

**SYLLABUS**  
*for*  
**Choice Based Credit System**  
(CBCS)

**On the basis of**  
**Outcome Based Education**  
**(OBE)**

**MASTER OF COMPUTER APPLICATIONS**  
**(MCA)**

CC/DSE/GI/SEC



**PATNA WOMEN'S COLLEGE**

Autonomous

PATNA UNIVERSITY

3<sup>rd</sup> Cycle NAAC Accredited at 'A' Grade with CGPA 3.58/4  
*"College with Potential for Excellence" (CPE) Status Accorded by UGC*

## **Vision**

Rooted in the life, vision and teachings of Jesus Christ and inspired by Mother Veronica, the foundress of the Apostolic Carmel, Patna Women's College strives to become a centre of academic excellence in higher education, social responsibility, and empowerment of women.

## **Mission Statement**

Patna Women's College, the first college for women in Bihar, is committed to the holistic development of women so as to make an effective contribution to the creation of a better society.

### **To this end, we strive**

- To become a center of excellence in higher education for women in an atmosphere of autonomy.
- To excel in teaching-learning, research, and consultancy.
- To provide education that promotes capacity building and holistic development of a person.
- To offer subjects for competency building and motivate/animate a workforce imbued with human values.
- To promote patriotism, communal harmony and cultural integration to maintain a free and peaceful atmosphere on the campus.
- To train the students in creative arts, social service, critical thinking, and leadership in order to make an effective contribution to the creation of a new and value-based society.
- To create women leaders and to make them agents of social change.
- To develop skill oriented and value-based courses, for the all-round development of individuals.
- To promote academic exchange and academia-industry interface.
- To form young women who are 'always wise' and who will dare to 'go ahead and conquer knowledge' through, competence, commitment, delicate conscience, and compassion.

# **MCA CBCS Syllabus**

**Note: 1 credit = 15 hours**

1. Theory paper: 5 credits each
2. Practical paper: 3 credits / 2credits

## **Core Courses (5 credits for theory papers / 3credits for lab papers)**

**Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

### **Semester I**

1. Software Engineering – MCA CS1T01
2. Advanced Database Management System - MCA CS1T02
3. Design & Analysis of Algorithm- MCA CS1T03
4. Computer Networks and Security- MCA CS1T04
5. Lab on Responsive Web Designing -MCA CS1L05

### **Semester II**

6. Object Oriented Analysis and Designing – MCA CS2T06
7. Distributed Computing- MCA CS2T07
8. Mini Project I(Lab)- MCA CS2L08

### **Semester III**

9. Advanced Web Designing using J2EE- MCA CS3T09
10. Cloud Computing-MCA CS3T10
11. Data & Web Mining- MCA CS3T11
12. Mini Project II(Lab)- MCA CS3L12

### **Semester IV**

13. Internship-MCA CS4P13
14. Project- MCA CS4P14

## **Generic /Interdisciplinary Papers (5 credits each)**

**Generic/Interdisciplinary Papers :** A course generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic / Interdisciplinary course.

## **Semester I**

1. Statistical and Numerical Computing - MCA GI1T1

## **Semester II**

2. Optimization Techniques - MCA GI2T2

## **Discipline Specific Elective (DSE) (5 credits each)**

**Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. These courses may be chosen from a pool of discipline specific specialized courses.

## **Semester II**

### **Elective-1–MCA DSE2T1**

1. Compiler Design
2. Digital Image Processing & Multimedia
3. Computer Graphics

### **Elective-2– MCA DSE2T2**

1. Introduction to Machine Learning
2. Artificial Intelligence
3. Soft Computing

## **Semester III**

### **Elective-3– MCA DSE3T3**

1. MIS and E-Commerce
2. Enterprise Resource Management
3. Principles of Management & Organizational Behaviour

### **Elective-4– MCA DSE3T4**

1. Parallel Computing
2. Wireless Network
3. Big Data Analytics

## **Skill Enhancement Courses (SEC)( 2 Credits )**

**Skill Enhancement Courses (SEC):** These courses are designed to provide value-based and/or skill-based knowledge.



## Semester I

1. Lab Based on Statistical Package- MCA SE1L01
2. Training on Computer Networking – MCA SE1L02

## Semester II

3. Technical Presentation & Report Writing- MCA SE2L03
4. Personality Development & Inter Religious Values- MCA SE2L04

## Semester III

5. MOOCs- MCA SE3L05
6. Seminar - MCA SE3L06

## MCA CBCS Syllabus

Sem	Core Course (14) 5 Credits each for theory papers (9) 3 credits each for Lab papers (3 ) 12 Credits each for OJT project/internship papers (2)	Generic Interdisciplinary (2) 5 Credits each	Discipline Specific Elective Papers (4) 5 Credits each	Skill Enhancement Course(6) 02 Credits each
I	<b>MCA CS1T01:</b> Software Engineering	<b>MCA GI1T1:</b> Statistical and Numerical Computing		<b>MCA SE1L01:</b> Lab Based on Statistical Package
	<b>MCA CS1T02:</b> Advanced Database Management System			
	<b>MCA CS1T03:</b> Design & Analysis of Algorithm			<b>MCA SE1L02:</b> Training on Computer Networking
	<b>MCA CS1T04:</b> Computer Networks & Security			
	<b>MCA CS1L05:</b> Lab on Responsive Web Designing			

<b>II</b>	<b>MCA CS2T06:</b> Object Oriented Analysis and Designing	<b>MCA GI2T2:</b> Optimization Techniques	<b>MCA DSE2T1:</b> Elective-1	<b>MCA SE2L03:</b> Technical Presentation & Report Writing
	<b>MCA CS2T07:</b> Distributed Computing		<b>MCA DSE2T2:</b> Elective-2	
	<b>MCA CS2L08:</b> Mini Project I ( Lab)			<b>MCA SE2L03:</b> Technical Presentation & Report Writing
<b>III</b>	<b>MCA CS3T09:</b> Advanced Web Designing using J2EE		<b>MCA DSE3T3:</b> Elective-3	<b>MCA SE3L05:</b> MOOCs
	<b>MCA CS3T10:</b> Cloud Computing		<b>MCA DSE3T4:</b> Elective-4	
	<b>MCA CS3T11:</b> Data & Web Mining			
	<b>MCA CS3L12:</b> Mini Project II ( Lab)			<b>MCA SE3L06:</b> Seminar
<b>IV</b>	<b>MCA CS4P13:</b> Internship			
	<b>MCA CS4P14:</b> OJT Project			

## Course Structure for MCA

Semester – I	Semester – II
<b>MCA CS1T01:</b> Software Engineering	<b>MCACS2T06:</b> Object Oriented Analysis and Designing
<b>MCA CS1T02:</b> Advanced Database Management System	<b>MCA CS2T07:</b> Distributed Computing
<b>MCA CS1T03:</b> Design & Analysis of Algorithm	<b>MCA CS2L08 :</b> Mini Project I ( Lab)
<b>MCA CS1T04 :</b> Computer Networks & Security	<b>MCA GI2T2:</b> Optimization Techniques

<b>MCA CS1L05 :</b> Lab on Responsive Web Designing	<b>MCA DSE2T1:</b> Elective-1
<b>MCA GI1T1 :</b> Statistical and Numerical Computing	<b>MCA DSE2T2:</b> Elective-2
<b>MCA SE1L01 :</b> Lab Based on Statistical Package	<b>MCA SE2L03:</b> Technical Presentation & Report Writing
<b>MCA SE1L02 :</b> Training on Computer Networking	<b>MCA SE2L04:</b> Personality Development & Inter Religious Values
<b>Semester – III</b>	<b>Semester – IV</b>
<b>MCA CS3T09:</b> Advanced Web Designing using J2EE	<b>MCA CS4P13:</b> Internship
<b>MCA CS3T10:</b> Cloud Computing	<b>MCA CS4P14:</b> OJT Project
<b>MCA CS3T11:</b> Data & Web Mining	
<b>MCA CS3L12:</b> Mini Project II ( Lab)	
<b>MCA DSE3T3:</b> Elective-3	
<b>MCA DSE3T4:</b> Elective-4	
<b>MCA SE3L05:</b> MOOCs	
<b>MCA SE3L06:</b> Seminar	

## Details of Credits for Courses under MCA Honours Communicative English and Media Studies

Semester	Course	Theory	Practical	Tutorial	Total Credits
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### I. Core Course –Computer Science (12 Papers)

I	1. Software Engineering	5	-	-	5
	2. Advanced Database Management System	5	-	-	5
	3. Design & Analysis of Algorithm	5	-	-	5
	4. Computer Networks & Security	5	-	-	5

	5. Lab on Responsive Web Designing	-	3	-	3
II	6. Object Oriented Analysis and Designing	5	-	-	5
	7. Distributed Computing	5	-	-	5
	8. Mini Project I ( Lab)		3	-	3
III	9. Advanced Web Designing using J2EE	5	-	-	5
	10. Cloud Computing	5	-	-	5
	11. Data & Web Mining	5	-	-	5
	12. Mini Project II ( Lab)	-	3	-	3
IV	13. Internship		-	12	12
	14. OJT Project		-	24	24

## **II. Generic / Interdisciplinary Papers(2 Papers) – 05 credits each**

I	1. Statistical and Numerical Computing	5	-	-	5
II	2. Optimization Techniques	5	-	-	5
	<b>II. Discipline Specific Elective Papers (4 Papers) ( 5 credits each )</b>				
I	1. Elective-1	5	-	-	5
II	2. Elective-2	5	-	-	5
III	3. Elective-3	5	-	-	5
IV	4. Elective-4	5	-	-	5

## **IV. Skill Enhancement Course (SEC) –(6 Papers) 02 credits each**

I	1. Lab Based on Statistical Package	-	2	-	2
	2. Training on Computer Networking	-	2		2
II	3. Technical Presentation & Report Writing	-	2	-	2
	4. Personality Development & Inter Religious Values	-	2	-	2
III	5. MOOCs	-	2	-	2
	6. Seminar	-	2	-	2
	<b>TOTAL</b>				<b>132</b>

**Institute should evolve a system/policy about ECA / General Interest / Hobby / Sports / NCC / NSS / related courses on its own.**

**\*wherever there is practical there will be no tutorial and vice-versa.**

## MCA PROGRAM OUTCOMES (POS)

Upon completion of the Post Graduate programme, the students will be able to achieve the following outcomes:

- PO1: Profound Professional Knowledge:** Obtain proficiency to maneuver in diverse context of the advance subject knowledge.
- PO2: Critical Thinking and Analysis:** Attain the analytical expertise to create, analyse, formulate, and solve challenging problems.
- PO3: Environment and sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO4: Research and Innovation:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5: Effective Communication:** Demonstrate skills such as effective communication, decision making, problem and adapt ability to create technical writing.
- PO6: Problem Solving:** Understand, interpret, explain, analyse and assess the tools, techniques, models and methodologies to solve problems.
- PO7: Employability:** Demonstrate skills for doctoral, post-doctoral education, professional development and employability.
- PO8: Advance tools and techniques:** Attain ability to work with advanced IT tools and techniques in their domain.
- PO9: Social Consciousness:** Acquire awareness towards gender, environment, sustainability, human values and professional ethics and understand the difference between acting, responding and reacting to various social issues
- PO10: Nation Building:** Introspect and evolve into dynamic and creative individuals capable of socially productive, constructive actions that positively impact our Nation and the World at large.

