

**ST. MARY'S COLLEGE (Autonomous)**

*(Re-accredited with 'A<sup>+</sup>' Grade by NAAC)*

**Thoothukudi-628001, Tamil Nadu**

**(Affiliated to Manonmaniam Sundaranar University)**



## **Syllabus**

**M.Sc. Computer Science**

**School of Computing Sciences**

*Outcome Based Curriculum*

**(w.e.f.2019)**

## **Preamble**

M.Sc. Computer Science program helps students to master their computer skills in programming and in managing databases and networks. The students are made globally competent and innovative.

## **Vision**

To make young women efficient computarians and highly successful in their personal and social life.

## **Mission**

To develop programming skills of the students by repetitive project sessions and practical exercises and to inculcate moral values in the students.

## **Programme Outcome:**

<b>PO.No.</b>	<b>At the end of the M.Sc. Program, the students will be able to</b>
PO-1	obtain in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in Science
PO-2	understand their subject areas more clearly and develop skills to critically reflect upon the theory they learn.
PO-3	adopt the scientific methods and hypothesis testing in designing and execution of experiments.
PO-4	think critically, work independently and focus in research oriented activities.
PO- 5	inculcate an ability to engage in life-long learning to improve professional competency.
PO-6	extend and understand the impact of science on society.
PO-7	apply their professional ability for entrepreneurship and self employment.
PO-8	understand and commit to professional ethics and social responsibility.

**Course Structure (w.e.f 2019-21)**

**SEMESTER – I**

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core I	19PCSC11	Design and analysis of algorithms	5	4	40	60	100
Core II	19PCSC12	J2EE	5	4	40	60	100
Core III	19PCSC13	Mathematical Foundations for computer science	4	4	40	60	100
Core IV	19PCSC14	Advanced computer architecture	4	4	40	60	100
Core V	19PCSC15	Neural Networks	4	4	40	60	100
Core Practical I	19PCSCR1	J2EE Lab	4	2	40	60	100
Core Practical II	19PCSCR2	Design and analysis of algorithm lab	4	2	40	60	100
			<b>30</b>	<b>24</b>			<b>700</b>

**SEMESTER – II**

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core VI	19PCSC21	DDBMS	4	4	40	60	100
Core VII	19PCSC22	.Net framework	5	4	40	60	100
Core VIII	19PCSC23	Data Mining & R Programming	5	4	40	60	100
Core IX	19PCCC21	Digital Image Processing	4	4	40	60	100
Core X	19PCSC24	Advanced Computer Networks	4	4	40	60	100
Core Practical III	19PCSCR3	Data Mining Lab (R Lab)	4	2	40	60	100
Core Practical IV	19PCSCR4	Network Simulation Lab I	4	2	40	60	100
			<b>30</b>	<b>24+2</b>			<b>800</b>

It is mandatory for students to complete one MOOC during the first year of study.

(19PCSM21) 2 credits

### SEMESTER – III

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core XI	19PCSC31	Wireless Communication	4	4	40	60	100
Core XII	19PCSC32	Cloud Computing & Big Data	4	4	40	60	100
Core-XIII	19PCSC33	Research Methodology	4	4	40	60	100
Elective I	19PCSE31	A. Fuzzy Logic / B. Cellular Mobile Computing	4	3	40	60	100
Elective II	19PCSE32	A. Object Oriented Software Engineering/ B. Artificial Intelligence	4	3	40	60	100
Core Practical V	19PCSCR5	Network Simulation Lab II (WAP)	4	2	40	60	100
Project	19PCSCR6	Mini Project	6	6	40	60	100
Self Study Course / MOOC/ Internship	19PCSSS1/ 19PCSM31/ 19PCSI31	Professional Ethics		+2		100	100
			<b>30</b>	<b>22+2</b>			<b>800</b>

### SEMESTER – IV

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Project	19PCSP41	Project work	30	16	100	100	200
			<b>30</b>	<b>16</b>			<b>200</b>

**Master of Science (Computer Science)**

<b>Components</b>	<b>Credit per Semester</b>	<b>No. of Courses</b>	<b>Total Credits</b>	<b>Extra Credits</b>
Core	20+20+12	13	52	
Practical	2	5	10	
Elective	3	2	6	
Project	6+16	2	22	
MOOC	2	1		+2
Self Study Course/MOOC/Internship	2	1		+2
			<b>90</b>	<b>+4</b>

## Program Specific Outcome

<b>PSO No</b>	<b>Students of MSc Computer Science will be able to</b>
<b>PSO-1</b>	program efficiently with computer languages using simplified logic
<b>PSO-2</b>	understand the use of Mathematics in Computer Science, in designing, programming and building machines
<b>PSO-3</b>	design and use algorithms for solving various problems and analyse data
<b>PSO-4</b>	store data in structured databases, extract data and analyse it for improvements in the system concerned
<b>PSO-5</b>	design and publish web pages and connect to Internet Technologies
<b>PSO -6</b>	design a computer machine with efficient computational and storage abilities
<b>PSO -7</b>	understand Networking concepts, its simulation and analysis
<b>PSO- 8</b>	develop user friendly projects and further the advancement in research

<b>SEMESTER –I</b>			
<b>Core I</b>		<b>Design and Analysis of Algorithms</b>	
<b>Code:19PCSC11</b>	<b>Hrs/week:5</b>	<b>Hrs/Sem:75</b>	<b>Credits:4</b>

### **Vision**

To be technologically adept, innovative and be able to develop new algorithms .

### **Mission:**

- To understand the course of the algorithm, its features and complexity
- To compare different algorithms for the same problem.

### **Course Outcome:**

<b>CO.No</b>	<b>Upon Completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	analyze the running time and space complexity of algorithms using asymptotic analysis.	1,3,4	An
CO-2	understand different tree traversals, graph traversals and spanning tress.	2,7	Un
CO-3	apply divide and conquer to binary search, quick sort, merge sort.	3	Ap
CO-4	apply greedy method to knapsack problem, prims, kruskal algorithms.	3	Ap
CO-5	apply dynamic programming to optimal binary search trees,0/1 knapsack problem, etc.	3	Ap
CO-6	apply Backtracking ton-queen problem, sum of subsets problem, graph coloring etc.	3	Ap
CO-7	apply branch and bound to Travelling sales person problem, 0/1 knapsack problem.	3	Ap
CO-8	describe the notions of P, NP, NP-complete, and NP-hard	2,7	Un

<b>SEMESTER –I</b>			
<b>Core I</b>		<b>Design and Analysis of Algorithms</b>	
<b>Code:19PCSC11</b>	<b>Hrs/week:5</b>	<b>Hrs/Sem:75</b>	<b>Credits:4</b>

### **Unit- I**

Introduction – Performance Analysis. Divide and conquer Method: Binary Search, Finding Maximum and Minimum, Merge Sort and Quick Sort.

### **Unit - II**

Greedy Methods: Knapsack Problem, Minimum Cost Spanning Trees, Optimal Storage on Tapes and Single Source Shortest Path Problem.

### **Unit - III**

Dynamic Programming: Multistage Graphs, 0/1 knapsack and Traveling Salesman Problem. Basic Traversal and Search Techniques: Techniques for Binary Tree, Techniques for Graphs: Depth First Search and Breadth First Search - Connected Components and Spanning Tree.

### **Unit - IV**

Backtracking: 8 Queens Problems, Sum of Subsets, Graph Colouring, Hamiltonian Cycle and Knapsack Problem.

### **Unit - V**

Branch and Bound: Least Cost Search. Bounding: FIFO Branch and Bound and LC Branch and Bound. 0/1 Knapsack Problem, Travelling Salesman Problem.

### **Text Book:**

1. E.Horowitz, S.Sahni and Sanguthevarrajasekaran , Fundamentals of Computer Algorithms , Second edition, Universities Press.

### **Books for Reference:**

1. S. K. Basu, Design Methods and Analysis of Algorithms , PHI, 2005.
2. Goodman and S. T. Hedetniem, Introduction to the Design and Analysis of Algorithms , MGH, 1977.
3. A.V. Aho, J.D. Ullman and J.E.Hospcraft, The Design and Analysis of Computer Algorithms , Pearson Education.
4. Discrete Mathematical Structures with applications to Computer Science“, Tata McGraw Hill.
5. Discrete Mathematics by Dr.M.K.Venkatraman , Dr. N. Sridharan and N.Chandrasekaran



SEMESTER – I			
Core II		J2EE	
Code : 19PCSC12	Hrs / Week : 5	Hrs / Sem : 75	Credits : 4

**Vision:** To acquire knowledge on the usage of recent platforms in developing web applications

**Mission:**

- Enhancing the students skills to design and develop interactive, client-side, server-side executable web applications.
- Able to apply the skill learnt for projects.

