BOARD OF COMPUTER ENGINEERING
SCHEME AND SYLLABUS FOR SEM VII AND VIII OF RC-2016-17

COURSE

FINALYEAR: COMPUTER ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER - VII

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	ThDuration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP7.1	Compiler Construction	3	1	2	3	100	25	--	--	25	**150**
COMP7.2	Data Mining	3	1	2	3	100	25	--	--	--	**125**
COMP7.3	Image Processing	3	1	2	3	100	25	--	--	25	**150**
COMP7.4	Elective I	3	1	2	3	100	25	--	--	--	**125**
COMP7.5	Elective II	3	1	-	3	100	25	--	--	25	**150**
COMP7.6	Project	--	--	4	--	--	--	--	--	25	**25**
TOTAL		**15**	**05**	**12**	**--**	**500**	**125**	**--**	**-**	**100**	**725**

#A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

Electives: A student must take One Elective from each Group.

Elective I		Elective II	
COMP7.4.1	VLSI Design	COMP7.5.1	Entrepreneurship Development
COMP7.4.2	Data Compression	COMP7.5.2	Geographical Information System
COMP7.4.3	Fuzzy Logic and Neural Networks	COMP7.5.3	Design Patterns and Frameworks
COMP7.4.4	Web Technologies	COMP7.5.4	Project Management and Quality Assurance
COMP7.4.5	Cloud Computing	COMP7.5.5	Big Data Analytics

FINAL YEAR: COMPUTER ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION

(RC 2016-17)

SEMESTER - VIII

Subject Code	Nomenclature of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P#	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP8.1	Distributed Operating Systems	3	1	2	3	100	25	--	--	25	**150**
COMP8.2	Network Security	3	1	2	3	100	25	--	--	--	**125**
COMP8.3	Elective III	3	1	2	3	100	25	--		25	**150**
COMP8.4	Elective IV	3	1	2	3	100	25	--	--	25	**150**
COMP8.5	Project	--	--	8	--	--	--	75	--	75	**150**
TOTAL		**12**	**04**	**16**	**--**	**400**	**100**	**75**	**-**	**150**	**725**

#A candidate is considered to have successfully fulfilled the requirement of a semester, provided he/ she submits to the department a certified journal reporting the experiments conducted during the semester.

Electives: A student must take One Elective from each Group.

Elective III		Elective IV	
COMP8.3.1	Operation Research	COMP8.4.1	Genetic Algorithms
COMP8.3.2	Multimedia Systems	COMP8.4.2	Real Time Systems
COMP8.3.3	Bio Informatics	COMP8.4.3	Mobile Computing
COMP8.3.4	Storage Area Networks	COMP8.4.4	Machine Learning
COMP8.3.5	Web Services	COMP8.4.5	Digital Signal Processing

COMP 7.1 COMPILER CONSTRUCTION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.1	Compiler Construction	3	1	2	3	100	25	-	-	25	**150**

Course Objectives:

1. This subject introduces various language translators involved in the process of translating a modern high-level language to executable code. The subject discusses phase/pass structure of Assembler, Macro preprocessor, Linker, Loader, and Compiler in greater detail.

Course Outcomes:

The student after undergoing this course will be able to:

1. Know the major steps involved in translating a high-level programming language down to a low-level target machine language.
2. understand the relationship between machine and assembly language, compilers, interpreters, linkers, loaders, assemblers and macro preprocessors.

UNIT - 1 (12 Hours)

Language processor concepts. Data Structures for language processors.
Introduction to Compiler, Phases of compilation, Bootstrapping and Porting, Compiler writing tools.
The role of a lexical analyser. Design of lexical analyzer. Implementation of lexical analyzer.
A Language for specifying lexical analyzer. Study of the features and applications of LEX/FLEX tool.

UNIT - 2 (14 Hours)

Overview of Context free grammar. Derivations and Parse trees, Ambiguity, Left recursion, Left factoring.
Top down parsing: Recursive descent parsing and Predictive parsers.
Bottom up parsing: Shift-reduce parsers. Operator precedence parsers, LR parsers. YACC parser generator

UNIT - 3 (14 Hours)

Intermediate Code Generation: Intermediate Language, Declarations, Assignment statements, Boolean expressions, Case statement, Procedure call.
Run Time environments: Source language issues, Storage organization, Storage allocation strategies.
Symbol tables: The content of a symbol table, Data structures for Symbol Table, Representing scope information.
Error detection and recovery: Lexical phase errors, Syntactic phase errors, Semantic errors.

UNIT - 4 **(12 Hours)**

Code generation: Issues in the design of a code Generator, Basic blocks and flow graphs, Next-use information, A simple Code generator, The DAG representation of Basic blocks, Peephole Optimization, Generating code from DAGS.

Code optimization: The principle sources of optimization, Optimization of basic blocks, Machine dependent optimization, Register allocation optimization.

Recommended Readings:

1. Aho and Ulman ; Principles of Compiler Design; Narosa publishing House, ISBN: 81-85015-61-9.
2. Aho, Ulman and Sethi; Compilers, Principles, techniques and tools; Pearson Education Asia, ISBN: 81-7808-046-X.
3. Vinu V. Das ; Compiler design with FLEX and YACC; PHI publication, ISBN:978-81-203-3251-5
4. Louden; Compiler Construction, Principles and Practice; Galgotia Publication, ISBN:0-534-93972-4

List of Experiments in Compiler Construction:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. A program to detect tokens from user defined expression.
2. A LEX program to find if the input is integer, real number or word.
3. A LEX program to add line numbers for given text.
4. A LEX program to convert decimal numbers to hexadecimal numbers.
5. A LEX program to compute average of given set of numbers.
6. A YACC program to parse an expression for a given grammar.

7. A program that combines YACC and LEX.

8. A program to obtain First and Follow for a user specified grammar.

9. A program to obtain Leading and Trailing for a user specified grammar.

10. To implement code generation algorithm.

COMP7.2 DATA MINING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP7.2	Data Mining	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

1. This course will focus on imparting a complete introduction to data mining for students.
2. It will provide a sound understanding of the foundations including fundamental concepts and algorithms of data mining which intend to search through data for hidden relationships and patterns.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the basic concept of preprocessing the data before using it in the mining algorithms and different types of data mining tasks.
2. Understand and apply the principles of various classification techniques
3. Understand and apply the principles of various association mining techniques.
4. Study and apply various clustering algorithms and anomaly detection techniques.

UNIT -1 (12 Hours)

Introduction –Challenges, Origin of Data Mining, Data Mining Tasks

Data -- *Types of Data*:Attributes and Measurement , Types of Data Sets
Data Quality:Measurement and Data Collection Issues, Issues Related to Applications
Data Pre-processing : Aggregation, Sampling, Dimensionality Reduction, Feature Subset Selection, Feature Creation, Discretization and Binarization, Variable Transformation.

UNIT - 2 (12 Hours)

Measures of Similarity and Dissimilarity
Similarity and Dissimilarity between Simple Attributes Dissimilarities between Data Objects Similarities between Data Objects Examples of Proximity Measures Issues in Proximity Calculation Selecting the Right Proximity Measures.

Summary Statistics
Frequencies and the Mode, Percentiles,
Measures of Location: Mean and Median

Measures of Spread: Range and Variance
Multivariate Summary Statistics, Other Ways to Summarize the Data

Data Cube and OLAP
Data Cube: A multidimensional data model.*Schemas for Multidimensional data model* : Star, Snowflakes and Fact Constellation schemas. *Dimensions*: The role of Concept Hierarchies. *Measures*: Categorization and Computation. *OLAP Operations*.