## PO1: MCA PROGRAM OBJECTIVES (PO)

Upon completion of the programme, the students will attain the ability to:

- PSO1:** Create systems through software development to solve problems in Industry domain areas.
- PSO2:** Contribute to societal growth through research in their chosen field.
- PSO3:** Perform both as an individual and in a team through good analytical, design and implementation skills.

- PSO4:** Possess professional development through continuous learning.
- PSO5:** Comprehend, explore and build up computer programs in the areas allied to Algorithms, System Software, Multimedia, Web Design and Big Data Analytics for efficient design of computer-based systems of varying complexity.
- PSO6:** Pursue careers in IT industry/ consultancy/ research and development, teaching and allied areas related to computer science.

## **MCA Details of CBCS Syllabus**

### **SEMESTER – I**

#### **MCA CS1T01 : SOFTWARE ENGINEERING**

##### **COURSE OBJECTIVES:**

- To gain knowledge of basic SW engineering methods and their appropriate application.
- To understand software testing approaches such as unit testing and integration testing.
- To produce efficient, reliable, robust and cost-effective software solutions.
- Students will be able to perform independent research and analysis.
- Students will be able to analyze, design, verify, validate, implement, apply, and maintain software systems.

##### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Explain a process model for a software project Development.
- CO2.** Prepare the SRS, Design document, Project plan of a given software system
- CO3.** Apply Project Management and Requirement analysis, Principles to S/W project development.
- CO4.** Analyze the cost estimate and problem complexity using various estimation techniques

- CO5.** Generate test cases using the techniques involved in selecting:  
Analyze  
(a) White Box testing (b) Black Box testing
- CO6.** Explain the advantages of configuration management and risk management activities.

<b>MCA CS1T01 : Software Engineering PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Introduction to Software Engineering: Characteristics of software -The Changing Nature of software – Legacy Software and Software myths – A Generic view of process – Software Engineering: A layered Technology and A process framework - Capability Maturity Model Integration - Process Models – Prescriptive models - Specialized Process Models and The Unified Process -An agile view of Process.	15
2	Requirements Analysis and Design : System Engineering - Requirements Engineering – Requirements Engineering Tasks - Initiating the Requirements Engineering Process-Eliciting Requirements – Building the Analysis Model - Analysis Modeling Approaches – Data Modeling Concepts and Scenario based Modeling and Flow Oriented Modeling– Design Engineering - Software Design Concepts- The Design Model	15
3	Testing Strategies and Tactics : Introduction to Testing - Definition of Testing Terminologies-Testing Strategies for Conventional Software-Validation Testing - System Testing - Debugging Process-Testing Tactics – White Box Testing - Black Box Testing - Testing for Specialized Environments. Project Management, Estimation and Scheduling : Project Management Spectrum - The People and the Product- The Process and the Project -Metrics for Process and Projects-Estimation - The Project	15

	Planning Process – Resources - Decomposition Techniques - Empirical Estimation Models - Project Scheduling Concepts – Timeline charts and Tracking the Scheduling	
4	Quality, Change and Risk Management: Reactive and Proactive Risk Strategies – Software Risks –Risk Identification and Risk Projection – Risk refinement and Risk Mitigation, Monitoring and Management -Quality Concepts -Software Quality Assurance -Software Reviews and Formal Technical Reviews -Statistical Quality Assurance - The Software Configuration Management and the SCM Repository -Business Process Reengineering - Reverse Engineering	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Roger, S. Pressman (2004), *Software Engineering: A Practitioner Approach*, McGraw Hill International Edition, Sixth Edition, New Delhi (For 1 to 5 units).
2. Waman, S Jawadekar (2004), *Software Engineering: Principles and Practice*, McGraw Hill Education Pvt. Limited, New Delhi.
3. RohitKhurana (2011), *Software Engineering-Principles and Practices*, Vikas Publishing House Pvt. Ltd., Second Edition, New Delhi.
4. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli (1991), *Fundamentals of Software Engineering*, Prentice Hall of India, New Delhi.



## **SEMESTER – I**

### **MCA CS1T02 : ADVANCED DATABASE MANAGEMENT SYSTEM**

#### **COURSE OBJECTIVES:**

- Learn about Database Management System and its advantage over the traditional file system, the DBMS environment, various data models and the steps involved in database design
- Learn and practice data modeling using the entity-relationship and developing database designs.
- It also covers integrity constraints and deals with constraints violation

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Describe the fundamental elements of relational database management systems.
- CO2.** Explain the basic concept of data modelling using the entity-relationship and developing database designs.
- CO3.** Convert E-R models to relational tables, populate relational database and formulate SQL queries on data.
- CO4.** Use database techniques such as SQL & PL/SQL
- CO5.** Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- CO6.** Apply advanced database Programming concepts of varying complexities

<b>MCA CS1T02 : Advanced Database Management System PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Introduction:</b> Database & Database Users, Characteristics of the Database Systems. Concepts & Architecture, Date Models: hierarchical, relational and network, Schemas &	15

	Instances, DBMS Architecture & Data Independence Data Modelling using the Entity-Relationship Approach, Attributes, Tuple, Domain Constraints, key constraints, Integrity constraints, Database Design , Conceptual Design ERD Logical Design Schema, subschema, Relational Data Model & Relational Algebra ( Union, Intersection, Cartesian product, Difference), Relational Model Concepts , Relation Operation( SELECT, PROJECT, JOINS DIVISION)	
2	<b>Structured Query Language: DBMS tools:</b> SQL - A Relational Database Language (DDL, DML, DLC) , View & Queries in SQL, <b>DBMS Applications:</b> ORACLE/a Relational Database Management Systems ORACLE/ INGRES, PL/SQL, Case studies on ER diagram, Normalization and SQL	15
3	<b>Relational Data Base Design:</b> Function Dependencies & Normalization for Relational Databases, Data Redundancy, Functional Dependencies, Normal forms based on primary keys (1NF, 2NF, 3NF & BCNF), Boyce-Codd Normal Form. Lossless Join & Dependency perservingdecomoposition, <b>Physical Design:</b> (File Organization, Heap Organization Sequential Organization, Index File, ISAM, VSAM), Query Processing and Optimization	15
4	<b>Database Transaction Management:</b> Concurrency Control Techniques & Recovery Techniques: Locking Techniques, Time stamp ordering, Granularity of Data items, Database Security & Recovery Techniques ,Recovery concepts, Database backup and recovery from catastrophic failures	15
5	<b>Assignment</b>	15
	<b>TOTAL</b>	<b>75</b>

### **Reading List :**

1. Date C.J., Kannan A., Swamynathan S., *Introduction to Database System*
2. Gehani Narain & Annamalai Melliya, *The Database Book Principles & Practice using the Oracle Database System*
3. Byrson, *SQL/PL/SQL ~ Prog. Language of Oracle*, BPB Pub

## **SEMESTER – I**

### **MCA CS1T03 : Design and Analysis of Algorithm**

#### **COURSE OBJECTIVES:**

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Analyze worst-case running times of algorithms using asymptotic analysis.
- CO2.** Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize Divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- CO3.** Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.

- CO4.** Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analyze them.
- CO5.** Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate. Synthesize new graph algorithms and algorithms that employ graph computations as key components, and analyze them.
- CO6.** Explain the different ways to analyze randomized algorithms (expected running time, probability of error). Recite algorithms that employ randomization. Explain the difference between a randomized algorithm and an algorithm with probabilistic inputs

MCA CS1T03 : Design & Analysis of Algorithm PWC (5 credits – 4 theory + 1 Assignment)		
Unit	Topics to be covered	No. of hours
1	Basics of Algorithms and Mathematics: What is an algorithm? Mathematics for Algorithm <b>Analysis of Algorithm:</b> The efficient algorithm, Average, Best and worst case Asymptotic Notations, Analyzing control statement, Loop invariant and the correctness of the algorithm, Sorting Algorithms and analysis: Bubble sort, Selection sort, Insertion sort, Shell sort Heap sort, Sorting in linear time: Bucket sort, Radix sort and Counting sort	15
2	<b>Divide and Conquer Algorithm:</b> Introduction, Recurrence and different methods to solve recurrence Knapsack Problem DP solution, Activity selection problem DP solution, All pairs shortest paths, Traveling salesman problem. <b>Dynamic Programming:</b> Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming, Knapsack Problem DP solution, Activity selection problem DP solution, All pairs shortest paths, Traveling salesman problem, Merge Sort, Strassen's matrix multiplication.	15

3	<p><b>Greedy Algorithm :</b> General Characteristics of greedy algorithms, Problem solving using , Greedy Algorithm -Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Graphs: Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code</p> <p><b>Graphs:</b> An introduction using graphs and games, Undirected Graph, Directed Graph, Traversing Graphs, Depth First Search, Breath First Search, Topological sort, Connected components, Euler Tour, Minimum Spanning Tree, Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path.</p> <p><b>Backtracking and Branch and Bound:</b> Introduction, The Eight queens problem , Knapsack problem, Travelling Salesman problem, Minimax principle</p>	15
4	<p><b>Randomized Algorithms and Amortized Analysis:</b> Basics ideas of randomized Algorithms (Las Vegas and Monte Carlo types), Simple examples (Randomized Quick sort and its analysis, Min-Cut algorithm and its analysis), Amortized analysis and its significance (Illustration through examples). Introduction to NP-Completeness: The class P and NP, Polynomial reduction, NP-Completeness Problem, NP-Hard Problems Travelling Salesman problem, Hamiltonian problem, Approximation algorithms.</p>	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Cormen, Thomas H., Charles E.,Leiserson, Ronald L. Rivest, and Stein, Clifford, "*Introduction to Algorithm*", PHI
2. Aho, A.V., Hopcroft, J.E. and Ullman J.D., "*The Design and Analysis of Computer Algorithms*", Pearson Education.