**Course Outcome:**

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	identifying a high-level overview of the J2EE architecture	2	Re
CO-2	identify the services and components which comprise the J2EE specification	2	Re
CO-3	explain how J2EE technology applications are packaged	1,2	Un
CO-4	illustrate Web application development using Web Components Servlet and JSP	1,5,8	Un
CO-5	summarize the features of Servlet and frameworks used in web applications development	5	Un
CO-6	understand design applications using Struts and Hibernate and Spring	1,6	Un
CO-7	finding new applications from existing beans in Enterprise beans.	1,8	An
CO-8	summarizing the types of Enterprise beans	2	Un
CO-9	recognizing the Hibernate framework in the development of Java application.	1,5	Re

<b>SEMESTER – I</b>			
<b>Core II</b>		<b>J2EE</b>	
<b>Code : 19PCSC12</b>	<b>Hrs / Week : 5</b>	<b>Hrs / Sem : 75</b>	<b>Credits : 4</b>

### **Unit I**

J2EE introduction – J2EE Architecture ( J2EE Tiers , Containers , Roles ) –J2EE Servers and services –Services of EJB Container – J2EE Technology – Packaging – Web services – Advantages of J2EE Applications

### **Unit II**

Enterprise Bean introduction – Benefits of Enterprise Beans - Types of Enterprise Beans – Session Bean – Entity Bean – Message-Driven Bean – The Contents of a Enterprise Bean – The Life Cycles of Enterprise Beans.

### **Unit III**

Servlet - Servlet Lifecycle - Servlet API -Object model of Servlet framework - Understanding web.xml, servlet tags and directory structure of web application - GenericServlet and HttpServlet, ServletConfig & ServletContext - Handling Form data with get and post request - Initializing a servlet - Request Dispatcher, Redirecting Request - Session Management -Filters in servlet -programs in servlet to read all parameters from form, database handling program, reading cookies values. JSP - What is JSP page? Compare it with servlet - Lifecycle of JSP page - JSP syntax using Directive, Declaration , Expression , Scriptlet, Comment - Using javabean and Action Tag in JSP - JSP implicit objects - Using JSP standard tag library ( JSTL) - Session management - Exception handling - Custom tag - Transferring Control to Another Web Component - Using JDBC in JSP -Programs in JSP -Integrating JSP with JQuery, Bootstrap, Angular JS, JSON.

### **Unit IV**

Basic of Struts2 - Understanding MVC architecture - Struts2 framework - Understanding default-stack - comparing struts with other framework - Working with Struts2 Actions - Introducing Struts 2 actions - Packaging your actions - Implementing actions Adding workflow with interceptors - Why intercept requests? - Interceptors in action - Surveying the built-in Struts 2 interceptors - Declaring interceptors - Building your own interceptor Data transfer: OGNL and type conversion - Data transfer and type conversion: common tasks of the web application domain - OGNL and Struts 2 - Built-in type converters - Customizing type conversion Validation framework - RequiredFieldValidator Class - RequiredStringValidator Class - ExpressionValidator Class - Email Validator Class - RegexFieldValidator Class - DateRangeFieldValidator Class Struts

## **Unit V**

Hibernate - Introduction to Hibernate - Understanding ORM (Object Relational Mapping) - Understanding Transient, Persistent and Detached Object states - Issues while writing manual JDBC code - Hibernate and JPA (Java Persistence API) - Writing persistence classes -Steps to work with Hibernate - Handling CRUD operations in Hibernate - Mapping Inheritance between classes with tables in database -HQL -One to One and One to One mapping in Hibernate- Core Spring -Springing into action -Wiring beans. -Advanced wiring. -Aspect oriented Spring - Spring in Web and Backend -Building spring web application -JDBC with spring / Hibernate with spring.

### **Text Book:**

1. Elliotte Rusty Harold, “ Java Network Programming”, O’Reilly publishers, 2000

### **Books for Reference:**

1. Ed Roman, “Mastering Enterprise Java Beans”, John Wiley & Sons Inc., 1999.
2. Hortsman & Cornell, “CORE JAVA 2 ADVANCED FEATURES, VOL II”, Pearson Education, 2002.
3. Patrick Naughton, “COMPLETE REFERENCE: JAVA2”, Tata McGraw-Hill, 2003.
4. Struts 2 in Action , Manning publication , Donald Brown, Chad Michael Davis, and Scott Stanlick Spring in Action , Craig Walls , Manning Dreamtech press
5. Pure JSP by James Goodwill Techmedia SAMS publication
6. Hibernate in Action Manning publication , Christian Bauer and Gavin King Java Servlet Programming O’Reilly Publication-Author: Jason Hunter.
7. Struts 2 Black Book James Holmes “Struts: The Complete Reference, " 2nd Edition 2007 McGraw Hill Professional
8. Patrick Peak And Nick Heudecker, Patrick Peak, Nick Heudecker Hibernate Quickly, " 2007 Dreamtech
9. Subrahmanyam Allamaraju and Cedric Buest , "Professional Java Server Programming (J2EE 1.3 Edition), ", Shroff Publishers & Distributors Pvt Ltd.

SEMESTER – I			
Core III Mathematical Foundations for Computer Science			
Code : 19PCSC13	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

**Vision :**

To equip the students with the key mathematical concepts necessary to understand. Building the ability of students to apply these mathematical concepts and tools to practical industrial and academic projects in various competitive fields.

**Mission :**

- To understand and apply the class of functions which transform a finite set into another finite set which relates to input output functions in computer science.
- To impart discrete knowledge through finite automata and Context free grammars

**Course Outcome:**

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	finding the complementary relationship of skewness with measures of central tendency and dispersion in describing a set of data.	3	An
CO-2	understanding ‘moments’ as a convenient and unifying method for summarizing several descriptive statistical measures.	2	Un
CO-3	identifying the strength and direction of a linear relationship between two variables using Correlation.	2	Re
CO-4	illustrating how much a dependent variable changes based on adjustments to an independent variable using regression.	2	Un
CO-5	acquire the knowledge of logical operations and predicate calculus needed for computing skill.	2	Un
CO-6	finding whether the given grammar is regular or not.	1	An
CO-7	apply the acquired knowledge of formal languages to the engineering areas like Compiler Design.	1	Ap
CO-8	distinguishing Deterministic Finite automata and Non Deterministic Finite automata.	2	An

SEMESTER – I			
Core III Mathematical Foundations for Computer Science			
Code : 19PCSC13	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

### Unit I

Moments-Skewness and kurtosis-Curve fitting-Method of least squares-fitting lines-parabolic, exponential & logarithmic curves

### Unit II

Correlation & regression –Scatter diagram- Karl Pearson’s coefficient of correlation- lines of regression coefficient - rank correlation.

### Unit III

Mathematical Logic : Propositions and logical operators - Truth table - Propositions generated by a set, Equivalence and implication - Basic laws- Some more connectives - Functionally complete set of connectives- Normal forms - Proofs in Propositional calculus – Predicate calculus.

### Unit IV

Formal Languages: Languages and Grammars-Phrase Structure Grammar- Classification of Grammars-Pumping Lemma for Regular Languages-Context Free Languages.

### Unit V

Finite State Automata : Finite State Automata-Deterministic Finite State Automata (DFA), Non Deterministic Finite State Automata (NFA)-Equivalence of DFA and NFA-Equivalence of NFA and Regular Languages.