UNIT - 3 (12 Hours)

Classification
General Approach to Solving a Classification Problem
Decision Tree Induction: Working, Construction, Methods for Expressing Attribute Test Conditions, Measures for Selecting the Best Split, Algorithm and Characteristics for Decision Tree Induction.
Model Overfitting: Overfitting Due to Presence of Noise, Overfitting Due to Lack of Representative Samples, Overfitting and the Multiple Comparison Procedures, Estimation of Generalization Errors, Handling Overfitting in Decision Tree Induction.

Rule-Based Classifier: Concept, Rule-Ordering Schemes, Building a Rule-Based Classifier
Direct Methods for Rule Extraction, Indirect Methods for Rule Extraction, Characteristics of Rule-Based Classifiers.
Nearest-Neighbor classifiers: Algorithm, Characteristics of Nearest-Neighbor Classifiers.

UNIT - 4 (12 Hours)

Association Analysis
Frequent Itemset Generation, The Apriori Principle, Frequent Itemset Generation in the Apriori Algorithm, Candidate Generation and Pruning, Support Counting, Computational Complexity, *Rule Generation*: Confidence-Based Pruning, Rule Generation in Apriori Algorithm, Maximal Frequent Itemsets, Closed Frequent Itemsets.
Alternative Methods for Generating Frequent Itemsets.

Cluster Analysis
K-means :The Basic K-means Algorithm, K-means: Additional Issues, Bisecting K-means
K-means and Different Types of Clusters, Strengths and Weaknesses.
Agglomerating Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm, Key Issues in Hierarchical Clustering, Strengths and Weaknesses.

Anomaly Detection

Statistical Approaches :Detecting Outliers in a Univariate Normal Distribution, Outliers in a Multivariate Normal Distribution, A Mixture Model Approach for Anomaly Detection
Strengths and Weaknesses.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Implementation of data preprocessing techniques
2. Implementation of measures of similarity and dissimilarity.
3. Study of Data Cube and OLAP Operations.
4. Implementation of K-Nearest Neighbor Classifier.
5. Implementation of Classification by Decision Tree Induction.
6. Implementation of Apriori Algorithm.
7. Implementation of FP Tree.
8. Implementation of K-Means Clustering Algorithm.
9. Implementation of Bisecting K-Means Clustering Algorithm.
10. Implementation of Agglomerative Hierarchical Algorithm.

Recommended Readings:

TEXT BOOK

1. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education, ISBN:81-317-1472-1

REFERENCE BOOK

1. Data Mining - Concepts and Techniques by Jiawei Han and Micheline Kamber, Elsevier, Second Edition, Original ISBN: 978-1-55860-901-3, Indian Reprint ISBN: 978-81-3120535-8

COMP7.3 IMAGE PROCESSING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.3	Image Processing	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To provide an introduction to basic concepts and methodologies in digital image processing.
2. To develop a foundation that can be used as the basis for further study and research in image processing.

Course Outcomes:

The student after undergoing this course will be able to:

1. Have a fundamental understanding of digital image processing techniques, including image smoothing, enhancement, restoration, segmentation and morphology.
2. Be able to implement working code for basic image processing algorithms.
3. Have the skill base necessary to further explore advanced topics of Digital Image Processing.

UNIT -1 (12 Hours)

Basic Concepts of Images: Analog Signals; Digital signals – Sampling and Quantization; Grey-Scale Images – Resolution and Grey Levels; Color Images Models – RGB, YIQ, YUV, HIS, CMYL; Image Storage Formats – BMP, RAW, JPEG, GIF; Video.

Basic Image Processing Tools: Correlation Operation and Convolution Operation; Fourier Transform – Continuous Fourier Transform (One and two dimensional), Discrete Fourier Transform, Properties of Discrete Fourier Transform, Fast Fourier Transform; Discrete Cosine Transform; Gabor Transform; Wavelet Transform – Continuous and Discrete Wavelet Transform.

UNIT - 2 (12 Hours)

Basic Image Processing Tools: Pixel Brightness (Grey level) Transformation – Image Enhancement Based on Histogram, Contrast Stretching; Concepts and Models of Image Processing; Image Smoothing using Spatial Domain Methods –

Neighbourhood Averaging, Threshold Averaging, Gaussian Filtering, Median Filtering, Weighted Median Filtering; Image Smoothing using Frequency Domain Methods – Ideal Low Pass Filtering, Trapezoidal Low Pass Filtering, Butterworth Low Pass Filtering; Image Enhancement – Gradient Image, Gradient Operators, High Pass Filtering; Image Restoration – Image Degradation Model, Image Restoration Based on the Degradation Model, Inverse Filtering, Wiener Filtering, Geometric Rectification; Processing Methods using Partial Differential Equations – Diffusion Based Models, TV Based Models, Discrete Formats of PDE Models

UNIT - 3 **(12 Hours)**

Image Segmentation: Thresholding –Semi Thresholding and Band Thresholding, Histogram Based Thresholding (Mode Method and adaptive (Local) Method), Optimal (Iterative) Thresholding; Edge Based Segmentation – Edge Image Thresholding, Edge Relaxation, Border Tracing, Hough Transform; Region Based Segmentation – Region Growing Method, Region Merging Method, Region Split and Merge Method.

UNIT - 4 **(12 Hours)**

Mathematical Morphology:Some Basic Concepts of Set Theory – Sets and elements, Relationships between two sets, Operations involving sets; Morphology for Binary Image – (Dilation Operation, Erosion Operation; Opening and Closing Operation, Hit or Miss Transformation), Applications of Binary Morphological Operations (Thinning and Thickening, skeleton Methods); Morphology for Grey Scale Morphological Operations – Basic Grey Scale Morphological Operations (Dilation Operation, Erosion Operation), Application of Grey-Scale Morphological Operations.

Recommended Readings:

1. Meiqing Wang, Choi-Honglai;AConcise Introduction to Image Processing Using C++;Chapman & Hall/CRC.
2. William K. Pratt ;Digital Image Processing.
3. Rafael C. Gonzales, Richar E Woods; Digital Image Processing.
4. Madhuri A. Joshi; Digital Image Processing, An algorithmic Approach.
5. SonkaHlavac Boyle; Digital Image Processing and Computer Vision.

List of Experiments in Image Processing:

1. Convert 24bit color Image to Grey Scale.
2. Program to calculate Fourier Transform of an Image
3. Program to calculate Discrete Cosine Transform of an Image.
4. Program to calculate the grey scale Histogram of an image.
5. Program to perform Median Filtering.
6. Program to obtain the Gradiant Image using Sobel-Operator

7. Image Restoration using the second and fourth order partial Differential Equation
8. Program for Optimal Thresholding Segmentation
9. Program for Border-Tracing
10. Program for Binary Erosion
11. Program to generate the Binary Skeleton of an Image.

COMP 7.4.1 VLSI DESIGN

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.4.1	VLSI Design	3	1	2	3	100	25	--	--	--	**125**

Course Objective:

1. To study various aspects of VLSI Design
2. To understand working of MOS Transistor under various bias.
3. To understand various semiconductor Technology processes.
4. To understand VHDL.
5. To understand verification Testing of MOS Circuits.

Course Outcomes:

1. To analyse the characteristics of MOS device under dc Bias.
2. To implement Digital Circuits using VHDL.
3. To verify ATPG Techniques on to digital Circuits.
4. To Design circuits for CMOS Transistor.

UNIT -1 (12 Hours)

Introduction, A Brief History, MOS Transistors, CMOS Logic – Inverter, NAND Gate, Combinational Logic, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, CMOS Fabrication and Layout.
MOS Transistor Theory – Ideal I-V Characteristics, C-V Characteristics – Simple MOS Capacitance Models. Nonideal I-V Effects – Velocity Saturation and Mobility Degradation, Channel Length Modulation, Body Effect, Junction Leakage, Tunneling.
DC Transfer Characteristics- Complementary CMOS Inverter DC Characteristics, Beta Ratio Effects, Noise Margin.