3. Harris Simen, Ross James, "Beginning Algorithms", Wiley India.
4. Johansonbaugh Richard, and Schaefer Marcus, "Algorithms", Pearson
5. Baase, S., "Algorithms–Introduction to Design and Analysis", Pearson Education.
6. Wilf, H.S. "Algorithms and Complexity", PHI

## **SEMESTER – I**

### **MCA CS1T04 : COMPUTER NETWORKS & SECURITY**

#### **COURSE OBJECTIVES:**

- To understand the basic concepts of data communication, layered models, protocols and inter- working between computer networks and switching components in telecommunication systems.
- To know the existing protocols and modify if required
- To understand the functioning of Frame Relay, ATM.
- To know the cryptography, security, issues and challenges of computer N/W

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Remember the techniques used in Data communication and types of transmission
- CO2.** Understand the need for data link control, error control mechanism
- CO3.** Apply various network layer techniques for designing subnets mask and routing addresses to fulfil networking requirements
- CO4.** Analyse OSI, TCP/IP and their protocols.
- CO5.** Evaluate issues of routing and congestion mechanism for independent and internetworking networks for wired and wireless link
- CO6.** Create or design application layer protocol with routing in switched networks

**MCA CS1T04 : Computer Networks & Security**  
**PWC (5 credits – 4 theory + 1 Assignment)**

Unit	Topics to be covered	No. of hours
1	<p><b>Data Communications, Data Networking and Data Transmission:</b> Fourier analysis, Band limited signals, The communication channel, Maximum data rate of a channel, Electromagnetic spectrum, electromagnetic waves, frequency and wave length, bandwidth, bandwidth and channel capacity, Modulation, types of Modulation, Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity</p> <p><b>Signal Encoding Techniques:</b> Digital Data, Digital Signals; Digital Data, Analog Signals; Analog Data, Digital Signals; Analog Data, Analog Signals</p> <p><b>Digital Data Communication Techniques:</b> Digital communication, advantages of digital communication, ,Sampling Theory, Analog to digital conversion -Pulse Code Modulation (PCM), Delta modulation (DM); encoding of digital signals, Multiplexing and Modulation of Digital Signals, digital radio, digital amplitude modulation, frequency shift keying (FSK), phase shift keying (PSK), quadrature amplitude modulation (QAM), bandwidth efficiency, carrier recovery, differential phase shift keying,(DPSK), clock recovery, probability of error &amp; bit error rate, trellis encoding, Asynchronous and Synchronous Transmission.</p>	15
2	<p><b>Data Link Control Protocols:</b> Need for Data Link Control, Service provided by the Data Link Layer, Frame Design Consideration, Flow Control Mechanism, Types of Errors, Error Detection, Error Correction, Line Configurations, Flow Control, Error Control, High-Level Data Link Control (HDLC), , Data Link Error Control Error Control in Stop-and-wait Mechanism &amp; Sliding Window</p>	15

	<p>Mechanism, Sequence numbering, Piggybacking Acknowledgements. Mac layer and its different protocols</p> <p><b>Multiplexing, Circuit Switching and Packet Switching:</b> Frequency-Division Multiplexing, Synchronous Time-Division Multiplexing, Statistical Time-Division Multiplexing, Asymmetric Digital Subscriber Line, xDSL, Switched Communications Networks, Circuit Switching Networks, Circuit Switching Concepts, Soft switch Architecture, Packet-Switching Principles, Modems</p>	
3	<p><b>FUNDAMENTALS AND MATHEMATICS OF CRYPTOGRAPHY</b></p> <p>Overview - Classical Crypto Systems – Substitution Ciphers – Transposition Ciphers - Stream and Block Ciphers – Introduction to Number Theory – Congruences – Chinese Remainder theorem – Modular Arithmetic - Modular Exponentiation – Fermats and Eulers Theorem - Finite Fields – GF(2n) Fields</p> <p><b>ENCRYPTION TECHNIQUES:</b> Data Encryption Standard – Advanced Encryption Standard – Confidentiality using Symmetric Encryption, Public-Key Cryptography and RSA – Key Management - Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Symmetric Key Distribution – Kerberos - X.509 Authentication Service.</p> <p><b>HASH FUNCTIONS AND SIGNATURES</b></p> <p>Message Authentication and Hash Functions – Description of MD Hash Family – Secure Hash Algorithms – SHA-512</p> <p>Digital Signatures and Authentication Protocols – Digital Signature Standard – Process - Services - Attacks on Digital Signature - Digital Signature Schemes.</p>	15



4	<b>NETWORK SECURITY</b> Security at the application layer - E-Mail - Pretty Good Privacy – S/MIME – Security at the transport layer - SSL Architecture – Protocols – Message Formats - TLS – Security at the Network Layer - IPSec – Two modes - Authentication Header (AH) – Encapsulating Security Payload (ESP) – Security Policy – Security Association – Internet Key Exchange.  <b>SYSTEM SECURITY</b> Intruders – Intrusion Detection – Password Management – Malwares and Related Threats – DOS Attacks - Distributed Denial of Service Attacks - Firewalls – Firewall Types-Configuration and Implementation - Demilitarized Zone - Firewall Forensics -Services and Limitations - Intrusion Prevention System.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Forouzan,"*Data Communication & Networking*", TMH
2. Tannenbaum, "*Computer Networks*", PHI
3. Dordal Peter, L, (2018) "*An Introduction to Computer Networks*"
4. Bonaveture Olivier (2011) "*Computer Networking: Principals, Protocols & Practice*"
5. Stallings William, (2013), "*Cryptography And Network Security – Principles and Practices*", Sixth Edition, Pearson Education.
6. ForouzanBehrouz A., Mukhopadhyay, Debdeep, (2010), "*Cryptography and Network Security*", Second Edition, Tata McGraw Hill.
7. KahateAtul,(2003), "*Cryptography and Network Security*", Tata McGraw Hill.
8. Kizza Joseph Migga, (2010), "*A Guide to Computer Network Security*", Springer International Edition.

## **SEMESTER – I**

### **MCA CS1L05 : LAB ON RESPONSIVE WEB DESIGNING**

#### **COURSE OBJECTIVES:**

- To learn how to make your web page designs adapt to different screen sizes using responsive grid layouts.
- To learn how to add navigation and other design elements to web pages.
- To learn how to separate data and display using JavaScript objects and templates.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Explain why users need to know where they are, where they can go and what is on a web page.
- CO2.** Create wireframe mockups of web pages.
- CO3.** Identify the key functional elements of web pages
- CO4.** Use Bootstrap components to realise page designs
- CO5.** Use JavaScript data structures such as arrays and objects to define the data used in a web page
- CO6.** Use the Handlebars template library to convert data to HTML

<b>MCA CS1L05 : Lab on Responsive Web Designing PWC (2 credits: 2 Practical)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	HTML Basics, HTML5 Semantic Elements, CSS, CSS3, Responsive Websites, Viewport, Bootstrap - Grid System, Typography, Navigation bar, Carousel, Glyphicons, Tables, Images, Tabs, Modal, Using JavaScript, Using jQuery	30
	<b>TOTAL</b>	<b>30</b>

## SEMESTER – I

### **MCA GI1T1: Statistical And Numerical Computing**

#### **COURSE OBJECTIVES:**

- To understand and implement various concepts of numerical analysis and statistics to solve real life problems.
- To do Analysis of Statistical Data: Frequency distribution; Frequency curve and histogram;
- To understand the process to measure central tendency and dispersion.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Understand the various approaches dealing with the data using theory of probability.
- CO2.** Analyze the different samples of data at different levels of significance using various hypothesis testing.
- CO3.** Develop a framework for estimating and predicting the different samples of data for handling the uncertainties.
- CO4.** Understand error, source of error and its effect on any numerical computation and also analyze the efficiency of any numerical algorithm.
- CO5.** Learn how to obtain numerical solutions of nonlinear equations using Bisection, Newton – Raphson and fixed-point iteration methods.
- CO6.** Solve system of linear equations numerically using direct and iterative methods.

<b>MCA GI1T1 : Statistical and Numerical Computing PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Basic statistics:</b> Measure of central tendency, dispersion. Probability' distribution,introduction to mass function, density function, distribution	15

	function, estimation of parameters. Regression Analysis: Linear and Non linear regression. Multiple regression Testing of Hypothesis: Test of Significance, Chi-square test, t-test, ANOVA, F-test.	
2	<b>Interpolation:</b> Newton's Forward, Backward, Sterling & Bessel's Interpolation formula. Lagrange's Interpolation.	15
3	<b>Integration:</b> Trapezoidal, Simpson's 1/3rd, Weddel's Rule, Romberg integration. Gauss-Legendre two & three point formula, Newton cotes Formula. Gram-Schmidt orthogonalisation, Tchebycheff Polynomial.	15
4	<b>Solution of transcendental and system of linear equations:</b> Method of Iteration, Method of Bisection. Newton - Raphson Method, Regula-Falsi method. Secant Method; Gauss Elimination Method, Gauss-Jacobi, Gauss-Seidel' LU factorization, Tridiagonalisation, Inverse interpolation. Least Square curve fitting: linear & non-linear.  <b>Solution of Differential Equations:</b> Picard's method, Euler-modified method, Taylor's Series method, Runge-Kutta method, Milne's Predictor-Corrector method.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Pal, *Numerical Methods*, OUP
2. Balaguruswamy. *Numerical and Statistical Methods*, TMH
3. V. Rajaraman, "*Introductory methods of Numerical Analysis*", PHI.
4. A.M. Goon, M.K. Gupta and T.S. Dasgupta, "*Fundamental of Statistics*", The World Press Pvt. Ltd.

