first Spring Application
- Introduction to Hibernate
  - Configuring Hibernate with Eclipse
  - Creating first model using Hibernate

**Laboratory**

- Programs that supplement the tutorial concepts are to be implemented.
- Mini Project

**Reference Books:**

1. Jim Keogh: The complete Refernce J2EE, 1<sup>st</sup>Edition, Tata McGraw Hill, 2002.
2. Mahesh P. Matha: JSP and Servlets, 1<sup>st</sup>Edition, PHI, 2013.

3. Sharanam Shah: Spring 3 with Hibernate 4 Project for Professionals, Shroff Publisher, 1<sup>st</sup> Edition, 2012.
4. Ranga Karanam: Mastering Spring 5.0, Paperback, 2017.
5. Kogent Learning solutions: Web Technologies Black Book, Dreamtech Press, 2012.
6. Bond, Law, Longshaw, Haywood, Roxburgh: Teach Yourself J2EE (J2EE 1.4), 2<sup>nd</sup> Edition, Pearson Education, 2005.

**Course Outcomes (COs):**

1. Develop server side components using Java servlet with the interaction of different tiers. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-11, PO-12)
2. Apply the concepts JSP, Beans and Java frameworks for Dynamic Web Applications. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-11, PO-12)
3. Demonstrate the concepts of framework and create Simple web-based application with the interaction of multi-tier architecture. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-11, PO-12)

<b>MOBILE APPLICATION DEVELOPMENT</b>	
<b>Subject Code: MCAE52</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: MCA21</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### Topics to be Covered in Tutorial

- Introduction to android, features, Android Architecture
- Exploring linear layout and Relative layout
- Exploring widgets
- Android activity life cycle
- Intents in Android, Shared preferences
- Fragments in android
- Animations
- Databases and content providers
- Services
- Sensors and location based services
- Audio playback and image capture
- Introduction to frameworks (Flutter, Cordova)

### Laboratory

- Programs supplement the tutorial concepts will be based on the latest version of Android.
- Mini Project

### Reference Books:

1. Reto Meier: Professional Android 4 Application Development. Wiley India Edition, 2012.
2. Jerome (J.F.) Di Marzio: Android A Programmer's Guide, Tata McGraw-Hill, 2010.
3. B.M. Harwani: Android Programming, Pearson, 2013.
4. Jason Ostrander: Android UI Fundamentals Develop and Design, Pearson, 2014.
5. John Horton: Android Programming for Beginners, Packt publishing, 2015.
6. **Web Reference:** Any Google developer sites

### Course Outcomes (COs):

1. Describe the Android SDK, Development Framework and Demonstrate Android Application Life Cycle. (PO-1, PO-2, PO-3, PO-5)
2. Apply the Android UI and animations API for enhancing the user experience and developing advanced applications. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11)
3. Develop the Android Applications using sensors, location based services, databases and Background services. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-10, PO-11, PO-12)

<b>OBJECT ORIENTED MODELING AND DESIGN PATTERNS</b>	
<b>Subject Code: MCAE53</b>	<b>Credits: 2:0:1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28L 28P</b>
<b>Course Coordinator:</b>	

### Unit 1

**Introduction, Modeling Concepts, Class Modeling:** What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history.

**Modeling as a Design Technique:** Modeling; abstraction; the three models.

**Class Modeling:** Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models.

### Unit 2

**Advanced Class Modeling:** Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes. Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages.

**State Modeling:** State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior.

### Unit 3

**Interaction Modeling:** Use case models; Sequence models; Activity models.

Use case relationships; Procedural sequence models; Special constructs for activity models.

**System Conception:** Devising a system concept; elaborating a concept; preparing a problem statement.

**Domain Analysis:** Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.

### Unit 4

**Application Analysis:** Application interaction model; Application class model; Application state model; adding operations.

**Class Design:** Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recurring downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example.