UNIT - 2 (12 Hours)

CMOS Processing Technology: CMOS Technologies – Background, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide, Isolation, Gate Oxide, Gate and Source/Drain Formation, Contacts and Metallization, Passivation, Metrology.
Circuit Characterization and Performance Estimation: Delay Estimation, RC Delay Models – Elmore Delay Model. Power Dissipation – Static Dissipation, Dynamic Dissipation, Interconnect – Resistance, Capacitance, Design Margin – Supply Voltage, Temperature, Process Variation, Design Corners. Reliability – Reliability Terminology, Electromigration, Self-heating, Hot Carriers, Latchup. Scaling – Transistor Scaling Interconnect Scaling Properties

UNIT - 3 (12 Hours)

Combinational Circuit Design: Circuit Families – Static CMOS – Bubble Pushing, Compound Gates, Asymmetric Gates, Skewed Gates. Cascode Voltage Switch Logic, Pass- transistor Circuits – CMOS with Transmission Gates, Complementary Pass Transistor Logic(CPL), More Circuit Families – Differential Circuits (Differential Split-Level and Cascode Nonthreshold Logic), BiCMOS Circuits. Analog Circuits: MOS Small-signal Model, Current Mirrors, Differential Pairs, Simple CMOS Operational Amplifier. CMOS Physical Design Styles: Static CMOS Gate Layout, General CMOS Layout Guidelines. Layout Optimization for Performance.

UNIT - 4 **(12 Hours)**

Design Methodology and Tools: Design Methodology – Structured Design Techniques, Microprocessor/DSP, Programmable Logic – Programmable Logic Devices, Field Programmable Gate Arrays(FPGA). Testing and Verification: Logic Verification, Basic Digital Debugging Hints. Manufacturing Tests – Manufacturing Test Principles – Fault Models, Observability, Controllability. Fault Coverage, ATPG, Delay Fault Testing. Design For Testability – Built-in Self-Test(BIST). Basic Programming using VHDL.

Recommended Readings:

1. *Ayan Banerjee,David Harris,Neil H.E. West;* **CMOS VLSI Design: A Circuits and Systems Perspective, (Third Edition);** *Pearson Education , 2011*
2. Neil H.E. West and Kamran Eshraghian; Principles of CMOS VLSI Design; Prentice Hall of India, 1995
3. Douglas Pucknell and Kamran Eshraghian ; Basic VLSI Design; Prentice Hall of India, 1990

List of Experiments

1. Introduction to VHDL and VLSI Design
2. Use of NAND and NOR Gates for realizing other gates using VHDL.
3. Design of Half adder and Full adder using VHDL
4. 4: 1 MUX Design using VHDL
5. Solving of a SOP Expression using VHDL
6. Asynchronous D-Flip Flop using VHDL
7. Decade Counter using VHDL
8. Serial Shift Register using VHDL

COMP7.4.2 DATA COMPRESSION

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.4.2	Data Compression	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

1. To provide basic introduction to concepts and methodologies and data compression.
2. To develop knowledge about the conceptual and practical aspect of data compression .
3. To develop a foundation that can be used for further research in data compression.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the basic concept and techniques of data compression.
2. Understand the fundamental principles of data compression techniques which includes Huffman's coding, Arithmetic coding, dictionary techniques etc.
3. Be able to implement basic data compression algorithms

UNIT -1 (12 Hours)

Information and Coding: Information and Entropy - Characteristics of entropy; Noiseless and memoryless coding – the kraft inequality, Fundamental theorem of discrete coding.

Shannon-Fano Coding: Shannon coding; Shannon-Fano Coding

Huffman Coding: Huffman coding with low memory requirements; Adaptive Huffman coding.

UNIT - 2 (12 Hours)

Arithmetic coding: Implementation of arithmetic coding – integer implementation.

Dictionary Techniques: The LZ77 technique – LZSS Technique; LZ78 Technique – LZW Technique.

Sampling and Quantization: Sampling; Quantization (scalar quantization) – Uniform quantization; Vector quantization – The K means algorithm.

UNIT - 3 (12 Hours)

Predictive Coding: Delta modulation – Adaptive delta modulation, delayed coding and delta modulation; Differential pulse code modulation – adaptive differential pulse code modulation, adaptive prediction.

Transform Coding: Define a transform; The Karhunen–Loeve Transform;The Hadamard Transform; Discrete Fourier Transform; Discrete Wavelet Transform.

UNIT - 4 (12 Hours)

Subband Coding:Filters; Down sampling and Up sampling

Compression of still images:**JPEG**: The Base line system – Source Image format, DCT based coding; Hierarchical mode of operation; Sequential lossless mode of operation.

Recommended Readings:

1. Adam Drozdek;Elements of Data Compression;Thomson Brooks/Cole;
2. Khalid Sayood; Introduction to Data Compression; Elseivier;Second Edition.
3. Ida MengyiPu, Butterworth-Heinemann; Fundamental Data Compression.

List of Experiments in Data Compression:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Case study on information and entropy.
2. Case study noiseless and memoryless coding
3. Implementation of Shannon coding.
4. Implementation of Shannon – Fano coding.
5. Implementation of Huffman coding.
6. Implementation of LZ77 Technique.
7. Implementation of LZSS Technique.
8. Implementation of LZW Technique.

COMP7.4.3 FUZZY LOGIC AND NEURAL NETWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.4.3	Fuzzy Logic and Neural Networks	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

1. To provide basic introduction to concepts and methodologies of Fuzzy Logic and Neural Networks.
2. To develop knowledge about the conceptual and practical aspect of Neural Networks and Fuzzy Logic.
3. To develop a foundation that can be used for further research in Fuzzy Logic and Neural Networks.

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain the basic concept and techniques of Neural Networks.
2. Differentiate between crisp set and fuzzy set.
3. Describe the learning rules used in Neural Networks.
4. Apply the concepts of Fuzzy Logic and Neural networks in practical applications.

UNIT -1 (12 Hours)

History of Neural Networks. Structure and function of a single neuron. Neural Net Architecture. Neural Learning. Common usage of neural networks in classification, clustering, vector quantization. pattern association, function approximation and forecasting. Evaluation of networks. Implementation of neural networks.

Perceptrons. Linear Separability Perceptron Training Algorithm, Guarantee of Success, Pocket algorithm, Adaline. Multilayer networks, Multilevel discrimination, Architecture, objectives and working of Backpropagation algorithm. Setting the parameter values of Backpropagation algorithm. Accelerating learning process and applications of Backpropagation algorithm.

UNIT - 2 (12 Hours)

Prediction tasks using Recurrent Networks and feedforward networks, Radial basis functions. Polynomial networks. Unsupervised learning. Hamming networks, simple competitive learning. counter-propagation network, adaptive resonance theory, Self

organizing maps. Non-iterative procedures for association, Discrete Hopfield Network, Brain-State_in_a_box Network, Boltzmann Machine, Bi-directional Associate memory.

UNIT - 3 **(12 Hours)**

History and Motivation for Fuzzy Logic. Classical sets, Fuzzy sets, Operations of Fuzzy sets, Properties of Fuzzy sets, A Geometric interpretation of Fuzzy sets, possibility theory. (03 hrs) Fuzzy relations, composition of Fuzzy relations, Fuzzy graphs and numbers, Functions with Fuzzy arguments, arithmetic operations on Fuzzy numbers. Basics of Fuzzy rules, Fuzzy mapping rules, Fuzzy implication rules, Fuzzy rule based models for function approximation, Theoretical foundation of fuzzy mapping rules, Types of fuzzy rule based models: Mamdani model, TSK model, and standard additive model.