## **SEMESTER – I**

<b>MCA SE1L01 : Lab based on Statistical Package PWC (2 credits : 2 Practicals)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Analyze the data from the term experiment. Be sure you interpret the results to your instructor. Then, practice with the following problems. As you do the problems remember to answer these questions. You may collaborate with your classmates, but you should try to do the analyses yourself.  1. How many means are being tested? 2. Are the observations independent or related? 3. Is the hypothesis one-tailed or two-tailed? 4. Do the means fit the hypothesis? 5. Where the means significantly different? 6. How do you know?	30
	<b>TOTAL</b>	<b>30</b>

## **SEMESTER – I**

<b>MCA SE1L02 : Training on Computer Networking PWC (2 credits : 2 Practicals)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	IP Addressing Data Sharing Data Security Blocking of Site RAID Configuration Blocking of ICMP	30
	<b>TOTAL</b>	<b>30</b>

## **SEMESTER – II**

### **MCA CS2T06 : Object Oriented Analysis and Design**

#### **COURSE OBJECTIVES:**

- To Explain OOAD concepts and various UML diagrams
- Select an appropriate design pattern.
- Illustrate about domain models and conceptual classes
- Compare and contrast various testing techniques
- Construct projects using UML diagrams

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Demonstrate the importance of modelling in the software development life cycle.
- CO2.** Abstract object-based views for generic software systems.
- CO3.** Understand the object-oriented approach to analysing and designing systems and software solutions.
- CO4.** Employ the Unified modelling Language notations to create effective and efficient system designs.
- CO5.** Understand the difference between writing programs for the software and doing analysis and design.
- CO6.** Analyse and Design the given System

<b>MCA CS2T06 : Object Oriented Analysis and Design PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Introduction: Object Oriented approach, its features & significance., S/W Complexity & its causes, S/W Crisis & the related issues need to be resolved	15
2	Modeling : Object Modeling : Objects & classes, Links & Associations, Generalization & inheritance, Grouping Constructs, Advanced Object Modeling	

	Aggregation, abstract classes, multiple inheritance, Meta data, candidate keys and Constraints. Dynamic Modeling: Events & states, operations, nested state diagram, concurrency. Functional Modeling : DFDS, specifying operations, constraints., Analysis and System design: Analysis: object modeling, Functional modeling adding operations, iteration	
3	System design : subsystem, concurrency, allocation to processors and tasks, management of data stores, control implementation, Boundary condition, Architectural framework, Object Design, Optimization, Implementation of control, Adjustment of inheritance, Design of associations, documentation, comparison of methodologies	15
4	Implementation: Using a programming language, using a database system, Programming Styles: Object Oriented style : Reusability, extensibility, robustness and Programming-In-The-Large.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### **Reading List :**

1. Object Oriented Modeling and Design, J. Rum Baugh, PHI,2003
2. Object Oriented Analysis and Design, G.Booch,2000

## **SEMESTER – II**

### **MCA CS2T07:Distributed Computing**

#### **COURSE OBJECTIVES:**

- Study software components of distributed computing systems.
- Know about the communication and interconnection architecture of multiple computer systems.

- Recognize the inherent difficulties that arise due to distributed-ness of computing resources.
- Understanding of networks & protocols, mobile & wireless computing and their applications to real world problems.

### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Understand the design, implementation and security issues of distributed systems.
- CO2.** Apply knowledge of distributed systems techniques and methodologies.
- CO3.** Explain the design and development of distributed systems and distributed systems applications.
- CO4.** Use the application of fundamental Computer Science methods and algorithms in the development of distributed systems and distributed systems applications.
- CO5.** Understand the difference between writing programs for the software and doing analysis and design.
- CO6.** Discuss the design and testing of a large software system, and to be able to communicate that design to others.

<b>MCA CS2T07 : Distributed Computing PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Fundamentals: Definition, Evolution of distributed Computing System Distributed Computing System Models, Distributed Operating System, Designing a distributed Operating System, Introduction of distributed computing environment  Message Passing: Introduction Desirable features, Issues in IPC by message passing, synchronization, Buffering, Multi datagram messages, encoding and decoding message data.	15
2	Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC	15



	<p>mechanism RPC messages server management, parameter-passing and call semantic, Communication protocols for RPC's.</p> <p>Distributed Shared Memory: Introduction, Architecture of DSM Systems Design and implementation, granularly, structure of shared memory space Consistency models, replacement strategy, Thrashing.</p>	
3	Resource Management: Desirable feature, Task assignment approach, Load-balancing approach, Load-sharing approach. Process Management: Process Migration, Threads.	15
4	Distributed File Systems: Intakes, Desirable features, File models, File accessing models, file-sharing semantic, File-caching schemes, File replication Fault tolerance, Automatic Transactions, Design principle	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. George Coulouris, Jean Dollimore and Tim Kindberg, (2002), "*Distributed Systems Concepts and Design*", Third Edition, Pearson Education Asia.
2. Liu, *Distributed Computing*, Pearson Education.
3. HagitAttiya and Jennifer Welch, *Distributed Computing*, Wiley India.
4. Sinha P.K., *Distributed Operating Systems: concept and Design*, PHI
5. Tanenbaum, *Distributed Operating System*, Pearson Education

## **SEMESTER – II**

<b>MCA CS2L08 : Mini Project I (Lab)</b> <b>PWC (3 credits: 2 Practical + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
	Student will complete the Synopsis work of the Mini Project II to be covered in the next semester	30
		15
	<b>TOTAL</b>	<b>45</b>

## **SEMESTER – II**

### **MCA GI2T2: OPTIMIZATION TECHNIQUES**

#### **COURSE OBJECTIVES:**

- To impart knowledge in concepts and tools of Optimization Techniques.
- To understand mathematical models used in Optimization Techniques.
- To apply these techniques constructively to make effective business decisions.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Analyze any real life system with limited constraints and depict it in a model form.
- CO2.** Convert the problem into a mathematical model.
- CO3.** Understand a variety of problems such as assignment, transportation, travelling salesman etc.
- CO4.** Solve the problems using a linear programming approach.
- CO5.** Understand different queuing situations and find the optimal solutions using models for different situations.
- CO6.** Identify and develop Optimization Techniques models from the verbal description of the real system.

MCA GI2T2 : Optimization Techniques PWC (5 credits – 4 theory + 1 Assignment)		
Unit	Topics to be covered	No. of hours
1	<b>Introduction:</b> Nature and Meaning, History, Management Applications, Modeling. Principles. Characteristics, Scope, Development of OR In India, Role of Computers in OR	15
2	<b>Linear Programming:</b> Introduction and Applications of LP, Limitations of LP Formulation of a LP Model, Graphical Solution of a LPP, Simplex Method, Two Phase Method, Big-M Method.	15
3	<b>Transportation, Assignment and Replacement Problem:</b> Introduction to Transportation Problem. Mathematical Formulation, Feasible Solution and Optimum  <b>Solution:</b> Introduction to Assignment Problem, Mathematical Formulation. Traveling Salesman Problem; Introduction to Replacement Problem, Capital Equiprnent, DiscountedCost. Replacement in Anticipation of Failure.	15
4	<b>Queuing Problems:</b> Classification of self problems, processing of n jobs through two machines, three machines, processing of two jobs through m machines.  <b>Project Managementb5' PERT-CPM:</b> Introduction, History &Applications, Basic Steps. Network DiagramRepresentation, Rules, Time Estimates and Critical Path in Network, Analysis, Uses and Applications of PERT/CPM.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

#### Reading List :

1. Pai, "Operation Research", OUP.
2. Paneerselvam, "Operation Research", PHI.
3. Hillier & Liebermann, "Operations Research", TMH.

## SEMESTER – II

### **MCA DSE2T1 Elective 1 (Option 1: Compiler Design)**

#### **COURSE OBJECTIVES:**

- To explore the principles, algorithms, and data structures involved in the design and construction of compilers. Topics include context-free grammars, lexical analysis, parsing techniques, symbol tables, error recovery, code generation, and code optimization.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Understand the concept of Compilers and translators, the phases of a compiler, and Compiler writing tools.
- CO2.** Construct a parse tree, or explain why no parse tree exists, given a BNF grammar and a string over the appropriate alphabet.
- CO3.** Implement a lexical analyzer from a specification of a language's lexical rules.
- CO4.** Compute the FIRST set and the FOLLOW set for a BNF grammar
- CO5.** Apply simple intermediate code optimizations.
- CO6.** Implement code generator.

<b>MCA DSE2T1-1 : Compiler Design</b>		
<b>PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1.	<b>INTRODUCTION TO COMPILING:</b> Compilers Analysis of source Program, The Phases of a compiler, The tasks of a compiler, Analysis of the Source Program, Phases and Passes in compilers.  <b>LEXICAL ANALYSIS:</b> Lexical Analysis - The role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A Language for Specifying Lexical Analyzer, Review of Regular Expressions, Finite State Machines, Finite	15

	Automata based, Pattern Matching. Specification and recognition of tokens, a language for specifying lexical analyser, Lexical Analyser Generator, Design of Lexical Analyzer generator, Programming assignment on lex, Regular expression to finite automation - Use of a tool for generating lexical analyser.	
2	<p><b>SYNTAX ANALYSIS</b>– Introduction to syntax analysis, the Role of Parser, Review of grammars, Chomsky Hierarchy, Context-free Grammars, Writing a Grammar, Top-down Parsing, error recovery in Top down parsers, Bottom-up Parsing, Overview of Shift reduce parsing, Operator-Procedure Parsing, Finite automata of LR(0) items and LR (0) parsing, SLR parsing, Canonical LR Parsing, LALR Parsing, Compaction of LR parsing table, Using ambiguous grammars, Error recovery in bottom up</p> <p><b>TYPE CHECKING:</b> Type systems, Specification of simple type checker, equivalence of type expressions, type conversions, overloading of functions and operators, Polymorphic functions, an algorithm for unification.</p>	15
3	<p><b>DYNAMIC STORAGE ALLOCATION TECHNIQUES:</b> Introduction to Dynamic storage, symbol tables, Symbol Table Organization, Symbol attributes and Symbol table entries, Local Symbol Table management, Global Symbol table structure, language facilities for dynamic storage allocation, dynamic storage allocation techniques. Symbol Table for block structured language, Different types of dynamic storage Allocation Techniques, Static versus dynamic storage allocation techniques.</p> <p><b>INTERMEDIATE CODE GENERATION:</b> Intermediate Languages, Declarations, Assignments, Boolean Expression, Flow control statements - Back patching, Case Statements</p>	15

	<b>CODE GENERATION:</b> Introduction to optimization techniques , Issues in the design of code Generator, the target Machine, Run-Time storage Management, Basic blocks and flow graphs, Next-use information	
4	<p><b>A SIMPLE CODE GENERATOR:</b> Design of a simple code generator, A simple code generator, Register allocation and Assignment, The DAG representation of Basic blocks.</p> <p><b>CODE OPTIMIZATION-I:</b> Introduction, Early Optimizations, The Principle of Optimization, Optimization of Basic Blocks, Loops in flow graphs, Constant-Expression Evaluation (Constant Folding, Algebraic Simplifications and Re-association, Value numbering, Copy Propagation. Redundancy Elimination: Common-Sub expression Elimination, Loop-Invariant Code Motion, Partial- Redundancy Elimination, Redundancy Elimination and Re-association, Code Hoisting, Loop Optimizations: Induction-Variable Optimizations, Unnecessary Bounds – Checking Elimination. Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination, Procedure Integration, In-Line Expansion, Leaf-Routine Optimization and Shrink Wrapping.</p>	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Torben/ MongensenEgidius, *Basics of Compiler design*
2. W Andrew, *Modern Compiler Implementation in C*. AppelCombridge University Press
3. Aho Alfred V., Lam Monica S., Jeffrey Ravi Sethi, , Ullman D., *Compiler Principles, techniques and Tools*, 2nd edition, Pearson Publication.