### Unit 5

**Implementation Modeling:** Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; realizing associations; Testing.

**Legacy Systems:** Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance.

### Laboratory

- Develop Object Oriented Analysis and design models for a real world problem
- Identify the model elements

- Draw the necessary diagrams in UML, using any UML tool
- Generate source code in Java/C++/C#

**Text Books:**

1. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, 2<sup>nd</sup> Edition, Pearson Education, Prentice Hall of India, 2005.  
Chapters 1 to 5, 7 to 13, 15 to 17 and 23

**Reference Books:**

1. Grady Booch et al: Object-Oriented Analysis and Design with Applications, 3<sup>rd</sup> Edition, Pearson Education, 2007.
2. Brahma Dathan, Sarnath Ramnath: Object-Oriented Analysis, Design, and Implementation, Universities Press, 2011.
3. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado: UML 2 Toolkit, Wiley-Dreamtech India, 2004.

**Course Outcomes (COs):**

1. Apply the concept of object oriented modeling and design techniques. (PO-1, PO-5, PO-9, PO-11)
2. Use the notations of class, state, use case, sequence and activity diagrams and various UML notations. (PO-1, PO-5, PO-7, PO-9, PO-11, PO-12)
3. Analyze the domain, application artifacts, and construct domain model and application model. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-9, PO-11, PO-12)
4. Design classes using suitable design techniques. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-9, PO-11, PO-12)
5. Explain implementation modeling and the legacy systems. (PO-1, PO-3)

<b>DEVOPS</b>	
<b>Subject Code: MCAE54</b>	<b>Credits: 0:1:2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28T 56P</b>
<b>Course Coordinator:</b>	

### **Concepts to be covered in Tutorial**

- Introduction to Agile, Agile Phases.
- Introduction to DevOps, DevOps Life Cycle, Agile vs DevOps
- DevOps Work Flow and Principles.
- Roles, Responsibilities and Skills of a DevOps Engineer.
- overview of Git, GitHub, Git Workflow.
- Overview of Jenkins.
- Introduction to Docker, Docker Architecture.
- Container, Containerization vs Virtualization.

### **Exercises for Lab**

- Git Installation, Environment Setup.
- Creating local repository using Git.
- Creating an Account in GitHub, Creating Remote Repository.
- Working in local repository using Basic Git commands.
- Working with remote repository using Git remote commands.
- Jenkins Master–Slave Installation on AWS
- Installing Jenkins Plugins.
- Creating Jenkins Builds, Creating Scheduled Builds
- Installing Docker, Running a Container.
- Pulling an Image from the Docker Registry.
- Running an Image, Stopping and Starting Containers.
- Pushing an Image to the Repository.
- Basic Docker Commands.

### **References:**

1. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer Paperback – Import, 1st ed. Edition ,1 December 2019 by Mariot Tsitoara .
2. Continuous Delivery with Docker and Jenkins: Create secure applications by building complete CI/CD pipelines, 2nd Edition by Rafal Leszko.
3. <https://git-scm.com/book/en/v2>
4. <https://www.jenkins.io/doc/tutorials/>
5. <https://docs.docker.com/get-started/>

**Course Outcomes (COs):**

1. Exemplify the usage of DevOps and its life cycle. (PO-3, PO-6, PO-7, PO-8)
2. Demonstrate the basic commands and Source Control Management using Git (PO-3, PO-5, PO-6, PO-8)
3. Implement the CI/CD Pipelines using Jenkins. (PO-3, PO-5, PO-6, PO-9)
4. Demonstrate the Containerization with Docker. (PO-3, PO-5, PO-6, PO-9)



<b>EDGE COMPUTING</b>	
<b>Subject Code: MCAE55</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

Fog and Edge Computing Completing the Cloud, Advantages of FEC: SCALE, How FEC Achieves, These Advantages: SCANC, Hierarchy of Fog and Edge Computing, Addressing the Challenges in Federating Edge Resources.

### **Unit 2**

Optimization Problems in Fog and Edge Computing, Middleware for Fog and Edge Computing: Design Issues.

### **Unit 3**

Data Management in Fog Computing.