UNIT - 4 **(12 Hours)**

Propositional logic and first order predicate calculus. Fuzzy logic: Fuzzy implication, approximate reasoning, Criteria of Fuzzy implications, Three families of Fuzzy implications. Possibility versus Probability, Probability of a Fuzzy event. Probabilistic interpretation of Fuzzy sets. Fuzzy Logic in Expert Systems. intelligent agents and Mobile robot navigation,. Fuzzy logic in database systems, Fuzzy relational data models and operations, Fuzzy object oriented database. Fuzzy information Retrieval and Web search.

Recommended Readings:

1. Kishan Mehrotra, Chilukuri Mohan, and Sanjay Ranka; Elements of Artificial Neural Networks by Penram International Publishing (India)
2. John Yen and Reza Langari,Fuzzy Logic, Intelligence, Control and Information; Pearson Education
3. Neural Networks and Fuzzy Systems: A dynamical Systems Approach toi Machine Intelligence, by Bart Kosko, PHI
4. Neural Networks: A comprehensive Foundation, - By Simon Haykin, Pearson Education
5. Introduction to Artificial Neural Networks, - By Jacek M. Zurada, Jaico PublishingHouse
6. Neural Networks, Fuzzy Logic, and Genetic Algorithms Synthesis and Applications by S. Rajasekaran, G.A. Vijayalakshmi Pai, PHI

List of Experiments in Data Compression:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Implementation of basic logic gates using Neural networks

2. Designing a Neural Network to simulate any Boolean function.
3. Implementation of Perceptron Learning Algorithm
4. Implementation of Back propagation Algorithm
5. Implementation of Hebbian rule
6. Implementation of fuzzy set operations.
7. Implementation of fuzzy inference rules.
8. Implementation of an application using Neuro Fuzzy techniques.

COMP7.4.4 WEB TECHNOLOGY

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP7.4.4	Web Technology	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

The purpose of this course is to provide students with a basic understanding of web programming. It will focus on the client-side as well as server-side implementation of web applications.

Course Outcomes:

1. Understand the basics of the internet and related underlying protocols involved in web development.
2. Discuss the insights of internet programming and implement complete application over the web.
3. Demonstrate the important HTML tags for designing static pages and separate design from content using Cascading Style sheet.
4. To design data using XML,perform validations and display in HTML format.
5. Utilize the concepts of JavaScript and Angular JS in developing dynamic web applications
6. Ability to develop server-side applications using PHP and JSP.

UNIT -1 (12 Hours)

Introduction to Web Technologies

History of the Web, OSI Reference Model, Understanding Web System Architecture, understanding 3-Tier Web Architecture, Layers in the TCP/IP Model, Web, Overview of HTTP,Using Cookies to Remember User Information, Exploring Web Technologies, Introduction to Web Services, About IIS,Services Supported by IIS 7, Installation of IIS 7, Administer Web Server Remotely, Creating Web Sites.

HTML and JAVASCRIPT Programming

HTML, Introducing HTML Document structure, Creating Headings on a web page, Working with Links, creating a paragraph, working with images, working with tables, working with frames, Introduction to Forms and HTML Controls, Introducing JavaScript.

UNIT - 2 (12 Hours)

Cascading Style Sheets

Coding CSS, Properties of Tags, Property Values, Other Style Properties, In-Line Style Properties, Embedded Style Sheets, Grouping, Inheritance, Class as Selector, ID as Selector, Contexual Selectors, Pseudo Classes and Pseudo-elements, Positioning, Backgrounds, Element Dimensions

Extensible Mark-Up Language (XML)

Introduction, HTML vs XML, Syntax of XML Document, XML Attributes, XML Validation, XML DTD, The Building Blocks of XML Documents, DTD Elements, DTD Attributes, DTD Entities, DTD Validations, XSL, XSL Transformation, XSL Namespaces, XML Schema

UNIT - 3 (12 Hours)

Angular JS

Introducing AngularJS

Introducing AngularJS, What Is MVC (Model-View-Controller), AngularJS Benefits, The AngularJS Philosophy, Starting Out with AngularJS , A Basic AngularJS Application ,Angular JS Hello World

Basic AngularJS Directives and Controllers

AngularJS Modules,Creating Our First Controller,Working with and Displaying Arrays,More Directives , Working with ng-repeat, ng-repeat Over an Object ,Helper Variables in ng-repeat , Track by ID , ng-repeat Across Multiple HTML Elements

Forms, Inputs, and Services
Working with ng-model,Working with Forms, Leverage Data-Binding and Models ,Form Validation and States ,Error Handling with Forms ,Displaying Error Messages ,Styling Forms and States ,Nested Forms with ng-form Other Form Controls: Textareas ,Checkboxes ,Radio Buttons ,Combo Boxes/Drop-Downs

Java Server Pages (JSP)
Introduction,Advantages of JSP, Developing first JSP, Components of JSP, Reading Request Information, Retrieving the Data posted, JSP Sessions, Cookies, Disabling Sessions.

UNIT - 4 (12 Hours)

Introducing PHP
Versions of PHP, Features of PHP, Advantages of PHP over other scripting languages, creating a PHP Script, running a PHP Script, Handling Errors in a PHP Script

Working with variables and constants
Using variables, using constants, exploring datatypes in PHP, Exploring operators in PHP.

Controlling Program Flow
Conditional Statements, Looping Statement, Break,Continue and Exit Statement

Working with Functions,Arrays,Files and Directories
User-Defined Functions in PHP, Built-in functions in PHP, Recursive, Variable and call-back Functions, Introducing Arrays, Types of Arrays, Traversing Arrays using Loops and Array Iterators, Built-in Array Functions, Working with Files, Working with Directories

Working with Forms and Databases
Introduction to Web Forms, working with the <form> Tag and Form Elements, processing a Web Form, validating a Form, Using PHP and MySQL

Exploring cookies and sessions
Working with cookies, Working with sessions

Recommended Readings:

1. Web Technology: A Developer's Perspective by N. P. Gopalan and J. Akhilandeswari, PHI ,Second Edition,ISBN:978-81-203-5006-9
2. Web Technologies Black Book by Kogent Learning Solutions, dreamtechpress,ISBN: 9788177228496
3. AngularJS: Up and Running By ShyamSeshadri and Brad Green ,First Edition, Shroff Publishers and Distributors,ISBN: 978-1-491-90194-6

List of Experiments:
(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Selection of a Project which will incorporate HTML5, CSS3, XML, XSLT, DOM , DTD, Javascript, Angular js , PHP, Mysql

2. Implementation of HTML5 and CSS3.
3. Implementation of DTD and XML
4. Implementation of DOM and XSLT.
5. Implementation of Javascript.
6. Implementation of Angular JS/Ajax.
7. Implementation of MySql.
8. Implementation of PHP. (Creation and connection)
9. Implementation of PHP. (Update and Search)
10. Implementation of PHP. (View and Delete) (Along with Final DEMO)

COMP 7.4.5 Cloud Computing

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.4.5	Cloud Computing	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

1. Analyze the components of cloud computing showing how business agility in an organization can be created
2. Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
3. Critically analyze case studies to derive the best practice model to apply whendeveloping and deploying cloud based applications.

Course Outcomes:

The student after undergoing this course will be able to:

1. Compare the advantages and disadvantages of various cloud computing platforms.
2. Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
3. Solve a real-world problem using cloud computing through group collaboration.

UNIT - 1 (12 Hours)

Cloud Computing Fundamental: Cloud Computing definition, private, public and hybrid cloud.

Cloud types;IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud;

Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

UNIT - 2 (10 Hours)

Cloud Applications: Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.

Software as a Service (Saas)-Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA.