## **SEMESTER – II**

### **MCA DSE2T1 Elective 1 (Option 2 : Digital Image Processing & Multimedia)**

#### **COURSE OBJECTIVES:**

- To describe and explain basic principles of digital image processing;
- To design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement);
- To design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation & image representation);
- To assess the performance of image processing algorithms and systems.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Explore and evaluate the role of different components of a digital image processing.
- CO2.** Understand the wide range of present and future applications of digital image processing, both for the visible spectrum images such as those from other sensors (Radar, Ultrasonic, etc.).
- CO3.** Explain and Understand the multidimensional digital signal processing in the field of images (2D) and video (3D).
- CO4.** Differentiate and justify the two major approaches to image processing: processing in the spatial and frequency domains.
- CO5.** Analyze and implement different techniques of coding and image compression
- CO6.** Understand the image analysis and use methods of image segmentation and mathematical morphology.

<b>MCA DSE2T1-2 : Digital Image Processing &amp; Multimedia PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Overview, Computer imaging systems, Image analysis, preprocessing, Human visual system, Image model, Electronic Eye Contact, Spectrum Oct09, Image enhancement	15
2	Gray scale mods, Histogram mod, Discrete transforms, Fourier, Discrete cosine, Walsh-Hadamard, Haar, PCT, Filtering, Wavelet transform, Pseudocolor, Image enhancement, Sharpening, Smoothing, Image restoration, Overview, System model, Noise removal: order filters	15
3	Image restoration: noise removal: mean & adaptive filters, Degradation model, Inverse filter, Freq. filters, Geometric transforms, Image compression: system model, Lossless methods, Image compression: lossy methods	15
4	Multimedia Overview-Definition; Applications and Design;Authoring (HyperStudio), Introduction to HyperStudio-The Metaphor; The Basics (Cards, Buttons, Text);HyperStudio Resources, Instructional Design-Objectives;Content (print, graphics, sounds, etc.); Interaction; Assessment; Closure,Screen Design-Metaphors and Themes; Colors and Backgrounds; Text (size, color, placement); Navigation; Consistency; Transitions and Links, Use of Sound, HyperStudio Sounds, Internet Resources, HyperStudio Tips and Tricks, Multimedia Portfolios, Advanced Button Features	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Gonzalez Rafael.C. &Woods Richard E. *Digital Image Processing* , 2nd Ed., Prentice Hall



2. Gonzalez R.C. and Thomason M.G. *Syntactic Pattern Recognition : An introduction*
3. Devijver P.A. and Kittler J. *Pattern Recognition - A Statistical Approach*
4. Jain A.K. *Fundamentals of Digital Image Processing*
5. Duda R.O. and Hart P.E. *Pattern Classification and Scene Analysis*
6. Li Ze – Nian *Fundamentals of Multimedia*
7. Mayer Richard E. *Multimedia Learning*

## **SEMESTER – II**

### **MCA DSE2T1 : ELECTIVE 1 (OPTION 3: COMPUTER GRAPHICS)**

#### **COURSE OBJECTIVES:**

- To introduce the components of a graphics system and become familiar with building the approach of graphics system components and algorithms related with them.
- To learn the basic principles of 3- dimensional computer graphics.
- Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
- Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
- Provide brief ideas about the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** List the various concepts used in computer graphics.
- CO2.** Implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.

- CO3.** Explain and Understand the multidimensional digital signal processing in the field of images (2D) and video (3D).
- CO4.** Describe the importance of viewing and projections.
- CO5.** Define the fundamentals of animation, virtual reality and its related technologies.
- CO6.** Design an application with the principles of virtual reality.

<b>MCA DSE2T1-3 : Computer Graphics</b> <b>PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Introduction:</b> History, Advantages, Application, I/O Devices Graphic Packages, Languages. Jag Free Images on a Raster CRT Interactive Graphics processor for Digital Logic Simulation System	15
2	<b>Graphics Techniques:</b> Video-Display Devices, Raster-Scan and Random-Scan Systems; Graphics Monitors, Input Devices, Points and Lines; Line Drawing Algorithms, Mid-Point Circle and Ellipse Algorithms; Scan Line Polygon Fill Algorithm, Boundary-Fill and Flood- Fill Translation, Scaling, Rotation, Reflection and Shear Transformations; Matrix Representations and Homogeneous Coordinates; Composite Transforms, Transformations Between Coordinate Systems, Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View-Port Coordinate Transformation, Viewing Functions, Line and Polygon Clipping Algorithms.	15
3	<b>2-D Geometrical Transforms and Viewing::</b> Drawing Elementary figures, Polygon Filling, Transformations, Windowing and clipping, Display file segmentation. Interactive Graphics: Interactive input techniques, Event handling, Input functions; Hidden line and surface removal, rendering, Computer Animation, 3D Shaded computer	15

	Animation the use of 3D abstract Graphical types in Computer Graphics and Animation. 3-Dimensional Reconstruction. A case study, Real-time graphics.	
4	3-D Object Representation, Geometric Transformations and Viewing: Polygon Surfaces, Quadric Surfaces, Spline Representation, Bezier and B-Spline Curves; Bezier and B-Spline Surfaces; Illumination Models, Polygon Rendering Methods, Viewing Pipeline and Coordinates; General Projection Transforms and Clipping.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### **Reading List :**

1. Hearn Donald, and Baker M. Pauline "*Computer Graphics*" C Version, Pearson Education.
2. Hearn, and Baker "*Mathematical Elements for Computer Graphics*", Tata McGraw Hill Computer Graphics by, PHI
3. Newman and Sproull R. F. "*Principles of Interactive Graphics*", McGraw-Hill.

## **SEMESTER – II**

### **MCA DSE2T2-1: Elective 2 (Option 1: Introduction to Machine Learning)**

#### **COURSE OBJECTIVES:**

- To introduce students to the basic concepts and techniques of Machine Learning.
- To develop skills of using recent machine learning software for solving practical problems.
- To gain experience of doing independent study and research.

## **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Recognize the characteristics of machine learning that make it useful to real-world problems.
- CO2.** Understand the basic underlying concepts for supervised discriminative and generative learning.
- CO3.** Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised.
- CO4.** Understand the concept behind neural networks for learning non-linear functions.
- CO5.** Understand and apply unsupervised algorithms for clustering.
- CO6.** Understand the foundation of generative models.

<b>MCA DSE2T2-1 : Introduction to Machine Learning PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Introduction to Machine Learning</b> Introduction, Different Types of Learning, Hypothesis Space and Inductive Bias, Evaluation and Cross-Validation, Linear Regression, Introduction to Decision Trees, Learning Decision Tree, Overfitting	15
2	<b>KNN, Feature Selection and Extraction, Bayesian Learning</b> k-Nearest Neighbour, Feature Selection, Feature Extraction, Collaborative Filtering, Exercise on kNN and PCA Bayesian Learning, Naive Bayes, Bayesian Network	15
3	<b>Logistic Regression, SVM and Neural Network</b> Logistic Regression, Introduction Support Vector Machine SVM : The Dual Formulation, SVM : Maximum Margin with Noise, Nonlinear SVM and Kernel Function, SVM : Solution to the Dual Problem Neural Network Introduction, Multilayer Neural Network, Neural Network and Backpropagation Algorithm, Deep Neural Network	15

4	<b>Computational Learning, Sample Complexity and Clustering</b> Introduction to Computational Learning Theory, Sample Complexity : Finite Hypothesis Space, VC Dimension Introduction to Clustering, K Means Clustering, Agglomerative Hierarchical Clustering	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### **Reading List :**

1. Tom M. Mitchell (2017), *Machine Learning*, McGraw Hill Indian Edition.
2. Andreas Muller and Sarah Guido (2017), *Introduction to Machine Learning with Python*, O' Reilly Publication, 2nd Edition.
3. Yuxi (Hayden) Liu (2017), *Python Machine Learning By Example*, Packt Publishing, Mumbai.

## **SEMESTER – II**

### **MCA DSE2T2 Elective 2 (Option 2: Artificial Intelligence)**

#### **COURSE OBJECTIVES:**

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- Experiment with a machine learning model for simulation and analysis.
- Explore the current scope, potential, limitations, and implications of intelligent systems

## **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
- CO2.** Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- CO3.** Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- CO4.** Demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
- CO5.** Demonstrate proficiency in applying scientific method to models of machine learning.
- CO6.** Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

<b>MCA DSE2T2-2 : Artificial Intelligence PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Approaches to AI: Turing Test and Rational Agent Approaches; State Space Representation of Problems, Heuristic Search Techniques, Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures.	15
2	Knowledge Representation: Logic, Semantic Networks, Frames, Rules, Scripts, Conceptual Dependency and Ontologies; Expert Systems, Handling Uncertainty in Knowledge. Planning: Components of a Planning System, Linear and Non Linear Planning; Goal Stack Planning, Hierarchical Planning, STRIPS, Partial Order Planning.	15

3	<b>Natural Language Processing:</b> Grammar and Language; Parsing Techniques, Semantic Analysis and Pragmatics. Multi Agent Systems: Agents and Objects; Agents and Expert Systems; Generic Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Agent Development Tools.	15
4	<b>Fuzzy Sets:</b> Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification; Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference; Fuzzy Control System and Fuzzy Rule Based Systems. <b>Artificial Neural Networks (ANN):</b> Supervised, Unsupervised and Reinforcement Learning; Single Perceptron, Multi Layer Perceptron, Self Organizing Maps, Hopfield Network	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Norving Peter and Russell Stuart J., "*Artificial Intelligence: A modern Approach*"
2. S.S, Chandra, Vinod and HareendransAnand, "*Artificial Intelligence and Machine Learning*", PHI

## SEMESTER – II

### **MCA DSE2T2-3 : Elective 2 (Option 3: Soft Computing)**

#### **COURSE OBJECTIVES:**

- To introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft

computing-based solutions for real-world and engineering problems.

- Introduce students to fuzzy systems, fuzzy logic and its applications.
- Explain the students about Artificial Neural Networks and various categories of ANN.

### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- CO2.** Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- CO3.** Understand the fundamental theory and concepts of neural networks
- CO4.** Identify different neural network architectures, algorithms, applications and their limitations
- CO5.** Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- CO6.** Reveal different applications of these models to solve engineering and other problems.