### Text Book:

1. S. Arumugam and A. Issac, Statistics, New Gamma publishing House. Palayamkottai, 2011

### Books for Reference:

1. Tremblay and Manohar, „Discrete Mathematical Structures with applications to Computer Science“, Tata McGraw Hill.
2. Discrete Mathematics by Dr.M.K.Venkatraman , Dr. N. Sridharan and N.Chandrasekaran
3. John E. Hopcroft and J.D.Ullman -- Introduction to Automata Theory, Languages and Computation, Narosa Pub. House, N. Delhi.
4. Michael Sipser -- Introduction to The Theory of Computation, Thomson Course Technology.
5. Kenneth H.Rosen, “ Discrete Mathematics and Its Applications”, Tata McGraw Hill, Fourth Edition, 2002
6. A.Tamilarasi & A.M.Natarajan, “Discrete Mathematics and its Application”, Khanna Publishers, 2nd Edition 2005.
7. Juraj Hromkovic, “Theoretical Computer Science”, Springer Indian Reprint, 2010.

<b>SEMESTER –I</b>			
<b>Core IV</b>		<b>Advanced Computer Architecture</b>	
<b>Code:19PCSC14</b>	<b>Hrs/week:4</b>	<b>Hrs/Sem:60</b>	<b>Credits:4</b>

### **Vision**

To give the students a deep insight on the hardware organisation of a computer system.

### **Mission**

- To understand various addressing modes and program and network properties ,
- Learn the computer arithmetic principles and super scalar techniques
- Understand data storage and memory organisation

### **Course Outcome:**

<b>CO No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	understand basic structure of computer.	6	Un
CO-2	perform computer arithmetic operations.	6,2	Ev
CO-3	understand the concept of cache mapping techniques.	6	Un
CO-4	understand the concept of I/O organization	6	Un
CO-5	conceptualize instruction level parallelism	6	Un
CO-6	understand pipelining and its concepts	6	Un
CO-7	understand various data transfer techniques in digital computer.	6	Un
CO-8	analyze performance issues in processor and memory design of a digital computer.	6	An

SEMESTER –I			
Core IV		Advanced Computer Architecture	
Code:19PCSC14	Hrs/week:4	Hrs/Sem : 60	Credits: 4

### Unit I : Review of basics and ISA design:

CISC vs RISC. Performance measure of a Computer: Performance measures, Performance parameters –Measuring the performance –Amdahl’s Law and CPU performance. Benchmarks for evaluating the performance.

Design factors - operand and opcode types – Instruction formats and addressing modes – compiler Issues – structure of modern compilers.

### Unit II : Pipelining:

Pipelining: Definition – Basic characteristics of pipelined processing – Functional structure of pipelined computer – pipelined processor design principles - Performance issues- different types of Pipeline hazards.

### Unit III: Parallelism:

Definition and types of parallelisms – Instruction level parallelism – Different typed of dependencies in programs. – Dynamic scheduling –Score boarding– Tomasulo’s approach- Branch prediction. Software Solution to ILP: Super Scalararchitecture – static and dynamic scheduling on a super scalar architecture. VLIW architecture

### Unit IV:Shared Memory Architecture and Memory Organization:

Parallel processing Configurations – Flynn’s classification – Centralized and distributed memory models. Communication models and memory architectures – Performance metrics for communication mechanisms- challenge- Cache coherence – Directory based cache coherence protocols. Memory hierarchy –strategies of Cache write – cache performance and improvements –Main Memory performance issues –Interleaved memory- Virtual Memory

### Unit V: Memory Organisation and I/O issues:

Memory hierarchy –strategies of Cache write – cache performance and improvements –Main Memory performance issues –Interleaved memory- Virtual Memory

.I/O : Storage types, Busses –Bus transactions – I/O device Performance metrics –Queuing theory –Bus Standards –I/O transfer using memory bus -Connecting bus to Cache

**Text Book:**

1. K. A. Parthasarathy et.al – Advanced Computer Architecture, 2/e, Thomson Learning, Indian Edition, 2006

**Books for Reference:**

1. K. Hwang & F. A. Briggs – Computer Architecture and Parallel Processing, TMH, New Delhi 2004
2. Kai Hwang & Naresh Jotwani “Advanced Computer Architecture Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition, 2011
3. D. Sima, T. Fountain & P. Kacsuk. Advanced Computer Architectures, Pearson. Education, New Delhi 2004.



<b>SEMESTER –I</b>			
<b>Core V</b>		<b>Neural Networks</b>	
<b>Code:19PCSC15</b>	<b>Hrs/week:4</b>	<b>Hrs/Sem: 60</b>	<b>Credits: 4</b>

**Vision:**

To make the students understand neural networks and thereby relate to artificial intelligence and machine learning

**Mission:**

- Learn about network models
- Understand fault diagnosis in neural nets

**Course Outcome:**

<b>CO No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	understand basic architecture of neural networks	1	Un
CO-2	understand basic learning algorithms	3	Un
CO-3	understand the classification taxonomy of NN	4	Un
CO-4	compare and analyse the training algorithms	4	An
CO-5	apply NN models to find solutions	4,6	Ap
CO-6	analyse the use of Associative memory	1	An
CO-7	learn to diagnose the cause and rectification of faults	4	Re
CO-8	compare different network models	4	An

SEMESTER –I			
Core V		Neural Networks	
Code:19PCSC15	Hrs/week:4	Hrs/Sem: 60	Credits: 4

### **Unit I: Introduction to Neural Networks**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

### **Unit II: Essentials of Artificial Neural Networks**

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

### **Unit III: Single Layer Feed Forward Networks**

Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.

### **Unit IV: Multi- Layer Feed Forward Networks**

Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

### **Unit V: Associative Memories**

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis. Neural network applications: Process identification, control, fault diagnosis.

### **Text Book:**

1. Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004.

### **Books for Reference:**

1. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003.
2. S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TATA Mc Graw Hill, 2006.
3. S. Rajasekharan and G. A. Vijayalakshmi pai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication, 2004.
4. Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-Hill Inc. 2000

<b>SEMESTER – I</b>			
<b>Core Practical - I</b>		<b>J2EE Lab</b>	
<b>Code : 19PCSCR1</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 2</b>

1. Write a Servlet to display “Hello World” on browser.
2. Write a Servlet to display all the headers available from request.
3. Write a Servlet to display parameters available on request
4. Write a Servlet to display all the attributes available from request and context
5. Write a Servlet which displays a message and also displays how many times the message has been displayed (how many times the page has been visited).
6. Assume that the information regarding the marks for all the subjects of a student in the last exam are available in a database, Develop a Servlet which takes the enrollment number of a student as a request parameter and displays the marksheet for the student.
7. Develop a Servlet which looks for cookies for username and password, and forwards to a home.jsp in case the cookies are valid and forwards to login.jsp, in case the cookies are not found or the cookies are not valid.
8. Develop a Servlet to authenticate a user, where the loginid and password are available as request parameters. In case the authentication is successful, it should setup a new session and store the user's information in the session before forwarding to home.jsp, which displays the user's information like full name, address, etc.
9. Write a simple JSP page to display a simple message (It may be a simple html page).
10. Write a JSP page, which uses the include directive to show its header and footer.
11. Create a Java class called Product with the following properties: name, description, price. Create a listener that notifies (through System.out) whenever a user adds a product to a shopping cart (i.e. adds an object to the session object) or removes it again. Hint: check out the class HttpSessionAttributeListener. Make it print the name and price of the object (hint: access the session through the HttpBindingEvent object). Also, let the listener print the total price of all objects saved in the session so far (one way to accomplish this could be to keep a collection of all objects saved to the session – or just their keys – in the listener or an associated class).
12. Create a servlet filter that logs all access to and from servlets in an application and prints the following to System.out: a. the time the request was received b. the time the response was sent c. how much time it took to process the request d. the URL of the resource requested e. the IP address of the visitor
13. Develop a interest calculation application in which user will provide all FACULTY OF COMPUTER APPLICATIONS information in HTML form and that will be processed by servlet and response will be generated back to the user.
14. Develop an application to demonstrate how the client (browser) can remember the last time it visited a page and displays the duration of time since its last visit. (Hint: use Cookie)
15. Develop an application to keep track of one user across several servlet invocations within the same browser session.