Platform as a Service (PaaS)- IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages ofPaas Solutions.

Infrastructure as a Service (Iaas)-Understanding IaaS, Improving Performancethrough Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices,

UNIT - 3 **(13 Hours)**

Cloud Services Management: Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment.

Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services.

Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

UNIT - 4 **(12 Hours)**

Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Best Practice Cloud IT Model : Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO)

Recommended Readings:

1. GautamShroff, Enterprise Cloud Computing Technology Architecture Applications
   [ISBN: 978-0521137355]
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach [ISBN: 0071626948]
3. Cloud Computing: Implementation, Management and Security, John W. Rittinouse, James F Ransome. CRC Press, rp2012.
4. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. George Reese, O'RedI SPD, rp2Oll.
5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKtriaraswamy, ShahedLatif, O'Redç SPD, rp2Oll.

List of Experiments in Cloud Computing:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1.Software study for cloud computing Software.
2. Service Development & Usage over Cloud.
3. Managing Cloud Computing Resources
4.Using existing cloud characteristics & Service models
5.Performance evaluation of service over cloud.
6. Installation and Configuration of Cloud.
7. Create an application using Cloud.
8. Case Study

COMP 7.5.1 Entrepreneurship Development

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.5.1	Entrepreneurship Development	3	1	--	3	100	25	--	--	25	**150**

Course Objectives:

1. Study of this subject provides an understanding of the scope of an entrepreneur.
2. Analyze the key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.
3. Critically analyze case studies to derive the best practice model to apply when developing and deploying real life applications.

Course Outcomes:

The student after undergoing this course will be able to:

1. Identify the concept of entrepreneurship and its functions.
2. Learn the competencies of an Entrepreneur.
3. Able to differentiate Entrepreneur, Business man and employee.

UNIT - 1 (12 Hours)

ENTREPRENEUR AND ENTREPRENEURSHIP

Entrepreneur, Concept , definition, features , significance of Entrepreneurship,function,process, quality of Entrepreneur , mindset of employees vs entrepreneur, Entrepreneurship – Characteristicsentrepreneur vs Entrepreneurship,Intrapreneur –Myths ofEntrepreneurship, Role of entrepreneurship in Economicdevelopment, challenges of Entrepreneurship, Social responsibility ofEntrepreneurship

UNIT - 2 (14 Hours)

ENTREPRENEURIAL COMPETENCIES

Introduction – competencies of entrepreneurs-(1) Decision Making (2)Problem Solving (3) Risk Taking (4) Leadership(5) Communication(5)Dealing with customers, Entrepreneurial Values and attitudemotivation-Need Hierarchy Theory of Motivation - David MC llandNeed Theory of Motivation- Life Skills - Managing Self and Others,Positive Attitude Creativity, Team Building and motivation.

UNIT - 3 (13 Hours)

ENTREPRENEURSHIP JOURNEY

Self Assessment of Qualities, Skills, Resources and DreamsIdentify your personality type before starting a business venture –Trailblazers, Go-getters,Managers, Motivators, Authoritarians, Collaborators, Diplomats -Business Ideas- Generating Ideas- Ways to Generate Ideas- EnvironmentScanning- Creativity and Creative Problem Solving –Brainstorming Focus Groups- Feasibility Study- Types of feasibility study- MarketFeasibility- Technical Feasibility- Financial Feasibility- OrganizationalFeasibility- Features of Feasibility Study- Role of society and family inthe growth of an entrepreneur- Rural Entrepreneurship- Agripreneurship– Social Entrepreneurship – Women Entrepreneurship StudentEntrepreneurship.

UNIT - 4 (12 Hours)

ENTREPRENEUR THE INNOVATOR

Innovations leading entrepreneurial ventures - the role of technologyfor Entrepreneurship development- social media in creating new formsof business organizations - networks and co-operative clusters -Concept of Risk Taking- Types of Risk Taking: EntrepreneurshipDevelopment Club - Entrepreneur Support Scheme(ESS). – Businessincubation.

RECOMMENDED READINGS

1. Forbat, John, "Entrepreneurship" New Age International.
2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India.

4.Tendon ,C: Environment and Entrepreneur; Cliugh Publications, Allahabad.

5. SinerA David: EntrepreneuralMegabuks; John Wiley and Sons, New York.

6.Srivastava S. B: A Practical Guide to Industrial Entrepreneurs; Sultan Chand and Sons,New Delhi.

COMP 7.5.2 GEOGRAPHICAL INFORMATION SYSTEM

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
						Marks					
		L	T	P	ThDuration (Hrs)	Th	S	TW	P	O	Total
COMP 7.5.2	Geographical Information System	3	1	--	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand the basic concepts of Geographical Information Systems.
2. To Learn the procedures employed in Geographical Information Systems.
3. To study the applications of the Geographical Information Systems.

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain the GIS data processing.
2. Describe the concepts of data Modeling.
3. Explain the GIS Design issues w.r.t. an application.
4. Design a GIS system for the given environment.

UNIT – 1 (12 Hours)

Introduction to GIS: Definition, Evolution, Component of GIS. Functions and Characteristics of GIS applications. Contributing and Allied Disciplines. Map scale, Classes of map, Mapping process, Coordinate systems – plane and geographic, Map projection, Spatial framework for mapping locations – georeferencing, Topographic mapping, Attribute data for Thematic mapping. Digital Representation of Geographic data: Object representation and data analysis Relationship between Data representation and Data analysis.

UNIT - 2 (12 Hours)

Data Quality and Standards: Concepts and definition of data quality, Component of geographic data, Data quality assessment, Spatial data error management, Geographic data standards, Geographic data standards and GIS development. Raster based GIS data processing: Acquiring and Handling raster geographic data, Raster based GIS data analysis, output functions of raster data processing, Cartographic modeling. Vector based GIS data processing: Characteristics of vector based GIS data processing, Vector data input functions, Non topological GIS analysis , functions, Feature based topological functions, Layer based topological functions, Vector based output functions, Application programming.

UNIT - 3 (12 Hours)

Visualization of Geographic Information and Generation of Information Products: Cartography in GIS context, Human computer interaction and GIS, Visualization of geographic information, Principles of Cartographic design in GIS, Generation of information product. Data Modeling: Digital Terrain Modeling, Approaches to digital terrain data modeling, Acquisition of digital terrain data, Data processing, Analysis and visualization, Applications of digital terrain models.

Spatial modeling: Descriptive statistics, Spatial autocorrelation, Quadrant counts and Nearest-Neighbor analysis, Trend surface analysis, Gravity models, Network analysis, GIS modeling..

UNIT - 4 (12 Hours)

GIS Modeling: Binary Models, Index Models, Regression Models, Process Models.

GIS Project Design And management: Software engineering as applied to GIS, GIS project planning, System analysis and study of user requirement, Geographic database design methodology, GIS application software design methodology, System implementation and technology rollout, system maintenance and support.
GIS issues And Future of GIS: Issues of implementation, Trend of GIS development, GIS applications and GIS users.

Recommended Readings:

1. C.P. La, Albert K.W. Yeung; Concepts and Techniques of Geographic Information Systems; PHI, ISBN:81-203-2230-4
2. Kang-Tsung Chang; Introduction to Geographic Information Systems; TMH, ISBN:0-07-049552-1
3. Lan Heywood, Sarah Cornelius, Steve Carver; An Introduction to Geographical Information System;, Pearson Education, ISBN:81-7808-541-0

COMP 7.5.3 DESIGN PATTERNS AND FRAMEWORKS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.5.3	Design Patterns and Frameworks	3	1	--	3	100	25	--	--	25	**150**

Course Objectives:

1. To provide an introduction to basic concepts and methodologies in design patterns and frameworks.
2. To develop a foundation that can be used as the basis for further study and research in patterns and frameworks.