<b>MCA DSE2T2-3 : Soft Computing</b>		
<b>PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Neural Networks, Application Scope of Neural Network, Fuzzy Logic, Genetic Algorithm, Hybrid Systems and Soft computing. Artificial Neural Network: Fundamental Concept, Evolution of Neural Networks, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, McCulloch-Pitts Neuron, and Hebb Network	15



2	Introduction to Fuzzy logic, Classical Sets(Crisp Sets), Operations of Classical Sets, Fuzzy Sets Operations. Classical Relations and Fuzzy Relations: Cartesian Product of Relation, Classical Relation, Fuzzy Relations, Tolerance and Equivalence Relations, No interactive Fuzzy Sets. Membership Functions: Features of Membership Functions, Fuzzification and Defuzzification.	15
3	Fuzzy Rule Base and Approximate Reasoning Introduction, Truth Values and Table in Fuzzy Logic, FuzzyPropositions, Fuzzy Reasoning, Fuzzy Inference System. Fuzzy Decision Making: Individual Decision Making, Multiperson Decision Making, Multiobjective Decision Making, Multiattribute Decision Making, Fuzzy Bayesian Decision Making. Fuzzy Logic Control Systems: Control System Design, Architecture and Operation of FLC system, FLC System Models, Application of FLC Systems.	15
4	Hybrid Soft Computing Techniques Neuro-Fuzzy Hybrid Systems, Generic Neuro-Hybrid Systems,Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems, Simplified Fuzzy ARTMAP. Applications of SoftComputing: A Fusion Approach of Multispectral Images with SAR (Synthetic Aperture Rader),Optimization of Traveling Salesmen Problem using Genetic Algorithm Approach, Genetic Algorithm-Based Internet Search Technique, Soft computing Based Hybrid Fuzzy Controllers.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Sivanandam S.N., Deepa S.N. *Principles of Soft Computing*, Wiley.
2. Bernadette Bouchon-Meunier *Fuzzy Logic and Soft Computing*, World Scientific.

3. ChaturvediDevendraK., *Soft Computing: Techniques and its Applications in Electrical Engineering*, Springer Science & Business Media.

## **SEMESTER – II**

<b>MCA SE2L03 : Technical Presentation and Report Writing PWC (2 credit : 2 Practicals)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
	<p><b>Grammatical Use:</b> punctuation, vowel, consonant, Preposition + noun, uncountable and plural nouns, verb patterns, uses of tenses, Meanings &amp; opposites</p> <p><b>Writing Skills:</b> Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.</p> <p><b>Technical Writing:</b> Differences between technical and literary style, Elements of Style, Common Errors.</p> <p><b>Letter Writing:</b> Formal, informal and demi-official letters; business letter</p> <p><b>Job Application:</b> Cover letter, Differences between bio-data, CV and Resume.</p> <p><b>Report Writing:</b> Basics of Report Writing, Structure of a report; Types of reports.</p> <p><b>Presentation Skills:</b> Oral presentation and public speaking skills; business presentations.</p> <p><b>Technology-based Communication:</b> Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software</p>	30
	<b>TOTAL</b>	<b>30</b>

## SEMESTER – II

<b>MCA SE204 : Personality Development &amp; Inter Religious Values PWC ( 2 credits: 2 Practical )</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Nature and Need of Inter-Religious study, Scope of Comparative Religion.	05
2	Salient Features of Hinduism, Jainism and Buddhism, Salient Features of Christianity, Islam, and Sikhism	10
3	Similarities and Differences among Religions, Conflicting Truth claim of different religions and inter-religious Harmony	10
4	Religious Tolerance, Secularism	05
	<b>TOTAL</b>	<b>30</b>

### **Reading List :**

1. Chudhary, C. Neeraj (1979). "Hinduism", B.I. Publication, New Delhi.
2. Devraj, N.K., (1917)- "Hinduism and Christianity" Asian Publishing House.
3. Gordh, Geo rge, -"Christian Faith and its Cultural Expression", Printed in USA.
4. Hick, John,- "Philosophy of Religion", Prentice Hall of India.
5. Hopfe, M. Lewis (1983)- "Religion of the World", Macmillan Publishing Co. Inc, New Yourk.
6. Masih, Y. (1990)- "Comparative study of Religion", MotilalBanarsidass.
7. Seth, S. Arijit, Pummer, Reinhard, (1979)- "Comparative Religion", Vikas Publishing House Pvt. Ltd. Delhi.
8. Singh, B.N. (1994)- "Vishwa Dharma DarshankiSamasyain", Ratna Printing Works.
9. Tiwari, NathKedar, (1983)- "Comparative Religion", MotilalBaranrsidass.
10. Ward,CHS (1998)- "Early Buddhism", Caxton Publication, Delhi.

## Semester – III

### **MCA CS3T09 : Advanced Web Designing using J2EE**

#### **COURSE OBJECTIVES:**

- Create Web Applications using Java Servlet
- Manage Web Session using Servlet and JSP
- Use JavaBeans in JSP
- Develop Custom Tags in JSP
- Handle Errors and Exceptions in Web Applications
- Use NetBeans IDE for creating J2EE Applications

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Learn the Internet Programming, using Java Applets
- CO2.** Create a full set of UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists
- CO3.** Apply event handling on AWT and Swing components.
- CO4.** Access database through Java programs, using Java Data Base Connectivity (JDBC)
- CO5.** Create dynamic web pages, using Servlets and JSP.
- CO6.** Understand the multi-tier architecture of web-based enterprise applications using / Enterprise JavaBeans (EJB).

<b>MCA CS3T09 : Advanced Web Designing using J2EE PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Web Programming :</b> Concept of JDBC (Java Database Connectivity), working with SQL, Stored Procedure, Security in Java, Class loader, Byte code Verification, security Manager and permission, Digital Signatures, Code Signing, Encryption.	15

	<b>Introduction to J2EE :</b> Its advantage, Enterprise Architecture Types, Understanding EJB, its architecture, EJB Roles, Benefits and limitations of Enterprise Beans. Session Beans: Stateful and Stateless Beans, Entity Beans, Beans Managed Persistence, Container Managed Persistence.	
2	<b>Advanced Web technology in J2EE:</b> Understanding Directory Services and JNDI, Introduction to LDAP, LDAP operation, working with LDAP Server, Introduction to Web Containers and Web Applications, Introduction to HTTP protocol, Web Application Life Cycle.	15
3	<b>Creating Web Application:</b> Understanding Servlet programming, its Life-Cycle, Servlet Configuration, Understanding Servlet sessions. Understanding of JSP and JSTL, JSP documents, Elements, tag extensions, tag libraries, validation, translation time mechanism, translation-time classes. Understanding JavaServer Pages Standard Tag Library, tags in JSTL, core tag library, XML tag library, using Internationalization Actions,	15
4	<b>Web Application Deployment and Authentication:</b> Enterprise Application Development Process, Deploying Web Application, Understanding CLASSPATH, Securing Web Applications, basic authentication with JAX-RPC Example, Client Certificate Authentication over HTTP/SSL	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Shah Deven N (2012), "A Complete Guide to Internet and Web Programming", DreamTech Press, New Delhi
2. KamaRaj I (2002), "Internet and Web Technologies", TataMcGraw Hill, New Delhi.
3. YoungMargaretLevine (2002), "Internet the Complete Reference", TataMcGraw Hill, Second Edition, New Delhi.

## **SEMESTER – III**

### **MCA CS3T10 : CLOUD COMPUTING**

#### **COURSE OBJECTIVES:**

- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students a sound foundation of Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios.
- To enable students exploring some important cloud computing driven commercial systems and applications.
- To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
- CO2.** Apply the fundamental concepts in data centers to understand the trade-offs in power, efficiency and cost.
- CO3.** Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
- CO4.** Analyze various cloud programming models and apply them to solve problems on the cloud.

<b>MCA CS3T10 : Cloud Computing PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Introduction-</b> Objectives, From collaborative to the Cloud – A short history Client – Server Computing, Peer-to-Peer Computing, Distributed	15

	<p>Computing, Collaborative Computing, Cloud Computing, Functioning of Cloud Computing, Cloud Architecture, Cloud Storage, Cloud Services, Industrial Applications, Infrastructure Services , Platform Services, Software Services - Software as service , Management and Administration, Performance, Security and Energy Efficiency</p> <p><b>Cloud Computing Technology-</b> Introduction- Objectives, Clients – Mobile – Thin – Thick, Security - Data Linkage - Offloading Work - Logging - Forensics - Development – Auditing, Network-Basic Public Internet- The Accelerated Internet- Optimized Internet Overlay- Site-to-Site VPN- Cloud Providers- Cloud Consumers - Pipe Size- Redundancy, Services- Identity- Integration- Mapping- Payments- Search.</p>	
2	<p><b>Accessing the Cloud and Data Management -</b> Introduction-Objectives, Platforms- Web Application Framework- Web Hosting Services- Proprietary Methods, Web Applications- API's in Cloud Computing, Browsers for Cloud Computing- Internet Explorer- Mozilla Firefox- Safari- Chrome.</p> <p><b>Information Storage in Cloud Computing-</b> Introduction- Objectives, Storage as a Service, Storage Providers- Amazon Simple Storage Service- Nirvanix- Google</p>	15
3	<p><b>Data Management- Introduction-</b> Objectives, Data Security- Data Location- Data Control- Securing data for transport, Scalability and Cloud Services- Large Scale Data Processing- Databases and Data Stores- Data Archival.</p> <p><b>Cloud Computing Standards-</b> Introduction- Objectives, Best Practices and Standards, Practical Issues- Interoperability- Portability- Integration- Security, Standards Organizations and Groups- Cloud Security Alliance- Distributed Management Task Force (DMTF)- National Institute</p>	15

	of Standards and Technology (NIST)- Open Cloud Consortium (OCC)	
4	<b>Desktop and Device Management-</b> Introduction- Objectives, Desktop Virtualization- Across Industries- Client Desktops, Desktop placement in the cloud- Merits- Desktop as a Service (DaaS), Desktop Management- Watching the four areas- Asset Management. . <b>Cloud Governance-Introduction-objectives,</b> IT Governance, Deciding the Governor, Risk Assessment of running the cloud- Understanding possible risks- Performance monitoring and measurement- Measurement Methods, Working of Governance- Establishment of the Governance Body- IT Service Performance – Monitoring and Measuring- Cataloging control and Compliance Data, Virtualization concepts	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Kai Hwang, Geoffrey C.Fox, and Jack J. Dongarra, "Distributed and Cloud Computing", Elsevier India Private Limited, 2012.
2. Foster and Kesselman, "The Grid : Blueprint for a New Computing Infrastructure", Morgan Kauffman publishers Inc.2004
3. Coulouris, Dollimore and Kindber, "Distributed System: Concept and Design", Fifth Edition, Addison Wesley, 2011.
4. Michael Miller, "Cloud Computing", Dorling Kindersley India,2009.
5. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, "Cloud computing: A practical Approach", McGraw Hill,2010



## **SEMESTER – III**

### **MCA CS3T11 : DATA AND WEB MINING**

#### **COURSE OBJECTIVES:**

- Learn about introduction to methods and theory for development of data warehouses and data analysis using data mining.
- To identify the scope and essentiality of Data Warehousing and Mining.
- Data quality and methods and techniques for preprocessing of data.
- To analyze data, choose relevant models and algorithms for respective applications.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Understand Data Warehouse fundamentals, Data Mining Principles.
- CO2.** Design data warehouse with dimensional modelling and apply OLAP operations.
- CO3.** Identify appropriate data mining algorithms to solve real world problems.
- CO4.** Apply the association rules for mining the data
- CO5.** Design and deploy appropriate classification techniques.
- CO6.** Cluster the high dimensional data for better organization of the data.