### **Unit 4**

Open Architecture, Applications and Issues, Difference between an IoT device and an edge device, IoT and edge computing use cases

### **Unit 5**

Data Preprocessing and filtering, Edge Analytics, Distributed Applications

#### **Text Books:**

1. Rajkumar Buyya, Satish Narayana Srirama: Fog and Edge Computing: Principles and Paradigms, Wiley, 2019.

#### **Course Outcomes (COs):**

1. Explain the fundamentals of edge computing. (PO-1, PO-2, PO-3)
2. Explain the optimization problems and middle ware for fog and edge computing. (PO-1, PO-2, PO-3)
3. Illustrate the concepts of data management in fog computing. (PO-1, PO-2, PO-3)
4. Apply the principles of edge computing and provide the solution (PO-1, PO-2, PO-3)
5. Perform data preprocessing and edge analytics. (PO-1, PO-2, PO-3)

## **ELECTIVE VI**

<b>SOFTWARE PROJECT MANAGEMENT</b>	
<b>Subject Code: MCAE61</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Introduction to Software Project Management and Project Evaluation:** Importance of Software Project Management, Activities, Methodologies, Categorization of Software Projects, Setting objectives, Management Principles, Management Control, Project portfolio Management, Cost-benefit evaluation technology, Risk evaluation.

### **Unit 2**

**Project Planning and Effort Estimation:** Stepwise Project Planning, Basics of Software estimation, Effort estimation techniques, COSMIC Full function points, COCOMO II A Parametric Productivity Model.

### **Unit 3**

**Project Approach Selection and Activity Planning:** Software process and Process Models, Choice of Process models, Rapid Application development, Agile methods, Extreme Programming, SCRUM, Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Network Planning models, Forward Pass and Backward Pass techniques, Critical path (CRM) method.

### **Unit 4**

**Risk Management and Project Monitoring:** Risk identification, Assessment, Monitoring, PERT technique, Framework for Management and control, Collection of data Project termination, visualizing progress, Cost monitoring, Earned Value Analysis-Project tracking, Change control - Software Configuration Management.

### **Unit 5**

**Resource Allocation and Software Quality:** Resource Allocation, Creation of critical paths, Software Quality in Project Planning, Software Quality Models, Product and Process Metrics and Quality Management, Quality Management Systems, Process Capability Models.

#### **Text Books:**

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management, 6<sup>th</sup> Edition, Tata McGraw Hill, New Delhi, 2018.  
Chapters: 1.1 to 1.16, 2.1 to 2.6, 3, 4.1 to 4.5, 4.13 to 4.16, 5.1 to 5.13, 6, 7.1 to 7.12, 8.1 to 8.5, 9, 13.1 to 13.5, 13.7 to 13.10.2

#### **Reference Books:**

1. Robert K. Wysocki: Effective Software Project Management, Wiley Publication, 2011.
2. Walker Royce: Software Project Management, Addison-Wesley, 1998.

3. Gopaldaswamy Ramesh: Managing Global Software Projects, McGraw Hill Education (India), Fourteenth Reprint, 2013.

**Course Outcomes (COs):**

1. Discuss the scope of software project management and adapt the software project evaluation principles. (PO-1, PO-2, PO-4, PO-6, PO-8, PO-9, PO-10)
2. Explain the project planning approach and apply the software effort estimation techniques. (PO-1, PO-2, PO-4, PO-8, PO-9, PO-12)
3. Determine the appropriate process model and produce activities plan. (PO-1, PO-2, PO-4, PO-8, PO-9, PO-12)
4. Manage the risks, monitor the progress of projects and manage the change control. (PO-1, PO-2, PO-4, PO-6, PO-8, PO-9)
5. Handle the resource allocation and practice the software quality standards. (PO-1, PO-2, PO-4, PO-6, PO-8, PO-9, PO-12)

<b>MANAGEMENT AND ENTREPRENEURSHIP</b>	
<b>Subject Code: MCAE62</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

**Nature and Functions of Management:** Importance of management, Definition of management, Management Functions or the Process of Management, Levels of Management, Organisational or Business Functions, Roles of a Senior Manager, Managerial Skills, Managerial Effectiveness, Management and Administration.

**Planning:** Nature of Planning, Importance of Planning, Types of Plans, Steps in Planning, Difference between Strategic Planning and Tactical Planning

### **Unit 2**

**Coordination:** Distinction Between Coordination and Cooperation, Distinction Between Coordination and Control, Need for Coordination, Types of Coordination. Techniques of Coordination (Approaches to Coordination), Difficulty of Coordination.