Course Outcomes:

The student after undergoing this course will be able to:

1. Have a fundamental understanding of design patterns and frameworks techniques, including Interface Patterns, Responsibility Patterns, Construction Patterns, and Operations Patterns.
2. Implement working code for basic design patterns.
3. Have the skill base necessary to further explore advanced topics of Design patterns and frameworks

UNIT -1 (12 Hours)

Interface Patterns: Introducing Interfaces – Summary, Beyond Ordinary Interfaces; Adapter – Adapting to an Interface, Class and Object Adapters, Adapting Data in .NET, Summary; Façade – An Ordinary Façade, Refactoring to FAÇADE, Facades, Utilities, Demos, Summary; Composite – An Ordinary Composite, Recursive Behavior in Composites, Composites, Tress and Cycles, Composites with Cycles, Consequences of Cycles, Summary; Bridge – An Ordinary Abstraction, From Abstraction to Bridge, Drivers as Bridges, Database Drivers, Summary.

UNIT - 2 (12 Hours)

Responsibility Patterns: Beyond Ordinary Responsibility; Singleton – Singleton Mechanics, Singleton and Threads, Recognizing SINGLETON, Summary; Observer – C# Support for Observer, Delegate Mechanics, A Classic Example(OBSERVER in GULs), Model/View/Controller, Layering, Summary; Mediator – A Classic Example (GUI Mediators), Relational Integrity Mediators, Summary; Proxy – A Simple Proxy, A Data Proxy, Remote Proxies, Summary; Chain of Responsibilities – An Ordinary CHAIN OF RESPONSIBILITY, Refactoring to CHAIN OF RESPONSIBILITY, Anchoring a Chain.

Flow through Pipes: Loss of head in pipes, major, minor losses,Darcy's weisbach equation, Hydraulic gradient andtotal energy line, Flow through siphon , Equivalent pipe -series &parallel pipes, Flow through nozzle, Water hammer in pipes.

UNIT - 3 (12 Hours)

Construction Patterns: Introducing Construction – A few construction challenges, summary, Beyound Ordinary Construction; Builder – An Ordinary Builder, Building under Constraints, A Forgiving Builder, Summary; Factory Method – A classic Example (Enumerators), Recognizing FACTORY METHOD, Taking Control of which class to Instantiate, FACTORY METHOD in parallel hierarchies, Summary; Abstract Factory – A Classic Example(GUI Kits), Abstract Factory and Factory Method, Namespaces and Abstract Factories, Summary; Prototype –Prototypes as Factories, Memento Durability, Persisting Mementos across sessions, Summary;

UNIT - 4 (12 Hours)

Operations Patterns: Introducing Operations – Operations and Methods, Signatures, Delegates, Exceptions, Algorithms and Polymorphism, Summary, Beyond Ordinary Operations; Template Method – A Classic Example (Sorting), Completing an Algorithm, TEMPLATE METHOD Hooks, Refactoring to TEMPLATE METHOD, Summary; State – Modeling States, Refactoring to STATE, Making States Constant, Summary; Strategy – Modeling Strategies, Refactoring to STRATEGY, A Classic example (Menu Commands), Using COMMAND to supply a service, COMMAND Hooks, COMMAND in relation to other patterns, Summary; Interpreter – An INTERPRETER Example, Interpreters, Languages and Parsers, Summary;

Recommended Readings:

1. Steven John Metsker; Design Patterns in C#; Addison-Wesley Professional.
2. Eric Gamma, Richard Helm, Ralph Johnson, John Vlissides; Design Patterns, Elements of Reusable Object Oriented Software; Pearson Education.

COMP 7.5.4 PROJECT MANAGEMENT & QUALITY ASSURANCE

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.5.4	Project Management and Quality Assurance	3	1	--	3	100	25	-	-	25	**150**

Course Objectives:

1. To help students to identify key areas of concern over Project Life Cycle (PLC) and use of project management principles across all the phases of PLC.

2. To make students understand the importance and necessity of project plan and how it is helpful to the project manager in monitoring and controlling the various aspects of the project such as schedule, budget, etc.

3. To make students understand the importance of team and how to work as a team member, share best project management practices.

Course Outcomes:

The student after undergoing this course will be able to:

1. Describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project.
2. Compare and differentiate organization structures and project structures.
3. Implement a project to manage project schedule, expenses and resources with the application of suitable protect management tools.

UNIT - 1 (10 Hours)

Introduction and Software Project Planning

Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM

Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.

UNIT - 2 (12Hours)

Project Organization, Scheduling, Monitoring and Control

Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques,Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.

Dimensions of Project Monitoring & Control.

Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV),

Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned

Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.

UNIT - 3 (10 Hours)

Software Quality Assurance and Testing

Testing Objectives, Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of

Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing

Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes,

Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA

Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance,

Cleanroom process.

UNIT - 4 (10Hours)

Project Management and Project Management Tools

Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk

Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management

Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit

Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools,

MS-Project.

Recommended Readings:

1. M. Cotterell; Software Project Management; Tata McGraw-Hill Publication.
2. Royce; Software Project Management; Pearson Education
3. Kieron Conway; Software Project Managemen; Dreamtech Press

4. S. A. Kelkar; Software Project Management; PHI Publication.

COMP 7.5.5 BIG DATA ANALYTICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 7.5.5	Big Data Analytics	3	1	--	3	100	25	-	-	25	**150**

Course Objectives:

1. To help students to identify key areas of concern over Big Data.
2. To make students understand the importance and necessity of data analysis tools.

Course Outcomes:

The student after undergoing this course will be able to:

1. Describe and determine the purpose and importance of Data Analytics tools.

UNIT - 1 (10 Hours)

Introduction to BigData Platform – Traits of Big data -Challenges of Conventional Systems -Web Data – Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs. Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions ReSampling- Statistical Inference - Prediction Error.
Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction.

UNIT - 2 (10 Hours)

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing -Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream –**Estimating Moments** – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT - 3 (10 Hours)

Mining Frequent Itemsets - Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Itemsets in a

Stream –Clustering Techniques – Hierarchical – K-Means – Clustering High Dimensional Data –CLIQUE And PROCLUS – Frequent Pattern based Clustering Methods – Clustering in NonEuclidean Space – Clustering for Streams and Parallelism.

UNIT - 4 **(10 Hours)**

NoSQL Databases:MongoDB,CouchDB
MapReduce – Hadoop, Hive, Pig, MapR
Storage: S3, Hadoop Distributed File System
Servers: EC2, Google App Engine, Elastic Bean Stalk, Heroku
Processing: R, Yahoo! Pipes, Mechanical Turk
Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association Intelligence from unstructured information-Text analytics-Understanding of emerging trends and technologies-Industry challenges and application of Analytics

TEXT BOOKS:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge
University Press, 2012.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
4. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007
5. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
6. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition,
Elsevier, Reprinted 2008.

COMP 8.1 1DISTRIBUTED OPERATING SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.1	Distributed Operating Systems	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To introduce the basic concepts upon which distributed systems at large and distributed operating systems in particular rely.

2. To understand the design issues, design problems, solutions and performance issues.
3. To present the principles underlying the functioning of distributed systems
4. To provide experience in the implementation of typical algorithms used in distributed systems

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain what a distributed system is, why you would design a system as a distributed system, and what the desired properties of such systems are.
2. List the principles underlying the functioning of distributed systems, describe the problems and challenges associated with these principles, and evaluate the effectiveness and shortcomings of their solutions.
3. Recognize how the principles are applied in contemporary distributed systems, explain how they affect the software design, and be able to identify features and design decisions that may cause problems.