<b>MCA CS3T11 : Data &amp; Web Mining</b>		
<b>PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Data Warehousing:</b> Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multidimensional Data Model, Introduction to KDD process – Knowledge Discovery from Databases - Need for Data Preprocessing –Data Cleaning – Data Integration	15

	and Transformation . Data Cubes, Stars, SnowFlakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting. ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Relationship between warehouse and mining. Data mining issues in object oriented databases, spatial databases and multimedia databases and text bases.	
2	<p><b>Data Mining:</b></p> <p>Overview, Motivation(for Data Mining),Data Mining-Definition &amp; Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer and Human inspection),Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Description of Data mining query language with examples.</p> <p>Introduction - Data Mining Functionalities - Association Rule Mining – Multidimensional and multilevel association rules. Classification association rules. Association rule algorithms-A priori and frequent pattern growth</p>	15
3	<p><b>Classification vs. Prediction:</b></p> <p>Different classification algorithms. Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by BackPropagation – fuzzy set theory and genetic algorithms, Classification methods K- nearest neighbor classifiers</p>	15
4	<p><b>Cluster Analysis:</b></p> <p>Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based - Grid-Based Methods – Model-Based Clustering for</p>	15

	continuous for discrete data, Scalability of clustering algorithms. Parallel approaches for clustering. Introduction, Web Usage mining, Web content mining, Web log attributes. Web Structure mining	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Han J.,Kamber M., Data Mining Concepts and Techniques, Harcourt India.
2. Dunham M.,Data Mining: Introductory and Advanced Topics, Pearson Pub.
3. Pujari, A.K.,Data Mining Techniques, Universities Prss.
4. PudiVikram,Krishna P.Radha, Data Mining,
5. Han Jiawei,KamberMicheline,Pei Jian,Data Mining Concepts and Techniques, Morgan Kaufmann Pub.

## SEMESTER – III

<b>MCA CS3L12 : Mini Project II (Lab)</b> <b>PWC (3 credits: 2 Practical + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	Apply the concept of Web Technology to develop mini project such as: 1) Online e-Market Buy/Sell Goods 2) Complaint management System 3) Dynamic College Website 4) Online Job Portal 5) E-Shop	30
2	Assignment	15
	<b>TOTAL</b>	<b>45</b>

## **SEMESTER – III**

### **MCA DSE3T3 : Elective 3 (Option 1: Management Information System and E-Commerce)**

#### **COURSE OBJECTIVES:**

- To understand the basic principles and working of information technology.
- Describe the role of information technology and information systems in business
- To contrast and compare how internet and other information technologies support business processes
- To give an overall perspective of the importance of application of internet technologies in business administration.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Remember the fundamental concepts of information systems.
- CO2.** Understand the knowledge about management of information systems
- CO3.** Apply a framework and process for aligning organization's IT objectives with business strategy.
- CO4.** Analyse the use information technology to solve business problems
- CO5.** Evaluate how information technology impacts a firm
- CO6.** Illustrate the impact of information systems in society

<b>MCA DSE3T3-1 : Management &amp; Information System And E-Commerce PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Management system:</b> Organization, Types of Organization, Types of Management system, Levels of Management, Management System Requirement, Role of MIS, Objectives, characteristics, Components of MIS, System-	15

	Information System: classification, characteristics, Information Resource Management: Objective, component, Information System: TPS, MIS, ISS, OAS, Data Processing, Introduction to DBMS: objectives, components	
2	<p><b>Decision Support System:</b> Types of Decision, Decision making process and MIS, Decision support system: DSS Definition, characteristics, Types of DSS, DSS components, DSS functions</p> <p>DSS Model: Development of DSS, DSS Applications, Group DSS</p> <p><b>Portfolio Management &amp; IT application:</b> Portfolio Management Concept, Portfolio Management Method, Design and Implementation of Portfolio management, Tools and Techniques.</p>	15
3	<p><b>Management Function and Business process:</b> Sale and Order processing, Finance &amp; Budgeting, Human Resource Management, Production Plan &amp; Control, Marketing</p> <p>Enterprise Resource Plan (ERP): Evolution of Enterprise Information System, Concept of ERP, Supply Chain Management, Customer Relationship Management, ERP Design and Implementation, ERP tools : SAP, iCUBE.</p>	15
4	Introduction, Advantages and Disadvantages of E-commerce, Traditional commerce vs. E-commerce, Growth of E-Commerce, E-Commerce Models, Electronic payment Systems, E-Customer Relationship Management, E-Supply Chain Management, security Issues in E-Commerce	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Laudon K.C. and Laudon J.P., *Management Information System (Managing the Digital firm)* PHI.
2. Sadagopan S., *Management Information System*, TMH

## **SEMESTER – III**

### **MCA DSE3T3 : Elective 3 (Option: 2 Enterprise Resource Management)**

#### **COURSE OBJECTIVES:**

- To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning Technology.
- To focus on a strong emphasis upon practice of theory in Applications and Practical oriented approach.
- To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth.
- To aim at preparing the students technological competitive and make them ready to self-upgrade with the higher technical skills.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Identify the important business functions provided by typical business software such as enterprise resource planning and customer relationship management.
- CO2.** Describe basic concepts of ERP systems for manufacturing or service companies.
- CO3.** Understand and be able to articulate the life cycle stages of any ERP implementation
- CO4.** Analyze a current architecture and perform an effective gap analysis before an ERP implementation.
- CO5.** Analyze the technical aspect of telecommunication systems, the internet and their roles in the business environment.
- CO6.** Develop skills necessary for building and managing relationships with customers, and stakeholders.

<b>MCA DSE3T3-2 : Enterprise Resource Management PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>ERP Introduction:</b> Introduction, ERP Planning, Definition, ERP-A System Perspective,	15

	<p>Components of an ERP System, Operating System, Evolution, Benefits of ERP, Reasons for the growth of ERP Market</p> <p><b>ERP &amp; Related Technologies :</b> Introduction: BPR, MIS, DSS, EIS, Introduction to Product Life Cycle Management ( PLM), Advantages &amp; Areas of PLM,</p>	
2	<p><b>ERP Marketplace and Market Dynamics</b> Market Overview, SAPAG, Product &amp; Technology, Knowing ERP Market, ERP Functional Modules: Introduction, Finance, Sales &amp; Distribution Manufacturing, Human Resources, Plant Maintenance,</p> <p><b>ERP Implementation Strategy:</b> ERP Implementation, BIG Bang Strategy, Variants, Phased &amp; Parallel Implementation</p>	15
3	<p><b>Vendors, Consultants and Employees</b> In-House ERP Development &amp; Implementation, Cost-Benefit Analysis, Supply Chain, Detailed Analysis,</p>	15
4	<p><b>ERP vs. E-Commerce:</b> Meaning of E-Commerce, Future Directives in ERP, ERP &amp; Internet, Integrating ERP into Organizational Culture, ERP &amp; CRM Integration.</p>	15
5	<b>Assignment</b>	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. ZaveriJyotindra (2012), "*Enterprise Resource Planning*", Himalaya Publishing House, 2nd Revised Edition
2. Goyel, D.P,(2011), "*Enterprise Resource Planning*", Tata Mc.Graw-Hill Education.

## **SEMESTER – III**

### **MCA DSE3T3 : Elective 3 (Option:3 Principles of Management & Organizational Behaviour)**

#### **COURSE OBJECTIVES:**

- To help students to develop cognizance of the importance of human behavior.
- To enable students to describe how people behave under different conditions and understand why people behave as they do.
- To provide the students to analyze specific human resources demands for future action.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Demonstrate the applicability of the concept of Organizational behaviour of people in the organization.
- CO2.** Demonstrate the applicability of analyzing the complexities associated with management of individual behaviour in the organization.
- CO3.** Analyze the complexities associated with management of the group behaviour in the organization.
- CO4.** Demonstrate how the organizational behaviour can interchange in understanding the motivation behind behaviour of people in the organization.
- CO5.** Explain organizational culture and describe its dimensions and to examine various organizational designs.
- CO6.** Identify the various leadership styles and the role of leaders in a decision making process.

<b>MCA DSE3T3-3 : Principles of Management &amp; Organizational Behaviour PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
<b>1</b>	<b>Management Fundamentals :</b> Managerial Skills – planning, forecasting, Staffing, directing, controlling, Social responsibilities, Levels of Management, Roles & Skills	<b>15</b>



	<p><b>Planning :</b> purpose, principles, characteristics of a good plan, reasons of failures of plans</p> <p><b>Decision Making:</b> Types of decisions, programmed &amp; non programmed, operational &amp; strategic, barriers in effective decision makings</p> <p><b>Delegation:</b> Decentralization, accountability, barriers in effective delegation</p>	
2	<p><b>Organizational Behaviour:</b> organization, organizational structure, culture; Perception &amp; Learning; Personality and values; Theories of personality, trait theory, psychoanalytic theory, Introversion, Extroversion, Type A and B personalities Motivation: Positive &amp; Negative Motivation; Theories of motivation –Mc Gregor's Participation Model theory X and theory Y, Maslow's Need Hierarchy theory, Herzberg's Two Factor theory, McClelland's Three Need theory Alderfer's ERG theory, Financial &amp; Non-financial incentives</p>	15
3	<p><b>Leadership:</b> Concept, Characteristics of good leadership, Leadership Styles, Likert's management Systems &amp; Leadership, Trait Theory of Leadership, Behavioural Theory of Leadership</p> <p>Group Dynamics: Formal &amp; informal groups, Clique, Group formation, Advantages &amp; disadvantages of informal groups, Team Development, Team Spirit</p>	15
4	<p><b>Organizational Conflict Management:</b> Dynamics of conflict, Resolution of conflict. Organizational Development: Concept; Change management Need for change, resistance to change; Theories of planned change.</p>	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

**Reading List :**

1. Koontz & Weirich, (2003), Essentials of Management, Tata McGraw Hill.
2. VSP Rao, V Hari Krishna – Management: Text and Cases, Excel Books.
3. Robbins.S. Organisational Behaviour, X edition., Prentice-Hall, India.
4. Hellinegal Slocum, Woodman, Organisational Behaviour, IX edn., Thomson learning.

**SEMESTER – III****MCA DSE3T04 : Elective 4  
(Option 1: Parallel Computing)****COURSE OBJECTIVES:**

- Learn the architectures and communication networks employed in parallel computers.
- Development of efficient parallel algorithms, including examples from relatively simple numerical problems, sorting, and graph problems.
- Able develops parallel computer programs.
- Solve programming problems themselves using parallel computers.

**COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Understand the basic construction and use of parallel computer and use of the terminology for how one measures the performance of parallel algorithms and parallel computers.
- CO2.** Design computer programs for different types of parallel computers.
- CO3.** Apply optimized sequential code for fastest possible execution, analyze sequential programs and determine if they are worthwhile to parallelize.

- CO4.** Develop parallel algorithms design and different parallel programming models for MPI, POSIX threads.
- CO5.** Develop algorithms for parallel computers. This applies both to computers with shared memory and with distributed memory.
- CO6.** Analyse parallel algorithms and performance measures for different programming models applicable to shared and distributed memory computers.

<b>MCA DSE3T4-1 : Parallel Computing</b>		
<b>PWC (5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Parallel Computers-Introduction</b> The Demand of Computational Speed, Types of Parallel Computers, Architectural Features of Message passing Multicomputer, Networked Computers as a Multicomputer Platform, Potential for increased computational speed. Parallel Computer Architecture: A Taxonomy of Parallel Architectures, Control Mechanism, Address-space Organization, Interconnection Networks, Processors Granularity ;SIMD Architecture : Overview of SIMD Architecture, Design and Performance Issues; <b>MIMD Architecture</b> : Shared Memory Architecture, Uniform and Non-uniform Memory Access Multi Processors, Parallel Vector Processors (PVP), Symmetric Multiple Processors (SMP), CC-NUMA, NUMA and COMA Architectures. <b>Distributed Memory Architecture:</b> Cluster Architecture - Design and other Issues ,MPP Architecture.	15
2	<b>System Interconnection and Gigabit Network Basics of Interconnection Network</b> Network Topologies and Properties, Buses, Crossbar, and Multistage switches, Gigabit Network Technologies, Comparison of Network Technologies Parallel Programming: Paradigms and Programmability: Algorithmic Paradigms,	15

	<p>Programmability issues Parallel Programming Examples; <b>Parallel Programming Models:</b> Implicit Parallelism, Explicit Parallel Models, Other Parallel Programming Models ;Shared Memory Programming : The POSIX Threads (P-threads) Model, The Openmp Standard; <b>Message-Passing Programming</b> : The Message Passing Paradigm, Message Passing Interface (MPI), Parallel Virtual Machine (PVM). <b>Data Parallel Programming:</b> The Data Parallel Model, The Fortran 90 Approach, Other Data Parallel Approaches.</p>	
3	<p><b>Performance Metrics and Benchmarks</b></p> <p>Performance Metrics for Parallel Systems, Run Time, Speedup, Efficiency Cost. <b>Scalability and Speedup Analysis:</b> Amdahl's Law: Fixed Problem Size, Gustafson's Law: Fixed Time, Sun and Ni's Law: Memory Bounding, Iso performance Models. System and <b>Application Benchmarks:</b> Micro Benchmarks, Parallel Computing Benchmarks, Business and TPC Benchmarks, SPEC Benchmark Family ; Performance v/s Cost, Performance of parallel Computers, Performance of Parallel Programs. <b>Parallel Paradigms and Programming Models:</b> Parallel Programming Models, Implicit Parallelism, Explicit Parallel Models, Other Parallel Programming Models. <b>Shared Memory Programming:</b> The POSIX Threads (P-threads) Model, The OpenMP Standard.</p>	15
4	<p><b>Message-Passing Programming</b></p> <p>The Message Passing Paradigm, Message Passing Interface (MPI), Parallel Virtual Machine (PVM). <b>Data Parallel Programming:</b> The Data Parallel Model, the FORTRAN 90 Approach, Other Data Parallel Approaches Parallel Algorithms and Applications Sorting Algorithms, Searching Algorithms, Dynamic Programming, Matrix Multiplication, Dense Matrix Computations, Sparse Matrix Computations.</p>	15

5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### **Reading List :**

1. Hwang Kai and ZhiweiXu (1997), “Scalable Parallel Computing”, McGraw Hill New York.
2. Wilkinson Barry and Allen Michael (1999), “Parallel Programming”, Pearson Education Asia.
3. Braver Steven, “ Introduction to Parallel Programming”
4. Shasikumar M., Shikhare Dinesh and Prakash P. Ravi, “Introduction to Parallel Processing”.
5. Rajaraman V. and Murthy C. Siva Ram, “Parallel Computers- Architecture and Programming”

## **SEMESTER – III**

### **MCA DSE3T4-2 : Elective 4 (Option 2: Wireless Network)**

#### **COURSE OBJECTIVES:**

- Learn about IEEE 802.11, various communication techniques, the wireless networking architecture and infrastructure
- Know about Ad Hoc networking, design issues, goals and classification related to medium access protocols
- Know the functionalities of various routing protocols
- Uses and working of various sensors in wireless environment

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

- CO1.** Understand fundamental underlying principles of wireless computer networking.
- CO2.** Describe and analyze the hardware, software, components of a wireless network and their interrelations.

- CO3.** Analyze the requirements for a given organizational structure and select the most appropriate architecture and technologies;
- CO4.** Gain a basic knowledge of the use of cryptography and network security
- CO5.** Install and configure wireless applications.
- CO6.** Specify and identify deficiencies in existing protocols and modify for new industry requirements

<b>MCA DSE3T4-2 : Wireless Network</b> <b>PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>Introduction:</b> Issues in mobile computing, overview of wireless telephony: cellular concept, GSM, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS. Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, BlueTooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications. Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks.	15
2	<b>Introduction to Adhoc networks</b> definition, characteristics features, applications. Characteristics of Wireless channel, Ad Hoc Mobility Models:- Indoor and outdoor models. MEDIUM ACCESS PROTOCOLS MAC Protocols: design issues, goals and classification. Contention based protocols-with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN. NETWORK PROTOCOLS Routing Protocols: Design issues, goals and classification.	15

3	<b>Routing:</b> ProactiveVs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing. END-END DELIVERY AND SECURITY Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols. Cross Layer Design and Integration of Ad Hoc for 4g Cross Layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective.	15
4	<b>Introduction to sensor networks and its applications</b> Architecture and factors influencing the sensor network design. Routing protocols- data centric routing protocols, hierarchical routing protocols, location based routing, energy efficient routing etc, Node Scheduling and coverage issues, topology control. Querying, data collection and processing, Collaborative information processing and group connectivity. Target tracking and identity management using sensor networks .Localization. Application & future research Challenges.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Adelstein Frank, Gupta S.K.S., Richard III Golden G. and Schwiebert Loren, "Fundamentals of Mobile and Pervasive Computing", McGraw-Hill Professional.
2. Taniar David, "Mobile Computing: Concepts, Methodologies, Tools, and Applications".
3. Toh C.K., Ad-Hoc Mobile Wireless Networks – Protocols and Systems, Prentice Hall.
4. Stojmenovic and Cacute, Handbook of Wireless Networks and Mobile Computing, Wiley.

## **SEMESTER – III**

### **MCA DSE3T4 : Elective 4 (Option 3: Big Data Analytics)**

#### **COURSE OBJECTIVES:**

- To introduce students to the various concepts of big data analytics, and the seven Vs. of big data—Volume, Velocity, Veracity, Variety, Value, Vision, and Visualization.
- To Explore big data concepts, platforms, analytics, and their applications using the power of Hadoop
- Provide HDFS Concepts and Interfacing with HDFS.
- Apply analytics on Structured, Unstructured Data.

#### **COURSE OUTCOME:**

**After completion of the course, the students will be able to:**

**CO1.** Describe the characteristics of Big Data

**CO2.** Describe the basics of Hadoop and HDFS architecture.

**CO3.** Deploy Job Execution in Hadoop Environment

**CO4.** Develop Big Data Solutions using Hadoop EcoSystem

**CO5.** Analyze Infosphere BigInsights Big Data Recommendations.

**CO6.** Deploy Machine Learning Techniques using R.

<b>MCA DSE3T4-3 : Big Data Analytics PWC ( 5 credits – 4 theory + 1 Assignment)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
1	<b>INTRODUCTION TO BIG DATA AND HADOOP :</b> Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, IBM Big Data Strategy, Introduction to NoSQL. Introduction to Infosphere BigInsights and Big Sheets	15
2	<b>HDFS(Hadoop Distributed File System) :</b> The Design of HDFS, HDFS Concepts, Command Line	15



	Interface, Hadoop file system interfaces, Data flow, Data Ingestion Tools, Data Ingest with Flume	
3	<b>Map Reduce</b> : Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	15
4	<b>Data Analytics with R</b> : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering.	15
5	Assignment	15
	<b>TOTAL</b>	<b>75</b>

### Reading List :

1. Eaton Chris, Deroos Dirk, "*Understanding Big data*", Tata McGraw Hill.
2. Lublinsky Boris, T. Smith Kevin, Yakubovich Alexey, "*Professional Hadoop Solutions*", Wiley Publication
3. White Tom, (2012) "*HADOOP: The definitive Guide*", O Reilly Publication.

## **SEMESTER – III**

<b>MCA SE3L05 : MOOCs</b> <b>PWC (2 credits: 2 Practical)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
	<b>Students can choose any course approved by the department from the following portals:</b> <ol style="list-style-type: none"> <li>1. Spoken Tutorial</li> <li>2. Swayam Portal</li> <li>3. NPTEL</li> </ol>	30
	<b>TOTAL</b>	<b>30</b>

### **SEMESTER – III**

<b>MCA SE3L06 : Seminar</b> <b>PWC (2 credits: 2 Practical)</b>		
<b>Unit</b>	<b>Topics to be covered</b>	<b>No. of hours</b>
	Industry seminars are suggested to enable the students of MCA to appreciate the software development which is going on in industries in India. These seminars will help the students to face interviews with some confidence. The students should attend these and submit a report.	30
	<b>TOTAL</b>	<b>30</b>

### **SEMESTER – IV**

<b>MCA CS4P13 : Internship</b> <b>PWC (12 credits)</b>
A student has to undertake at least two software development projects/ training work of at least one month duration during 1st, 2nd or 3rd semester.

### **SEMESTER – IV**

<b>MCA CS4P14 : OJT Project</b> <b>PWC (24 credits)</b>
OJT Project is of 500 Marks (24 credits) out of which all 24 credits for the development of the project and project report (unguided learning hours).The IV semester, being kept for fulfillment of the academic requirement, is entirely devoted to preparation of a major project report. For this purpose, each candidate shall have to undertake a major project, at least of 4 month durations, in a reputed organization. Project work has to be done individually. However if the project is done in groups, each student must be given a responsibility for a distinct module and care should be taken to see the progress of individual modules is independent of others.

## Notes

## Notes