**Staffing:** Importance and Need for Proper Staffing, Manpower Planning, Recruitment, Selection, Placement, Induction (Orientation).

**Managerial Control:** Steps in Control Process, Need for Control System, Benefits of Control

### **Unit 3**

**Entrepreneur:** Introduction, Evolution of the Concept of Entrepreneur, Characteristics of successful Entrepreneurs, the charm of becoming an Entrepreneur, The Entrepreneurial Decision Process, Functions of Entrepreneur, Need for an Entrepreneur, Types of Entrepreneurs, Distinction between an Entrepreneur and a Manager, Intrapreneur, Social Entrepreneur.

**Entrepreneurship:** Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development.

### **Unit 4**

**Start-Up: Micro and Small Enterprises:** Small Enterprises: Meaning and Definition, Micro and Macro units, Essentials, features and characteristics, relationship between Micro and Macro Enterprises, Role of Micro Enterprises in Economic Development, Package for Promotion of Micro and Small – Scale Enterprises, Problems of Micro and Small Enterprises.

**Opportunity Identification and Selection:** Need for opportunity Identification and Selection, Environmental Dynamics and Change, Business Opportunities in Various Sectors, Identification of Business Opportunity: Idea Generation, Opportunity/Product Identification, Opportunity Selection, Steps in setting up of a small Business Enterprise.

### **Unit 5**

**Forms of Business Ownership:** Sole Proprietorship, Partnership, Company, Cooperative, Selection of an Appropriate form of Ownership Structure, Ownership Pattern in Micro – Scale Enterprises in India: The Empirical Evidence.

**Institutional Finance to Entrepreneurs:** Need for Institutional Finance, Institutional Finance: Commercial Banks, Other Financial Institutions.

**Institutional Support to Entrepreneurs:** Need for Institutional Support, Institutional Support to small Entrepreneurs: National Small Industries Corporation Ltd (NSIC), Small Industries Development Organization (SIDO), Small Scale Industries Board (SSIB). State Small Industries Development Corporations (SSID), District Industries Centers (DICs), Industrial Estates, Specialized Institutions, Technical Consultancy Organizations (TCOs).

**Text Books:**

1. P C Tripathi, P N Reddy: Principles of Management. Tata McGraw Hill, 6th Edition, 2017.
2. Dr. S. S. Khanka: Entrepreneurial Developmen, Revised Edition, S Chand & Co., 2007.

**Course Outcomes (COs):**

1. Discuss the nature and functions of management and functions of manager. (PO-8, PO-9, PO-11, PO-12)
2. Exemplify the administrative skills coordination, staffing and managerial control. (PO-8, PO-11, PO-12)
3. Identify the skills required for an entrepreneur. (PO-8, PO-11, PO-12)
4. Discuss the role of micro and small enterprises. (PO-8, PO-11, PO-12)
5. Discuss the support of institutional finance to entrepreneurs and institutional support to entrepreneurs. (PO-8, PO-11, PO-12)

<b>DESIGN THINKING</b>	
<b>Subject Code: MCAE63</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

WHAT'S DESIGN THINKING? Why do we need design thinking? What makes design thinking unique?

DESIGN ACTION PLAN: 5 characteristics of action plan-- Empathize phase, Define phase, Ideate phase, Prototype phase, Test phase

### **Unit 2**

PROCESS OF DESIGN

Introduction – Product Life Cycle - Design Ethics - Design Process - Four Step – Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation

### **Unit 3**

THINKING MINDSETS- Anatomy of a design thinker, Mindset 1: Think users first; Mindset 2: Ask the right questions; Mindset 3; Believe you can draw; Mindset 4: Commit to ideate; Mindset 5: Prototype to test

THINK USERS FIRST: What are your users inherent needs? How do you empathize your users? Ask questions—What you need to know; Steps to take for preparing an interview; Persona; Empathy map

### **Unit 4**

ASK THE RIGHT QUESTIONS: Why ask the right questions? What are different type of questions? Who should you ask questions? How to align stakeholders in meetings?

Why should we communicate by drawing? What is the value of drawing? How to start drawing?