<b>SEMESTER –I</b>			
<b>Core Practical II</b>		<b>Design and Analysis of Algorithms Lab</b>	
<b>Code:19PCSCR2</b>	<b>Hrs/week:4</b>	<b>Hrs/Sem:60</b>	<b>Credits:2</b>

Using C++ programing write programs for the following:

1. Sorting
2. Graph traversal
3. Prim's Algorithm-Greedy Method
4. N queen problem
5. Knapsack problem
6. Single Source Shortest Path
7. Sum of Subsets
8. Binary Search Tree
9. Graph Coloring
10. Biconnected Components
11. Travelling Salesman Problem

SEMESTER – II			
Core VI		Distributed Database Management System	
Code : 19PCSC21	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

**Vision :** To build the background of database systems by deepening the understanding of the theoretical and practical aspects of the database technologies, showing the need for distributed database technology to tackle deficiencies of the centralized database systems and finally introducing the concepts and techniques of distributed database including principles, architectures, design, implementation and major domain of application.

**Mission :**

- Identify the introductory distributed database concepts and its structures.
- Describe terms related to distributed object database design and management.
- Produce the transaction management and query processing techniques in DDBMS.
- Relate the importance and application of emerging database technology.

**Course Outcome**

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand what is Distributed DBMS	4	Un
CO-2	understand various architectures of DDBMS	4	Un
CO-3	apply various fragmentation techniques in a given problem	4	Ap
CO-4	understand the steps of query processing	4	Un
CO-5	finding how optimization techniques are applies to Distributed Database	4,6	An
CO-6	learn and understand various Query Optimization Algorithms	3	Un
CO-7	understand Transaction Management & Compare various approaches to concurrency control in Distributed database	6	Un
CO-8	understand various algorithms and techniques for deadlock and recovery in Distributed database	3	Un

SEMESTER – II			
Core VI		Distributed Database Management System	
Code : 19PCSC21	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

### Unit I : Introduction

Distributed Data Processing, Distributed Database Systems, Promises of DDBSs, Complicating factors - Distributed DBMS Architecture Models- Autonomy, Distribution, Heterogeneity DDBMS Architecture – Client/Server, Peer to peer, MDBS

### Unit II: Data Distribution Alternatives:

Design Alternatives – localized data, distributed data Fragmentation – Vertical, Horizontal (primary & derived), hybrid, general guidelines, correctness rules  
Distribution transparency – location, fragmentation, replication - Impact of distribution on user queries.

### Unit III: Query Processing

Query Processing Problem, Layers of Query Processing Query Processing in Centralized Systems – Parsing & Translation, Optimization, Code generation, Example Query Processing in Distributed Systems – Mapping global query to local .

**Optimization of Distributed Queries:** Query Optimization, Centralized Query Optimization, Join Ordering Distributed Query Optimization Algorithms.

### Unit IV: Distributed Transaction Management & Concurrency Control

Transaction concept, ACID property, Objectives of transaction management, Types of transactions, Objectives of Distributed Concurrency Control, Concurrency Control anomalies, Methods of concurrency control, Serializability and recoverability, Distributed Serializability, Enhanced lock based and timestamp based protocols, Multiple granularity, Multi version schemes, Optimistic Concurrency Control techniques

### Unit V : Distributed Deadlock & Recovery Deadlock concept, Deadlock in Centralized systems

Deadlock in Distributed Systems – Detection, Prevention, Avoidance, Wait-Die Algorithm, Wound-Wait algorithm Recovery in DBMS - Types of Failure, Methods to control failure, Different techniques of recoverability, Write- Ahead logging Protocol, Advanced recovery techniques- Shadow Paging, Fuzzy checkpoint, ARIES, RAID levels, Two Phase and Three Phase commit protocols.

### Text Book:

1. Principles of Distributed Database Systems, Ozs, Pearson Publication

**Books for Reference:**

1. Rahimi & Haug, Wiley, Distributed Database Mangement Systems,
2. Chanda Ray, Distributed Database Systems, Pearson Publication
3. Sachin Deshpande, Distributed Databases, Dreamtech
4. A. Silberschatz, H.F. Korth and S. Sudharshan, 2006, Database System Concepts, 5th Edition, Tata McGraw Hill, New Delhi.

<b>SEMESTER- II</b>			
<b>Core VII – .Net Framework Programming</b>			
<b>Code: 19PCSC22</b>	<b>Hrs / week :5</b>	<b>Hrs / Sem: 75</b>	<b>Credits :4</b>

**Vision:**

Create and deploy database driven applications and services

**Mission:**

- Learn to use controls in programming
- Learn to develop user friendly applications

**Course Outcome:**

<b>CO No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	set up a programming environment for ASP.net programs	1	Ap
CO-2	creating ASP.Net applications using standard .net controls	1	Cr
CO-3	develop a data driven web application	1,4	Ap
CO-4	connecting to data sources and managing them	1,4	Ap
CO-5	maintain session and controls related information for user used in multi-user web applications	1	Ap
CO-6	understand the fundamentals of developing modular application by using object oriented methodologies	1,4	Re
CO-7	learn to diagnose the cause of errors and handle it	1	Ap
CO-8	create and deploy ASP.NET web applications	1,4,6,8	Cr



<b>SEMESTER- II</b>			
<b>Core VII</b>	<b>.Net Framework Programming</b>		
<b>Code: 19PCSC22</b>	<b>Hrs / week :5</b>	<b>Hrs / Sem: 75</b>	<b>Credits :4</b>

### **Unit I**

Introduction to Visual Basic .NET : Window forms – working with controls – working with dialog boxes –MDI- Drag and drop operation – variables – Controlling Program flow.- Procedures in VB.Net-Accessing a Database.

### **Unit II**

Introducing ASP.Net – Getting started with ASP.Net applications: Web forms – creating ASP.Net Webform applications – Using ASP.Net Webforms for server controls : Beginning with server controls – Taking a closer look at web controls – Illustrating Basic web controls – Working with Validation Controls : The compare Validator – The Range Validator – Regular Expression Validator – Custom validator –Validation Summery control – Multiple validation control.

### **Unit III**

Developing ASP.Net Server controls : Developing ASP.Net server controls – Creating and using Web User Control – Creating ASP.Net Pages to web user control – Using Rich Web controls: Calendar web server control.

### **Unit IV**

Debugging ASP.Net Web Applications: Tracing ASP.Net Applications – Handling Errors in ASP.Net applications – Using ADO.Net with ASP.Net: ADO.Net – ADO.Net Object model .

### **Unit V**

Welcome to C# - Working with variables, Operators and Expressions – Writing methods applying scope – using decision statements-Using Iteration Statements – Managing Errors and Exceptions – Creating and Managing Classes – Using Arrays and Collections

#### **Text Book:**

1. Mridula Parihar, Yesh Sinhal and Nitin Pandey, “Visual Studio .Net Programming”, PHI, 2002.

#### **Books for Reference:**

1. John Sharp, Jon Jagger, “Microsoft Visual C# .Net Step by Step”, PHI, 2005.
2. Nitin Pandey, “Microsoft Asp.NET”, PHI, 2002.
3. “ASP.NET Made Simple” BPB Publictaions, First Edition, 2001.
4. Kiric Allen Evans, Ashwin Kamanna, Joel and Muller, “XML and ASP.NET”, Pearson Education, First Indian Reprint, 2002.
5. Andrew Trolsen, “C# and the .NET Platform”, APress, Second Print, 2006.

SEMESTER- II			
Core VIII		Data Mining & R Programming	
Code: 19PCSC23	Hrs / week :4	Hrs / Sem: 60	Credits :4

**Vision:**

Extract patterns of usable data using appropriate algorithms

**Mission:**

- To study the basic and advanced concepts in Data Mining Techniques.
- To understand the various algorithms involved in data mining and its applications.

**Course Outcome:**

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	display a comprehensive understanding of different data mining tasks and the algorithms most appropriate for addressing them.	1	Un
CO-2	know Strengths & Limitations of Data Mining Methods	1	Un
CO-3	display interesting patterns from large data, to extract and analyse, make predicitions and solve problems	1, 4	An
CO-4	evaluate models/algorithms with respect to their accuracy.	6	Ev
CO-5	demonstrate capacity to perform a self directed piece of practical work that requires the application of data mining techniques.	1	Ev
CO-6	develop hypotheses based on the analysis of the results obtained and test them.	1	Ev
CO-7	learn to Set Up Data for Experiments	1,4	Ap
CO-8	conceptualize a data mining solution to a practical problem.	1,4, 8	Ap

<b>SEMESTER- II</b>			
<b>Core VIII</b>	<b>Data Mining &amp; R Programming</b>		
<b>Code: 19PCSC23</b>	<b>Hrs / week :4</b>	<b>Hrs / Sem: 60</b>	<b>Credits :4</b>

### **Unit I**

Introduction: Basic Data Mining Tasks- Data Mining Versus Knowledge Discovery in Databases. Data Mining Techniques: Introduction-A Statistical Perspective on Data Mining-Similarity Measures- Decision Trees-Neural Networks-Genetic Algorithms

### **Unit II**

Classification: Introduction- Statistical Based Algorithms-Distance Based Algorithms-Decision Tree Based Algorithms-Neural Network Based Algorithms- Rule Based Algorithms-Combining Techniques.