UNIT -1 (11 Hours)

Introduction to distributed operating systems: What is a distributed system? Goals, Hardware Concepts ,Software Concepts, Design Issues

Communication in distributed systems: Layered Protocols, Asynchronous Transfer Mode Networks, The Client-Server Model, Remote Procedure Call, Group Communication

UNIT - 2 (13 Hours)

Synchronization in Distributed Systems: Clock Synconization, Mutual Exclusion, Election Algorithms, Atomic Transactions, Deadlocks in Distributed Systems

Processes and Processors in Distributed Systems: Threads, System Models

UNIT - 3 (12 Hours)

Processes and Processors in Distributed Systems: Processor Allocation, Scheduling in Distributed Systems, Fault Tolerance

Distributed File Systems: Distributed File System Design, Distributed File System Implementation

UNIT - 4 (12 Hours)

Case Study of Distributed Systems

Case study 1: AMOEBA : Introductionto Amoeba, Objects and capabilities, Process management, Memory management, Communication, The Amoeba Servers

Case study 2: Distributed Computing Environment: Introduction, Threads, RPC, Time Service, Directory Service, Security Service

Recommended Readings:

1. A.S. Tanenbaum; Distributed Operating Systems; Pearson Education; ISBN: 978-81-7758-179-9
2. G. Coulouris, J. Dollimore and T. King Berg;Distributed Systems: Concepts and Design by; Addison Wesley; ISBN:81-7808-462-7
3. M. Singhal and N. G. Shivaratri;Advanced Concepts in Operating Systems; TMH; ISBN:0-07-047268-8
4. A. S. Tanenbaum, Maarten Van Steen; Distributed Systems: Principles and Paradigms; PHI; ISBN: 978-81-203-3498-4
5. William Buchanan; Distributed Systems and Networks; TMH, ISBN: 0-07-058753-1

List of Experiments in Distributed Operating Systems:

1. Socket programming in TCP
2. Socket programming in UDP
3. Remote Method Invocation
4. Clock Synchronization
5. Threads
6. Component Object Model
7. CORBA
8. Distributed Deadlocks
9. Distributed Databases

COMP 8.2 Network Security

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.2	Network Security	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

1. Understand Network Devices functions and configurations hub, switch, tap and routers)

2. Understand Network Security Devices (IDS, Firewall..etc)
3. Understand and analyze network services.
4. Understand and analyze network traffic and protocol
5. Understand network security concepts
6. Understand network intrusions and how to identify them such as
    a. Computer Viruses
    b. Network worms
    c. Botnets

Course Outcomes:

The student after undergoing this course will be able to:

1. Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.
2. Analyze performance of enterprise network systems
3. Develop solutions for networking and security problems

UNIT – 1 (12 Hours)

Systems Vulnerability Scanning

Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning –Netcat, Socat, understanding Port and Services tools –Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet

UNIT –2 (14Hours)

Network Defense tools

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless VsStateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System

Web Application Tools

Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities – Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA,

Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra

UNIT – 3 (13 Hours)

Introduction to Cyber Crime and law Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.

UNIT - 4 (13 Hours)

Introduction to Cyber Crime Investigation Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks

Recommended Readings:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication McGraw Hill.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelpure, Publication Wiley

List of Experiments in Cyber Security

(At least 8 experiments should be conducted.. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. TCP scanning using NMAP
2. Port scanning using NMAP
3. TCP / UDP connectivity using Netcat
4. Network vulnerability using OpenVAS
5. Web application testing using DVWA
6. Manual SQL injection using DVWA
7. XSS using DVWA
8. Automated SQL injection with SqlMap

COMP 8.3.1 OPERATION RESEARCH

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.3.1	Operation Research	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand the computer oriented approach in problem solving with the important methods of Operations Researchin solving realistic problems.
2. Learn the types of problems that can be solved by a particular method and to model the problem for solution.
3. To study the models involving optimum decision making.

Course Outcomes:

The student after undergoing this course will be able to:

1. Apply the following techniques in solving reallife problems: Linear Programming, Integer Programming, Dynamic Programming, Branch and Bound Techniques, Sequencing problems, Queuing theory, Network Models.
2. For a given problem will be able to formulate, construct a model, develop a method to solve the model and implement the solution for the problem.

UNIT - 1 (12 Hours)

Introduction: The Beginning and Progress of Operations Research, Classification of problems in Operations Research, Mathematical Modelling in Operations Research.

Linear Programming: Introduction, Formulation of Linear Programming models, Graphic Solution of Linear Programming models, Maximization and Minimization of functions with constraints, Simplex method, Transportation problem, Assignment problem.

UNIT - 2 (14 Hours)

Integer Programming: Introduction, Dual Simplex Method, Implicit Enumeration, Cutting plane technique.

Branch and Bound Technique: Introduction, Branch and Bound Algorithm for Assignment problem, Branch and Bound Algorithm for Travelling Salesman problem , Branch and Bound Algorithm for Integer Programming.

UNIT - 3 (13 Hours)

Dynamic Programming: Introduction,Investment problem, Stage-coach problem, Production Scheduling, Equipment Replacement.

Sequencing problems:Introduction ,Two-Machine sequencing problem, N-job,Three-Machine Sequencing Problem.

UNIT - 4 (13 Hours)

CPM and PERT: Network Representation, Critical Path(CPM) Computations, Time estimates for activities, Critical Path, Probability of completing events on Schedule.
Queuing Theory: Introduction, Notations and Assumptions, Queuing Models with Poisson Input – Exponential service, Queuing Models with Poisson Input –Arbitrary service time.

Recommended Readings:

1. Billey E. Gillett; Introduction to Operations Research: A Computer Oriented Algorithm Approach ; Tata McGraw Hill.
2. H.A. Taha;Operations Research An Introduction;8th Edition ; Pearson Education; 2009
3. Fredericks ,Hiller and Liberman ;Operations Research ; Tata McGraw Hill.
4. J. K. Sharma ;Operations Research – Theory and Applications ; MacMillan India Ltd.
5. P.K.Gupta, D.S Hira; Operations Research; S.Chand 2007.

List of Experiments in Operation Research:
(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Modeling with Linear Programming
2. Simplex Algorithm
3. Artificial Starting Solution
4. Dual Simplex Algorithm
5. Transportation Algorithm
6. Assignment Algorithm
7. Investment Problem using Dynamic Programming
8. Stage Coach Problem
9. N Job, 2-machine Sequencing Problem

COMP 8.3.2 MULTIMEDIA SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	P	O	Total
COMP 8.3.2	Multimedia Systems	3	1	2	3 hrs	100	25	-	-	25	**150**

Course Objectives:

1. The aim of this course is to help students develop an understanding of the fundamental principles of multimedia systems and how they are being

developed and applied and also to gain an intuitive understanding of multimedia concepts.