### **Unit 5**

COMMIT TO IDEATE: Why do you need to ideate? What are the rules of ideation? How to facilitate an ideation session? How to build a creative culture? Divergent- common ideation techniques; Convergent—simple ways to converge

PROTOTYPE TO TEST: What you could use as a prototype? Why do we need a prototype? Why do we test? How to conduct a structured test? How to conduct the interview? How to conduct the observers debrief?

### **Reference Books**

1. Daniel Ling: Complete Design Thinking Guide for Successful Professionals, Emerge Creatives Group LLP, 2015.
2. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Bloomsbury Academic, 2016.

3. John R. Karsnitz, Stephen O'Brien, John P. Hutchinson: Engineering Design: An Introduction, Cengage Learning, 2<sup>nd</sup> Edition.
4. Yousef Haik, Sangarappillai Sivaloganathan, Tamer M. Shahin: Engineering Design Process, Cengage Learning, 2018.

**Course Outcomes (COs):**

1. Describe the idea and action plan of design thinking. (PO-3, PO-4)
2. Illustrate the process of design. (PO-3, PO-4, PO-10, PO-12)
3. Explain various thinking mind sets. (PO-3, PO-4, PO-10)
4. Acquire verbal and drawing communication skills. (PO-3, PO-9)
5. Ideate the solutions for a given problem and Build prototype for testing. (PO-3, PO-4, PO-10, PO-12)



<b>ENTERPRISE RESOURCE PLANNING</b>	
<b>Subject Code: MCAE64</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

Introduction to ERP Overview, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering, Data Warehousing, Data Mining, On-line Analytical Processing, Supply Chain Management

### **Unit 2**

ERP Implementation: Implementation of Life Cycle, Implementation Methodology, Hidden Costs, Organizing Implementation, Vendors, Consultants and Users, Contracts, Project Management and Monitoring

### **Unit 3**

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

### **Unit 4**

ERP Market: ERP Market Place, SAP AG, People Soft, Baan Company, JD Edwards World Solutions Company, Oracle Corporation, QAD, System Software Associates.

### **Unit 5**

ERP–Present and Future: Turbo Charge the ERP System, EIA, ERP and E–Commerce, ERP and Internet, Future Directions in ERP.

#### **Textbooks:**

1. Alexis Leon: ERP Demystified, Tata McGraw Hill, 1999.
2. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner: Concepts in Enterprise Resource Planning, Thomson Learning, 2001.

#### **References:**

1. Vinod Kumar Garg and N.K .Venkata Krishnan: Enterprise Resource Planning
2. concepts and Planning, Prentice Hall, 1998.
3. Jose Antonio Fernandz: The SAP R /3 Hand book, Tata McGraw Hill.

#### **Course Outcomes (COs):**

1. Analyze the pros and cons of ERP, Data warehousing/Mining and OLAP for the given problem/application. (PO-1, PO-2, PO-3, PO-4, PO-8)
2. Analyze the implementation of ERP in the context of business of the different organization. (PO-2, PO-3, PO-8, PO-9, PO-11)
3. Apply ERP for different business modules. (PO-1, PO-2, PO-3, PO-4, PO-8)
4. With the help of a case study explain ERP marketing. (PO-2, PO-3, PO-8, PO-9, PO-11)
5. Analyze the design ERP with future E-commerce and internet. (PO-1, PO-2, PO-8, PO-11)

<b>MANAGEMENT INFORMATION SYSTEMS</b>	
<b>Subject Code: MCAE65</b>	<b>Credits: 3:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 42L</b>
<b>Course Coordinator:</b>	

### **Unit 1**

#### **Information Systems in Global Business Today**

How Information Systems Are Transforming Business, What's new in Management Information System, Globalization Challenges and Opportunities: A Flattened World, what is an Information System, Dimensions of Information Systems, Technical Approach, Behavioural Approach.

#### **Global E-Business and collaboration**

Business Process, how information Technology Improves Business Process, Systems for different management groups, Systems for linking the enterprise, The Information systems department, organizing the information systems function.