### **Unit III**

Clustering: Introduction-Similarity and Distance Measures-Outliers Hierarchical Algorithms-Partitional Algorithms.

### **Unit IV**

Introduction: Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized Operations, Reading and Writing Data. (5L) Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards. (5L) Scoping Rules, Debugging Tools, Simulation, R Profiler.

### **Unit V**

Association rules, frequent itemsets- Finding high-correlation with low-support- Classifiers - Bayesian, Nearest Neighbour- Decision Trees-Clustering techniques-Supervised, Semisupervised learning: Expectation maximization; Web search: HITS and PageRank

### **Text Book:**

1. Margaret H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson publications, Ninth Impression.

### **Books for Reference:**

1. K. P. Soman, ShyamDivakar, V. Ajay "Insight in to Data Mining Theory and Practice", PHI Learning Pvt. Ltd, 2006.
2. Jiawei Han, MichelineKamber, Jian Pei " Data Mining Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition
3. W. N. Venables, D. M. Smith, An Introduction to R, R-core team,2015
4. Jiawei Han, Micheline Kamber: Data mining: concepts and techniques (2nd ed), Morgan
5. Kaufman (2006).
6. Bing Liu: Web Data Mining: Exploring Hyperlinks, Contents and Usage Data, Springer (2006).
7. Soumen Chakrabarti: Mining the Web: Discovering knowledge from hypertext data, Elsevier (2003).
8. Christopher D Manning, Prabhakar Raghavan and Hinrich Schütze : An Introduction to Information Retrieval, Cambridge University Press (2009).

<b>SEMESTER II</b>			
<b>Core IX</b>		<b>Digital Image Processing</b>	
<b>Code: 19PCSC21</b>	<b>Hrs/Week: 5</b>	<b>Hrs/Sem: 75</b>	<b>Credits: 4</b>

### **Vision**

To interpret images mathematically and process them for the extraction of data using matlab

### **Mission**

To equip the students with the knowledge of fundamental concepts and techniques in basic digital image processing and their applications to solve real life problems.

### **Course Outcome:**

<b>CO. No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	calculate the Fourier transforms of standard functions both from the definition and by using tables.	2	Ap
CO-2	design and implement the different transforms like Fourier transform and Z transform.	2	Cr
CO-3	write given function in terms of sine and cosine in Fourier series and also to get knowledge in Fourier Transforms.	2	Re
CO-4	solve finite difference equations using Z- transform using MATLAB	1	Ap
CO-5	review the fundamental concepts of a digital image processing system.	3	Re
CO-6	analyze images in the frequency domain using various transforms.	2	Re
CO-7	interpret image compression, segmentation and representation standards	3,4	An
CO-8	understand image filtering for use in various applications	1	Un

SEMESTER II			
Core IX		Digital Image Processing	
Code: 19PCSC21	Hrs/Week: 5	Hrs/Sem: 75	Credits: 4

### Unit I- Introduction

Introduction – steps in image processing, Image acquisition, representation, sampling and quantization, relationship between pixels. – color models – basics of color image processing.

### Unit II - Image Enhancement

Image enhancement in spatial domain – some basic gray level transformations – histogram processing – enhancement using arithmetic , logic operations – basics of spatial filtering and smoothing.

### Unit III - Image Enhancement

Image enhancement in Frequency domain – Introduction to Fourier transform: 1- D, 2 –D DFT and its inverse transform, smoothing and sharpening filters.

### Unit IV - Image Restoration

Image restoration: Model of degradation and restoration process – noise models – restoration in the presence of noise- periodic noise reduction.. Image segmentation: Thresholding and region based segmentation.

### Unit V - Image Compression

Image compression: Fundamentals – models – information theory – error free compression – Lossy compression: predictive and transform coding. JPEG standard.

### Text Book:

1. R.C. Gonzalez, R.E.Woods, 2002, Digital Image processing, 2nd Edition, Pearson Education.

### Books for Reference:

1. T.Veerarajan : Transforms and Partial Differential Equations ( Updated Edition) .
2. Rafael C. Gonzalez, Richard E. Woods: Digital Image Processing, Pearsons Education, third edition.
3. RajkumarBansal , Ashok Kumar Goel , Manoj Kumar Sharma : MATLAB and its Applications in Engineering, Pearsons Publications.

<b>SEMESTER- II</b>			
<b>Core X</b>		<b>Advanced Computer Networks</b>	
<b>Code: 19PCSC24</b>	<b>Hrs / week :4</b>	<b>Hrs / Sem: 60</b>	<b>Credits :4</b>

### **Vision**

To give exemplary graduate education in information networking, information security, and mobility.

### **Mission**

- To understand modern computer networks
- to familiarize routing algorithms
- to detect the technical problems in networking

### **Course Outcome:**

<b>CO.No</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	solve technical problems in ARQ protocols, MAC protocols and Routing Algorithm.	3,7	Ap
CO-2	demonstrate the working of HUB and Switches.	7	Ap
CO-3	examine the Performance of ARQ Protocols, Ethernet LAN, Token Ring, RIP, TCP and UDP.	7	Ap
CO-4	identify the networking technologies and associated network standards.	7	An
CO-5	solve technical problems in ARQ protocols, MAC protocols and Routing Algorithm.	3,7	Ap
CO-6	construct the route discovery algorithm to determine the shortest path in an internet represented as a weighted graph.	5,7	Ap
CO-7	understand network architecture	7	Un
CO-8	implementation of protocols like TCP, UDP and IP using OPNET and NS-2	5,7	Ap

<b>SEMESTER- II</b>			
<b>Core X</b>	<b>Advanced Computer Networks</b>		
<b>Code: 19PCSC24</b>	<b>Hrs / week :4</b>	<b>Hrs / Sem: 60</b>	<b>Credits :4</b>

### **Unit I**

#### **Layered Network Architecture and Network Topologies:**

Introduction - Evolution of data Networks – Switching Techniques – Categories of networks - ISO/OSI Reference Model – TCP/IP Model, Network Topologies.

### **Unit II**

#### **Internetworking devices and Data Link Layer:**

Repeaters – Hubs – Switches – Bridges: Transparent and Source Routing– Routers.Logical Link Control – Error Detection Techniques – ARQ protocols – Framing – HDLC –Point to Point protocol. Medium Access Control – Random access Protocols – Scheduling approaches to MAC.

### **Unit III**

#### **Local Area Networks& Wide Area Networks and Network Layer:**

Ethernet- Token Bus/Ring , FDDI – Virtual LAN ,WAN Technologies – Frame Relay, ATM, Wireless LAN. Internetworking – IP Addressing – Subnetting – IPv4 and IPv6– Routing – Distance Vector and Link State Routing – Routing Protocols.

### **Unit IV**

#### **Transport Layer and Services:**

Connection oriented and Connectionless Service – User Datagram Protocol – Transmission Control Protocol – Congestion Control – QoS parameters.

### **Unit V**

#### **Application Layer and Contemporary Issues:**

Domain Name System – Simple Mail Transfer Protocol – File Transfer Protocol – Hypertext Transfer Protocol - World Wide Web.Contemporary Issues

#### **Text Book:**

1. Alberto Leon-Garcia, “Communication Networks” Tata McGraw-Hill 2012.

#### **Books for Reference:**

1. Robert Gallager, “Data Networks”, Prentice Hall, 2009.
2. W. Stallings, Data and Computer Communications, Prentice Hall, 2007
3. Fred Halsall, Data communications, “Computer Networks and Open systems”, Addison Wesley 2006.
4. BhushanTrivedy, Computer Networks, Oxford university press,2012.