### **Unit 2**

#### **IT infrastructure and Emerging Technologies**

Defining IT Infrastructure, Evolution of IT Infrastructure, Technology Drivers of Infrastructure Evolution, Computer Hardware Platforms, Enterprise Software applications, Data Management and storage, Networking/Telecommunication platforms, Internet platforms, Consulting and System Integration Services, Mobile Digital platform, Linux and open source software, Software for the web,

#### **Foundation of Business Intelligence: Databases and Information Management**

File organization terms and concepts, Problems with the traditional file environment, Database Management Systems, Capabilities of DBMS, Designing databases, Non-relational databases, Cloud databases, Blockchain, Challenges of Bigdata, BI Infrastructure.

### **Unit 3**

#### **Achieving Operational Excellence and Customer Intimacy: Enterprise Application**

Enterprise Systems, Enterprise software, Business value of enterprise systems, Supply Chain, Customer Relationship Management Systems, CRM software, Operational and analytical CRM, Business value of CRM.

#### **E-Commerce: Digital Markets, Digital Goods**

E-commerce today, The new E-commerce, why E-commerce is different, Key concepts in E-commerce, Types of E-commerce, E-commerce business models, Behavioral targeting, Social E-commerce and social network marketing, EDI, New ways of B2B Buying and selling.

### **Unit 4**

#### **Managing Knowledge and Artificial Intelligence**

Important Dimension of Knowledge, Knowledge Management value chain, Types of Knowledge management systems, Evolution of AI, Types of AI, Expert systems, Machine Learning, Neural Networks, Genetic algorithms, NLP, Computer vision systems and robotics, Intelligent Agents.

## **Enhancing Decision Making**

Business value of Improved Decision Making, Types of decisions, the decision making process, Managerial roles, Real world decision making, High velocity automated decision making, what is BI, BI environment, BI and analytic capabilities.

## **Unit 5**

### **Building and Managing Systems**

Systems Development and Organizational Change, Business process redesign, System Analysis, Systems design, Completing the systems development process, structured methodologies, Object oriented development, Computer Aided software engineering, Traditional systems life cycle, prototyping, End-user development, Application Software packages, Software services and out sourcing.

### **Managing Projects**

Runaway projects and System Failure, Project Management Objectives, Management structure for information systems projects, linking systems projects to the business plan, portfolio analysis, scoring models, Information system costs and benefits, capital budgeting for information systems, Limitations of Financial models, Dimensions of project risks, Change Management and the concept of Implementation, controlling risk factors, designing for the organization, project management software tools.

Case Study

### **Text books:**

1. Kenneth C.Laudon, Jane P.Laudon: Management Information Systems Managing the Digital Firm, 16<sup>th</sup> Edition, Pearson Education, 2020.  
Chapters: 1.1, 1.2, 1.3, 2.1, 2.2, 2.4, 5.1 to 5.4, 6.1 to 6.3, 9.1 to 9.3, 10.1 to 10.4, 11.1,11.2, 12.1 to 12.3, 13.1 to 13.4, 14.1 to 14.4.

### **Reference Books:**

1. Kenneth C.Laudon, Jane P.Laudon: Management Information Systems Managing the Digital Firm, 13<sup>st</sup> Edition, Pearson Education, 2015.
2. Management Information Systems, Jawadekar, 5<sup>th</sup> Edition, McGraw Hill 2013.

### **Course Outcomes (COs):**

1. Discuss the Role of Information Systems in Global Business Today. (PO-1, PO-2, PO-8, PO-11)
2. Apply the foundations of Business Intelligence and describe the IT Infrastructure for Business. (PO-1, PO-2, PO-8, PO-9, PO-10, PO-11)
3. Describe the Enterprise Systems and Digital Marketing in Industry. (PO-2, PO-8, PO-9, PO-10)
4. Describe managing knowledge and Analyze the Decision Making concepts for building and managing information systems in an organization. (PO-2, PO-8, PO-9, PO-10, PO-11)
5. Apply the Project Management principles for managing the system. (PO-1, PO-2, PO-8, PO-10, PO-11)

<b>MINI PROJECT</b>	
<b>Subject Code: MCAP1</b>	<b>Credits: 0:0:2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: 28P</b>
<b>Course Coordinator:</b>	