<b>SEMESTER- II</b>			
<b>Core Practical III</b>		<b>Data Mining Lab (R Lab)</b>	
<b>Code: 19PCSCR3</b>	<b>Hrs / week :4</b>	<b>Hrs / Sem: 60</b>	<b>Credits :2</b>

Using R programming language write programs for the following concepts:

1. Vectorization
2. Control structures
3. Functions
4. Scoping Rules
5. Loop functions
6. Graphics and visualization
7. Grammar of data manipulation (dplyr and related tools)
8. Debugging/profiling
9. Statistical simulation



<b>SEMESTER- II</b>			
<b>Core Practical IV</b>		<b>Network Simulation Lab I</b>	
<b>Code: 19PCSCR4</b>	<b>Hrs / week :4</b>	<b>Hrs / Sem: 60</b>	<b>Credits :2</b>

1. Implementation of File System Calls
2. Implementation of ICP Techniques – Pipe, Message Queue, Shared Memory
3. Socket Programming
  - a) TCP Sockets
  - b) UDP Sockets
  - c) Applications using Sockets
4. Simulation of Sliding Window Protocol
5. Simulation of Routing Protocols
6. RPC
7. Development of applications such as DNS / HTTP / E-mail / Multi-user chat

<b>SEMESTER-III</b>			
<b>Core XI</b>		<b>Wireless Communication</b>	
<b>Code: 19PCSC31</b>	<b>Hrs/Week: 4</b>	<b>Hrs/Sem: 60</b>	<b>Credits : 4</b>

### **Vision**

To initiate wireless technology research, development and commercialisation.

### **Mission**

- To understand the in-depth concepts of wireless networking
- learn signal processing

### **Course Outcome:**

<b>CO.No</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	understand wireless transceivers	7	Un
CO-2	describe the evolution and History of Wireless technology	7	Un
CO-3	compare 3G Cellular telephone data transfer rates with those over Wireless LAN	7	An
CO-4	list the use of at least two advantages of Digital encoding for cellular telephone systems	6	Ap
CO-5	identify two core networks associated with 3G Cellular networks	4	An
CO-6	describe the basic operation of GSM GPRS	7	Un
CO-7	apply the concepts learnt through theory and Laboratory in various applications to meet the empathetical needs our society.	8	Ap
CO-8	implement signal processing in wireless systems	6	Ap

SEMESTER-III			
Core XI	Wireless Communication		
Code: 19PCSC31	Hrs/Week: 4	Hrs/Sem: 60	Credits : 4

### Unit I Services and Technical Challenges

Types of Services, Requirements for the services, Multipath propagation, Spectrum Limitations, Noise and Interference limited systems, Principles of Cellular networks, Multiple Access Schemes.

### Unit II Wireless Propagation Channels

Propagation Mechanisms (Qualitative treatment), Propagation effects with mobile radio, Channel Classification, Link calculations, Narrowband and Wideband models.

### Unit III Wireless Transceivers

Structure of a wireless communication link, Modulation and demodulation – Quadrature Phase Shift Keying, Differential Quadrature Phase Shift Keying, Offset-Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Minimum Shift Keying, Gaussian Minimum Shift Keying, Power spectrum and Error performance in fading channels.

### Unit IV Signal Processing in Wireless Systems

Principle of Diversity, Macrodiversity, Microdiversity, Signal Combining Techniques, Transmit diversity, Equalisers- Linear and Decision Feedback equalisers, Review of Channel coding and Speech coding techniques.

### Unit V Advanced Transceiver Schemes

Spread Spectrum Systems- Cellular Code Division Multiple Access Systems- Principle, Power control, Effects of multipath propagation on Code Division Multiple Access, Orthogonal Frequency Division Multiplexing – Principle, Cyclic Prefix, Transceiver implementation, Second Generation(GSM, IS-95) and Third Generation Wireless Networks and Standards

### Text Book:

1. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

### Books for Reference:

1. Simon Haykin& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
2. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003.
3. Gordon L. Stuber, “Principles of Mobile Communication”, Springer International Ltd.,2001.
4. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

<b>SEMESTER – III</b>			
<b>Core XII</b>		<b>Cloud Computing and Big Data</b>	
<b>Code : 19PCSC33</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 4</b>

**Vision :** To make accurate analytical in business and to apply different cloud programming model as per need.

**Mission :**

- To explore the fundamental concepts of big data analytics
- To learn to analyze the big data using intelligent techniques.
- To understand the applications using Map Reduce Concepts.
- To know about the Cloud Computing architecture and services.
- To learn to design the trusted Cloud Computing system.
- To understand the concept of Virtualization and design of Cloud Services.

**Course Outcome:**

<b>CO. No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	carry out the decisions based on data analytics.	3,6	Ap
CO-2	analyze the big data analytic techniques for useful business applications.	4	An
CO-3	identify the data models in relation to Big Data Storage and Analytics.	2	Re
CO-4	implemen Big Data applications Using Pig and Hive	1,8	Ap
CO-5	plan to work with big data platform	1,2	Cr
CO-6	identify the architecture, infrastructure and delivery models of cloud computing	2	Re
CO-7	apply suitable virtualization concept.	5,8	Ap
CO-8	organize the core issues of cloud computing such as security, privacy and interoperability	3,6	An

SEMESTER – III			
Core XII	Cloud Computing and Big Data		
Code : 19PCSC33	Hrs / Week : 4	Hrs / Sem : 60	Credits : 4

### Unit I

Big data introduction – Characteristics of Big data – Structure of Big data – Evolution of Analytical Scalability – Map Reduce – Cluster Analysis – Real time analytics platform applications – Case studies for real time Sentiment analysis, Stock market predictions.

### Unit II

Introduction to NoSQL – Aggregate data models – HBase – Pig – Grunt - Hive .

### Unit III

Vision of Cloud computing – Cloud Definition – Characteristics and Benefits – Virtualization – Cloud computing Architecture – Cloud Reference Model, Types of Clouds – Cloud Platforms in Industry.

### Unit IV

Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

### Unit V

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

### Text Book:

1. Big Data: A Revolution That Will Transform How We Live, Work and Think by Viktor Mayer-Schonberger , Kenneth Cukier

### Books for Reference:

1. Big Data Analytics , Venkat Ankam 2016
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012
3. PeteWarden, “Big Data Glossary”, O’Reilly, 2011.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.

5. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
7. Kumar Saurabh, “Cloud Computing – insights into New-Era Infrastructure”, Wiley India,2011.
8. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud” O'Reilly
9. Ronald L. Krutz, Russell Dean Vines, “Cloud Security – A comprehensive Guide to Secure Cloud Computing”, Wiley – India, 2010.
10. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, ‘Mastering Cloud Computing’, TMGH,2013.

<b>SEMESTER – III</b>			
<b>Core XIII</b>		<b>Research Methodology</b>	
<b>Code : 19PCSC34</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 4</b>

**Vision:**

Achieve outstanding scientific research in various areas of knowledge.

**Mission:**

Encourage distinguished research work through the creation of an attractive and stimulating environment to achieve goals.

**Course Outcome :**

<b>CO. No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	integrating knowledge of research processes.	8	An
CO-2	identifying the overall process of designing a research study.	8	Re
CO-3	carrying out ethical issues in research.	8	Ap
CO-4	explaining the concepts of research and its methodologies.	2	Un
CO-5	identifying the key elements of a research report.	8	Re
CO-6	finding the problem for research.	8	An
CO-7	understanding Plagiarism and its types.	8	Un
CO-8	apply the knowledge of teaching methods for its wide applicability.	8	Ap

<b>SEMESTER – III</b>			
<b>Core XIII</b>		<b>Research Methodology</b>	
<b>Code : 19PCSC34</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 4</b>

### **Unit - I**

Research Methodology– Introduction - Meaning of research – Objectives of research – Types of Research – Research Approaches – Significance of Research – Research Methods versus Methodology – Research and Scientific Method – Research Process - Criteria of Good Research.

### **Unit – II**

Research Problem – Selecting the Problem – Necessity of Defining the Problem – Technique involved in defining a problem – Meaning of Research Design – Features of a good design.

### **Unit – III**

Component of Scientific report – Scientific writing style – Report writing and its types – Reporting and Thesis writing – Citations – Citation Styles – Journal impact Factor – Bibliography.

### **Unit – IV**

Ethical issues within the research process – Research Commercialisation – Types of intellectual property – Royalty – Plagiarism – Types of plagiarism - Tools for detecting plagiarism

### **Unit – V**

Methodology of teaching – Objectives for teaching – Structure of teaching – Phases of teaching – Various teaching methods.

### **Text Book:**

1. Statistical Methods - S.P. Gupta

### **Books for Reference:**

1. Research Methodology Methods and Techniques - C.R. Kothari
2. Statistics (Theory and Practice) - B.N. Gupta
3. Research Methodology Methods and Statistical Techniques - Santosh Gupta



SEMESTER – III			
Elective I A		Fuzzy Logic	
Code : 19PCSE31	Hrs / Week : 4	Hrs / Sem : 60	Credits : 3

**Vision:** Building the ability of students to utilizing precise problem solving methodology for the optimization of power systems.

**Mission:**

- Enhancing the students performance in research and analyses on the emerging challenges.
- Create Fuzzy system to match any set of input-output data.

**Course Outcome :**

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand fuzzy concepts and develop a Fuzzy expert system to derive decisions.	2	Un
CO-2	utilize the fuzzy equivalence relations for the classification of remotely sensed data.	3	Ap
CO-3	recognize the feasibility and applicability of the design and implementation of intelligent systems (that employ fuzzy logic) for specific application areas.	3,6	Re
CO-4	understand fuzzy system design methodology and how it impacts system design and performance.	2	Un
CO-5	identifying the significant concepts on Fuzzy relations to enhance the appearance of images.	2	Re
CO-6	designing Neuro Fuzzy system model for data clustering and classification.	6	Cr
CO-7	implementing evidence theory with computational tools for data analysis.	3,6	Ap
CO-8	understand the Fuzzy measures which provide the framework to examine possibility theory.	2	Un

SEMESTER – III			
Elective I A		Fuzzy Logic	
Code : 19PCSE31	Hrs / Week : 4	Hrs / Sem : 60	Credits : 3

### Unit I

Crisp sets and fuzzy sets :Crisp Sets, Fuzzy Sets (basic types), Fuzzy Sets (basic concepts); Representation of fuzzy sets; Decompositions theorems; Extension principle for fuzzy sets. Operations on fuzzy sets (Fuzzy compliment, Intersection and union); Combinations of operations.

### Unit II

Fuzzy relations :Crisp and fuzzy relations; Projections; Binary fuzzy relations; Binary relations on a single set; Fuzzy equivalence relations; Fuzzy compatibility relations; Fuzzy ordering relations; Fuzzymorphism; Sup-i compositions of binary fuzzy relations; Inf-wi compositions of fuzzy relations.

### Unit III

Fuzzy measures :Possibility theory, Fuzzy measure, Evidence theory, possibility theory, Fuzzy sets and possibility theory.

### Unit IV

Fuzzy logic and uncertainty :Fuzzy logic, Classical logic, Multivalued logic, Fuzzy propositions, Fuzzy quantifiers, inference from conditional fuzzy propositions, Uncertainty based Information: Information and Uncertainty, Non specificity of Crisp sets, Non specificity of Fuzzy sets.

### Unit-V

Neuro-fuzzy modeling :Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

### Text Book:

1. George J. Klir and Bo Yuan, “**Fuzzy Sets and Fuzzy Logic**”, Prentice Hall of India, 1995.

### Books for Reference:

1. Fuzzy Logic with Engineering Applications, 3<sup>rd</sup> Ed. John-Wiley, 2004, T.J. Ross
2. L. X. Wang, "A Course in Fuzzy Systems and Control", Prentice-Hall, 1997.
3. Fuzzy Set Teory, 1997, G.Klir et al. Prentice Hall
4. Fuzzy Sets and Fuzzy Logic 1995, G Klir et al. Prentice Hall
5. H.J. Zimmerman, “**Fuzzy Set Theory and Its Applications**”, Kluwer Academic Publishers.
6. George J. Klir and Tina A. Folger, “**Fuzzy Sets, Uncertainty and Information**”, Prentice-Hall of India Private Limited-Fourth printing-June 1995

7. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
8. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
9. Kwang H.Lee, “First course on Fuzzy Theory and Applications”, Springer–Verlag Berlin Heidelberg, 2005.

<b>SEMESTER – III</b>			
<b>Elective I B</b>		<b>Cellular Mobile Computing</b>	
<b>Code : 19PCSE31</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 3</b>

### **Vision**

To make the students completely familiar with the working and maintenance of cellular devices.

### **Mission**

- To gain knowledge in cellular technology with various transmission techniques.
- To understand the communication techniques under mobile computing.

### **Course Outcome:**

<b>CO No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	gain knowledge in cellular technology with various transmission techniques.	1, 7	Un
CO-2	understand the communication techniques under mobile computing.	1, 7	Un
CO-3	model radio signal propagation issues and analyze their impact on communication system performance	7,3	Cr
CO-4	understand how the various signal processing and coding techniques combat channel uncertainties	7, 1	Un
CO-5	understand the techniques of radio spectrum allocation in multi-user systems and their impact on networks capacity	7	Un
CO-6	evaluate the role of mobile applications in software intensive systems.	3	Ev
CO-7	assess and implement security principles in mobile applications.	7	An
CO-8	appraise the quality and performance of mobile applications.	6	An

<b>SEMESTER – III</b>			
<b>Elective I B</b>		<b>Cellular Mobile Computing</b>	
<b>Code : 19PCSE31</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 3</b>

#### **Unit I:**

Introduction to wireless mobile communications: History and evolution of mobile radio systems – types of mobile wireless services – cellular, WLL, paging, Satellite systems- Standards -Future trends in personal wireless systems.

#### **Unit II:**

Cellular concepts and system design fundamentals: Cellular concept and frequency reuse – Multiple access schemes- Channel assignment and handoff- Interference and system capacity- Trunking and Erlang capacity calculations.

#### **Unit III:**

Mobile radio propagation: Radio wave propagation issues in personal wireless systems – Propagation models - Multipath fading and based and impulse response models – Parameters of mobile multipath channels - Antenna systems in mobile radio.

#### **Unit IV:**

Modulation and signal processing: Analog and digital modulation techniques - performance of various modulation techniques – Spectral efficiency – error rate - power amplification – equalization .

Rake receiver concepts - Diversity and space-time processing - speech coding and channel coding.

#### **Unit V:**

System examples and design issues: Multiple Access techniques – FDMA, TDMA and CDMA systems

Operational systems -Wireless networking - Design issues in personal wireless systems.

#### **Text Book:**

1. K. Feher, 2000, “Wireless Digital Communications”, PHI, New Delhi,

#### **Books for Reference:**

1. T.S. Rappaport, “Wireless Communications - Principles and Practice”, 1996, PHI
2. W.C.Y. Lee, “Mobile Communications Engineering – Theory and Applications”, 2nd Edition, 1998, McGraw Hill International.

<b>SEMESTER – III</b>			
<b>Elective II A</b>		<b>Object Oriented Software Engineering</b>	
<b>Code : 19PCSE32</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 3</b>

**Vision:**

To be a professional developer of software products

**Mission:**

- To understand different conventions in software modelling
- To perform software testing and validation

**Course Outcome:**

<b>CO.No</b>	<b>Upon Completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	design and implement a software system to meet desired needs.	3,6	Cr
CO-2	identify requirements of systems and applications.	3	An
CO-3	use modern software systems and tools.	1,6	Ap
CO-4	understand different software life cycle concept.	7	Un
CO-5	study and design SRS documents for software projects.	3,8	An
CO-6	study and model software projects using different modelling techniques.	3,8	An
CO-7	understand different techniques to map models to code.	7	Un
CO-8	discuss about project organisation and communication.	8	Ev

SEMESTER – III			
<b>Elective II      A</b>	<b>Object Oriented Software Engineering</b>		
<b>Code : 19PCSE32</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 3</b>

### Unit I

**Software Life Cycle Models:** System concepts – Project Organisation – Communication – Life cycle models – Unified Process – Iterative and Incremental – Workflow – Agile Processes-Project Planning and Estimation.

### Unit II

**SRS Documentation:** Requirements Elicitation – Requirement Documentation – Use Cases – Unified Modeling language-Introduction.