**Guidelines:**

- The objective of this course is to work toward solving problems using latest technologies.
- Students are expected to take up mini project with a team size not exceeding 2. However, during the examination, each student has to demonstrate the project individually.
- Brief synopsis not more than two pages to be submitted by the team as per the format given. It is recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects.
- The team must submit a brief project report (25-30 pages) that must include the following
  - Introduction
  - Requirement Analysis
  - Software Requirement Specification
  - Analysis and Design,
  - Implementation
  - Testing
- The title, relevance of the title, novelty, synopsis and technologies used for developing an application or to carry out research work will be scrutinized by respective guides.
- Rubrics may be used to evaluate the Mini-Project

**Course Outcomes (COs):**

1. Design and implement solution for a given problem using software engineering approach. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-10, PO-12)
2. Manage as an individual or in a team in development of technical projects. (PO-1, PO-2, PO-3, PO-7, PO-8, PO-9, PO-11, PO-12)
3. Develop effective presentation skills in presenting project related activities. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-8, PO-9, PO-11, PO-12)

<b>SOCIETAL ACTIVITY</b>	
<b>Subject Code: MCASA</b>	<b>Credits: 0:0:0</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: Nil</b>
<b>Course Coordinator:</b>	

**Guidelines:**

- The student shall take up an activity with a NGO / Professional body / NSS / NCC etc.
- This course does not have any CIE or SEE; however, the students are required to submit a Completion Certificate and a report.
- The result is declared either pass or fail, based on the completion of the course in the stipulated time.

## **IV SEMESTER**

<b>PROJECT WORK</b>	
<b>Subject Code: MCA41</b>	<b>Credits: 20</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: Nil</b>
<b>Course Coordinator:</b>	

### **Dissertation Work Guidelines**

- The topic and title of the dissertation shall be chosen by the candidate in consultation with the guide and co-guide. However, modification of the title is permitted at the time of submission of dissertation report. The subject and topic of dissertation shall be from the major field of studies of the candidate.
- The dissertation work shall be carried out by each candidate independently under the guidance of one of the faculty members of the Department.
- If dissertation has to be carried out in any industry/factory/organization, outside the campus, the permission to that effect and the name of co-guide at any of these organizations shall be intimated to the Head of the Department.
- At the end of the semester each candidate shall submit a report of the dissertation work duly approved by the guide. The dissertation work shall be countersigned by the co-guide (if any) and Head of the Department.
- The candidate shall submit Two copies of the dissertation work to the Head of the Department. Duration of the dissertation work shall be 5 months. A separate calendar of events for submission of dissertation and viva-voce shall be fixed and will be notified by the Chairman of Board of Exam (BoE). The candidates who fail to submit the dissertation work within the stipulated time have to submit the same at the time of next ensuing examination.
- The dissertation shall be evaluated by two examiners-one internal and one external, appointed by the Chairman of BoE. The evaluation of the dissertation shall be made independently by each examiner. During the evaluation of the dissertation if anyone of the examiner/both/feels that the candidate is not getting the minimum marks for passing, he/they shall notify to the Chairman of BoE stating specific reasons for rejection and suggestions for resubmission. The viva-voce examination of such candidates shall not be conducted. The resubmitted dissertation may preferably send to the same examiners for the re-examination.
- The candidate may also choose another topic of dissertation under a new guide, if necessary. In such case dissertation may be submitted within 6 years from the date of admission to the course. A different set of examiners shall be constituted for evaluation of dissertation under such circumstances by the Chairman of BoE.
- A copy of the dissertation shall be sent to both the examiners by the Chairman of BoE.
- Both the examiners shall evaluate the dissertation normally within a period of not more than 3 weeks from the date of receipt of the dissertation. The external examiner shall be contacted by the head of the department to arrive at a convenient date for the conduct of viva-voce of the batch students allotted to the external examiner.
- The relative weightage for the evaluation of dissertation and the performance of the viva-voce shall be as per the scheme.
- Both the examiners shall evaluate the dissertation independently and marks shall be awarded jointly at the time of viva-voce examination.

- The viva-voce examination will be conducted jointly by the internal and external examiners and marks shall be awarded jointly. The marks shall be sent to the Controller of Examinations immediately after examination.
- Student has to publish a research paper in indexed journal / conference.