**UML Diagram:** - Class diagrams – Sequence diagrams – Object diagrams – Deployment diagrams – Use case diagrams –State diagrams, Activity diagram, Component diagrams, Case Study, Identifying Classes – Noun Phrase Approach, Common class Pattern Approach, Use-CaseDriven Approach, CRC.

### Unit III

**Analysis Phase:** Analysis Object Model (Domain Model)- Analysis Dynamic Models-Non-functional requirements – Analysis Patterns.

**Design Phase:** System Design Architecture – Design Principles – Design Concepts – Design Patterns – Architectural Styles – Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language.

### Unit IV

**Mapping:** Mapping Design(Models) to Code – Model Transformation – Refactoring – Mapping Associations – Mapping Activities.

**Testing & Implementation:** Testing – Configuration Management – Maintenance process – System documentation –program evolution dynamics.

### Unit V:

**Project Organization and Communication:** Introduction: A Rocket Example - An Overview of Projects - Project Organization Concepts - Project Communication Concepts - Organizational Activities.

**Methodologies:** Introduction: The First Ascent of K2 - Project Environment - Methodology Issues - A Spectrum of Methodologies - Case Studies.

**Text Book:**

1. Bernd Bruegge, Alan H Dutoit, “Object Oriented Software Engineering” Second edition, Pearson Education, 2004.

**Books for Reference:**

1. Craig Larman, “Applying UML and Patterns” Third edition, Pearson Education, 2005.
2. Object-Oriented Software Engineering Using UML, Patterns, and Java, 3rd Edition By Bernd Bruegge, Allen H. Dutoit Published by Pearson
3. Stephen Schach, “Software Engineering” Seventh edition. McGraw-Hill, 2007.
4. Ivar Jacobson, GrandyBooch, James Rumbaugh, “The Unified Software development Process”, Pearson Education, 1999.
5. Alistair Cockburn, “Agile Software Development” Second edition, Pearson
6. Education, 2007.



<b>SEMESTER – III</b>			
<b>Elective II B</b>		<b>Artificial Intelligence</b>	
<b>Code : 19PCSE32</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 3</b>

### **Vision**

To obtain knowledge in artificial intelligence as machine learning.

### **Mission**

- To obtain skills in perception, reasoning and learning.
- To provide in-depth understanding of major techniques used to simulate intelligence.

### **Course Outcome:**

<b>CO No.</b>	<b>Upon completion of this course, students will be able to</b>	<b>PSO addressed</b>	<b>CL</b>
CO-1	find appropriate idealizations for converting real world problems into ai search problems formulated using the appropriate search algorithm.	1	An
CO-2	understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving.	3,4	Un
CO-3	demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information .	3	Re
CO-4	use a bayesian network to make quantitative (probabilistic) and qualitative inferences	4	Un
CO-5	express programming & simulation for solving problems by applying knowledge representation, reasoning, and machine learning techniques to real-world problems.	2, 6	Ap
CO-6	carry out independent (or in a small group) research and communicate it effectively in a seminar setting .	8	Ap
CO-7	represent difficult real life problems in a state space representation so as to solve them using ai techniques like searching and game playing.	6, 8	Ev
CO-8	develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems	8	Ap

<b>SEMESTER – III</b>			
<b>Elective II      B</b>		<b>Artificial Intelligence</b>	
<b>Code : 19PCSE32</b>	<b>Hrs / Week : 4</b>	<b>Hrs / Sem : 60</b>	<b>Credits : 3</b>

### **Unit I**

Introduction: Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems – searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information.

### **Unit II**

Searching Techniques: Informed search and exploration – Informed search strategies – heuristic function – local search algorithms and optimistic problems – local search in continuous spaces – online search agents and unknown environments - Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision – games that include an element of chance.

### **UNIT III**

Knowledge Representation: First order logic – representation revisited – Syntax and semantics for first order logic – Using first order logic – Knowledge engineering in first order logic - Inference in First order logic – propositional versus first order logic – unification and lifting – forward chaining – backward chaining - Resolution - Knowledge representation - Ontological Engineering - Categories and objects – Actions - Simulation and events - Mental events and mental objects

### **UNIT IV**

Learning: Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming – Statistical learning methods - Learning with complete data - Learning with hidden variable - EM algorithm - Instance based learning - Neural networks - Reinforcement learning – Passive reinforcement learning - Active reinforcement learning - Generalization in reinforcement learning.

### **UNIT V**

Applications: Communication – Communication as action – Formal grammar for a fragment of English – Syntactic analysis – Augmented grammars – Semantic interpretation – Ambiguity and disambiguation – Discourse understanding – Grammar induction - Probabilistic language

processing – Probabilistic language models – Information retrieval – Information Extraction – Machine translation.

**Text Book:**

1. Russell Stuart, Norvig Peter, 2004, “Artificial Intelligence – A Modern Approach”, 2nd Edition, Pearson Education.

**Books for Reference:**

1. Rich Elaine , Knight Kevin, “Artificial Intelligence”, 2003, 2nd Edition, Tata McGraw-Hill,
2. Nilsson J. Nils, “Artificial Intelligence: A new Synthesis” ,2000, Harcourt Asia Pvt. Ltd.,
3. Luger F. George, “Artificial Intelligence-Structures and Strategies for Complex Problem Solving”, 2002, Pearson Education.

<b>SEMESTER III</b>			
<b>Core Practical V</b>	<b>Network Simulation Lab II (WAP)</b>		
<b>Code: 19PCSCR5</b>	<b>Hrs/Week: 4</b>	<b>Hrs/Sem: 30</b>	<b>Credits : 2</b>

1. Client Server Network Topology using Cisco Packet tracer
2. Simulation and analysis of point to point network using Ns-2
3. Simulation and Analysis of Queuing Mechanisms in Star Topology using NS-2
4. Simulation of Ring Topology and Analysis of Static & Dynamic Routing in case of link or node failures
5. Implementation of CRC (Cyclic Redundancy Check) using C-Program to perform Error Detection mechanism
6. Study and Analysis of Network Performance using NETSIM
7. a) Study and Analysis of Hidden Terminal Problem in WLAN using Netsim  
b) Simulation and Performance Analysis of ESS with several transmitting nodes in WLAN using Netsim
8. Simulation of Standard Ethernet (IEEE 802.3) LAN using Bus topology and analyze the performance impact of multiple loads and, transmitting at same time using NS2
9. Implementation of Dijkstra Algorithm using C
10. Simulation and Analysis of TCP Congestion Control Mechanism in Ns2

SEMESTER III	
Self Study Course / MOOC	Professional Ethics
Code: 19PCSSS1	Credits : +2

### Vision

To enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

### Mission

Empower Professionals to Develop Talent in the Workplace

### Course Outcome:

CO.NO	upon completion of this course, students will be able to	PSO addressed	CL
CO-1	the students will understand the importance of values and ethics in their personal lives and professional careers.	7	Un
CO-2	the students will learn the rights and responsibilities as an employee, team member and a global citizen.	7	An
CO-3	ability to engage in informed critical reflection on the nature of professionalism and ethical challenges inherent in professionalism	4	Ap
CO-4	knowledge of prominent normative ethics frameworks	7	Un
CO-5	awareness of types of ethical challenges and dilemmas confronting members of a range of professions (business, media, police, law, medicine, research)	7	Un
CO-6	ability to bring to bear ethical analysis	7	Ap
CO-7	ability to relate ethical concepts and materials to ethical problems in specific professions and professionalism	7	An
CO-8	ability to research appropriate material in relation to set questions in writing essays meeting the highest standards of rigor and clarity	7	Re

SEMESTER III	
Self Study Course / MOOC	Professional Ethics
Code: 19PCSSS1 (Optional)	Credits : +2

#### **Unit – I Introduction to Professional Ethics:**

Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

#### **Unit – II Basic Theories:**

Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

#### **Unit – III Professional Practices in Engineering:**

Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession. Central Responsibilities of Engineers – The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

#### **Unit-IV Work Place**

Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgement within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation. Ethics in changing domains of research – The US government wide definition of research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

#### **Unit V Global issues in Professional Ethics:**

Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business ethics and Corporate Governance, Sustainable development ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual property rights.

#### **Text Book:**

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.

#### **Books for Reference:**

1. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.
2. Engineering Ethics, Concepts Cases: Charles E Haris Jr., Michael S Pritchard, Michael J Rabins, 4e. Cengage learning, 2015.
3. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.