**Note:** All the above guidelines are subjected to the approval by the Chairman of Board of Studies, from time to time.

### **Course Outcomes (COs):**

1. Gather and analyze the requirements of the given application, survey the literature on existing methodologies, techniques and tools in the related area of the problem and analyze their applicability for the solution. (PO-1, PO-2, PO-3, PO-5, PO-7, PO-9, PO-10, PO-11, PO-12)
2. Model and design the solution ethically considering social issues. (PO-1, PO-2, PO-3, PO-5, PO-6, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)
3. Implement the design, verify, validate and analyze the results. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)
4. Demonstrate and document the project work efficiently. (PO-4, PO-5, PO-6, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)
5. Manage as an individual or in a team in development of technical projects. (PO-5, PO-7, PO-8, PO-9, PO-10, PO-11, PO-12)



<b>SEMINAR</b>	
<b>Subject Code: MCAS1</b>	<b>Credits: 2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: Nil</b>
<b>Course Coordinator:</b>	

**Seminar Guidelines:**

- The topic of the seminar shall be chosen by the candidate in consultation with the guide. The topic shall be from the emerging field of computer Science / Computer Applications.
- The seminar shall be carried out by each candidate independently under the guidance of one of the faculty members of the Department.
- The students shall gather literature related to their specific topic from IEEE explore or Science direct or ACM digital library, etc. and prepare a research paper.
- The research paper shall be published in Scopus indexed Conference / Journal before the end of the semester.
- At the end of the semester each candidate shall submit the published paper with plagiarism copy duly approved by the guide.
- The seminar examination will be conducted jointly by the internal and external examiners and marks shall be awarded jointly. The marks shall be sent to the Controller of Examinations immediately after examination.

**Course Outcomes (COs):**

1. Gather and review the literature in a state-of-the art research area. (PO-2, PO-5, PO-6, PO-7, PO-9, PO-10, PO-12)
2. Design and develop a solution for an identified problem. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-9, PO-10, PO-12)
3. Analyze and validate the findings. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-9, PO-10, PO-11, PO-12)
4. Communicate the research work professionally and develop the team spirit. (PO-1, PO-2, PO-5, PO-7, PO-9, PO-11)

<b>INDUSTRY INTERNSHIP</b>	
<b>Subject Code: MCAIN</b>	<b>Credits: 2</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: Nil</b>
<b>Course Coordinator:</b>	

- Internship of 4-weeks followed by a report
  - Students have to undergo the Internship in any Institute of National repute or any reputed/well-known industry
  - They are expected to submit a report and give a presentation

**Course Outcomes (COs):**

1. Design and implement solution for a given problem using software engineering approach. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-10, PO-12)
2. Contribute as an individual or in a team in development of technical projects. (PO-1, PO-2, PO-3, PO-7, PO-8, PO-9, PO-11, PO-12)
3. Develop effective presentation skills in presenting project related activities. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-6, PO-7, PO-8, PO-9, PO-11, PO-12)

<b>ABILITY ENHANCEMENT COURSE</b>	
<b>Subject Code: MCAAEC</b>	<b>Credits: 1</b>
<b>Pre requisites: Nil</b>	<b>Contact Hours: Nil</b>
<b>Course Coordinator:</b>	

**Guidelines:**

- Students have to acquire the credits by carrying out an On-line Course
  - Students can register for any On-line Course in the field of Computer Science/Management for a minimum duration of 8 weeks
  - They have to submit the Course Completion Certificate along with their scores

**Approval and Evaluation Process:**

- Approval and evaluation can be done by the committee along with the concerned proctor
- The students have to get prior approval from the committee to take up the course
- A stipulated period can be provided for the approval and evaluation process

**Course Outcomes (COs):**

1. Identify the course/technology to learn. (PO-1, PO-3, PO-5, PO-7)
2. Demonstrate the concepts/technology learnt. (PO-1, PO-2, PO-3, PO-5, PO-7)
3. Apply the concepts in solving real world problems. (PO-1, PO-2, PO-3, PO-4, PO-5, PO-7, PO-10)