2. In this course, students will be introduced to principles and current technologies of multimedia systems.

Course Outcomes:

The student after undergoing this course will be able to:

1. acquire fundamentals principles of multimedia, including digitization and data compression for non-textual information
2. understand issues in representing, processing, and transmitting multimedia data
3. understand core multimedia technologies and standards

UNIT - 1 (10 Hours)

Introduction: Branch Overlapping Aspects of Multimedia**,** Global Structure
Media and Data Steams: Medium**,** Main properties of a Multimedia System**,** Traditional Data Stream Characteristics, Multimedia Data Stream Characteristics for Continuous Media
Sound/Audio: Basic Sound Concepts Music Speech**,** Music**,** Speech
Image and Graphics: Basic Concepts**,** Computer Image Processing
Video and Animation: Basic concepts**,** Television, Computer-based Animation

UNIT - 2 (10 Hours)

Data Compression: Some Basic Compression Techniques, JPEG **,** H.261**,** MPEG, DVI

Computer Technology: Communication Architecture, Multimedia Workstation Multimedia
Multimedia Operating Systems: Introduction**,** Real time systems **,** File Systems

UNIT - 3 (10 Hours)

Networking Systems : Layers, Protocols and Services**,** Networks**,** LAN**,** MAN**,**WAN
Multimedia Communication Systems : Application Subsystem, Transport Subsystem, Quality of Service and Resource Management
Database Systems: Multimedia Database Management Systems **,** Characteristics of an MDBMS**,** Data Analysis, Data Structure**,** Operations on Data**,** Integration in a Database Model

UNIT - 4 (10 Hours)

User Interfaces: General Design Issues**,** Video at the User Interface **,** Audio at the User Interface **,** User-friendliness as the Primary Goal
Synchronization: Introduction, Notion of synchronization**,** Presentation Requirements, A Reference Model for Multimedia Synchronization**,** Synchronization Specification

Multimedia Applications: Introduction**,** Media Preparation**,** Media Composition, Media Integration, Media Communication, Media Consumption, Media Entertainment

Recommended Readings:

1. Ralf Steinmetz and Klara Nahrstedt; Multimedia: Computing, Communications and Applications; Pearson Education,
2. John F. Koegel Buford ; Multimedia Systems; Pearson Education, ISBN: 81-7808-162- 8
3. Tay Vaughan ; Multimedia: Making it Work; TMH, ISBN: 0-07-047276-93.

List of Experiments in Multimedia Systems:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. To Study different Multimedia Formats and Editors
2. To Create An Animation Using JAVA
3. To study different animations Software's
4. To create an Animation using Flash Software
5. To implement Run Length Technique
6. To implement Shortest Seek Time First Algorithm
7. To implement Earliest Deadline First Algorithm
8. To implement Group Sweeping Scheduling Algorithm
9. To Design E-Newspaper Website using Dreamweaver
10. To Study various operations on MDBMS

COMP 8.3.3 BIO INFORMATICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.3.3	Bio Informatics	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. Aims at providing an introduction to bioinformatics to interpret the rapidly expanding amount of biological information.
2. Discusses the basic concepts of bioinformatics and focuses on how to identify, obtain, establish, maintain and exchange research information in biology.
3. Examine the structure and function genes and proteins through the use of computational analysis, statistics and pattern recognition.
4. To discuss pattern representation, characterization and discovery in proteins.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understandmolecular bioinformatics concepts.
2. Study of Genome analysis and gene mapping.
3. Use of current bioinformatics tools and databases.
4. Study of Dynamic programming for sequence alignment.
5. Concepts of sequence analysis.
6. Analysis, visualization and representation of Molecular Structure.
7. Learn the key methods and tools used in bioinformatics.
8. Applications of bioinformatics in genomics

UNIT -1 (12 Hours)

Bioinformatics – an Introduction: Introduction, Historical Overview and Definition, Bioinformatics, Applications, Major databases in Bioinformatics, Data Management and Analysis, Molecular Biology and Bioinformatics, Central Dogma of Molecular Biology.

Information Search and Data Retrieval: Introduction, Tools for web search, Data Retreival Tools, Data Mining of biological databases.

Genome Analysis and Gene Mapping:Introduction, Genome analysis, Gene Mapping, The Sequence Assembly Problem, Genetic Mapping and Linkage analysis, Physical Maps, Cloning Entire Genome, Genome Sequencing, Applications of Genetic

Maps, Sequence Assembly Tools, Identification of Tools in Contigs, Human Genome Project.

UNIT - 2 (12 Hours)

Sequence Alignment: Introduction, Dot matrices and Hash coding, Dynamic programming in sequence algorithm.

Tools for Similarity Search and Sequence Alignment: Working with FASTA, Working with BLAST, Filtering and Gapped BLAST, FASTA and BLAST algorithm comparison.

Multiple Alignment, Substitution Matrices and Phylogenetic Trees: Multiple sequence alignment, Substitution Matrices, Phylogenetic Trees.

UNIT - 3 (12 Hours)

Protein and DNA Sequence Analysis:Pattern Representation and Characterization, Pattern Discovery and Sequence Classification in Proteins and Nucleic Acids.

Protein Structure Prediction and Protein Folding:Protein Secondary Structure Prediction, Protein tertiary Structure prediction.

Nucleic Acid Structure: RNA structure prediction, DNA Structural Polymorphism.

UNIT - 4 (12 Hours)

Gene Expression and Microarrays:Introduction, Working with DNA microarrays, Clustering Gene Expression Profiles, Data sources and tools for microarrays analysis, Applications – Functional Genomes, Comparative Geneomes, Medical Applications, Microarrays in Pharmaceutical industries, DNA Microarrays.

Protein Classification and Structure Visualisation: Introduction, Overview of protein structure, Protein Structure Visualization, Structure based protein classification, Protein Structure databases, Protein Structure Visualisation Database and Tools, Protein Structure Alignment, Domain Architecture Databases.

Introduction to Drug Discovery: Areas influencing drug discovery, Pharmacogenetics and Pharmacogenimics applications, Analysis of Single Nucleotide Polymorphism, Important parameters in Drug Discovery.

Recommended Readings:

1. S.C. Rastogi, N. Mendiratta, P. Rastogi; Bioinformatics – Methods and Applications; 4th Edition.
2. N. Gautham; Bioinformatics – Databases and Algorithms; Narosa Publication;
3. Jean-Michel Claveriw, CedrocNotredame; Bioinformatics – A Beginner's Guide;
4. Arthur M. Lesk; Introduction to Bioinformatics; OXFORD Publishers (Indian Edition);

5. T.K. Attwood, D J Parry; Introduction to Bioinformatics; Amith Addison Wesley Longman;

List of Experiments in Real Time Systems:

1. Study of biological databases.
2. Analysis of data retrieval and submission tools.
3. Implementation of dynamic programming methods for sequence alignment.
4. Study of BLAST and FASTA.
5. Understanding phylogenetic trees.
6. Clustering techniques for genes.
7. Protein structure visualization tools.
8. SAGE methodology for gene expression patterns.
9. Study of substitution matrices.
10. Analysis of protein structures.

COMP 8.3.4 Storage Area Networks

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.3.4	Storage Area Networks	3	1	2	3	100	25	--	--	25	**150**

Prerequisites: Information Retrieval System, Computer Networks & Cloud Computing

Course Educational Objectives:

The main objective of the course is to expose the students tostorage area network (SAN) infrastructure which facilitates storage consolidation, data sharing, server clustering,. This course focuses on the planning and implementation considerations associated with establishing that SAN infrastructure. Students will also learn the basic concepts and terminology associated with Storage Area Networks (SAN), Network Attached Storage (NAS) &Small Computer System Interface (SCSI)

Course Outcomes:

Upon completion of this course, the student should be able to:

1. Describe the characteristics and components of Storage Area Networks
2. Describe the challenges with Server Centric IT architecture and the advantages of Storage Centric IT architecture.
3. Describe the logical and physical components of storage infrastructure.
4. Describe processes involved in File sharing operations on NAS and SAN
5. Students will demonstrate effective oral and writing communication skills necessary to be effective and to compete at global business environment.
6. Describe the business continuity and disaster recovery in a storage infrastructure.

UNIT 1 (14 hours)

Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access.
Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.
I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage.

UNIT 2 (12 hours)

Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system.

File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.

UNIT 3 (14 hours)

Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.

SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective.

UNIT 4 (12 hours)

Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.

Management: Planning Business Continuity; Managing availability; Managing Serviceability; Capacity planning; Security considerations.

Appropriate required number of case studies/experiments be performed covering the entire syllabus.

Recommended Readings:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2007.
2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
3. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2003.
4. Richard Barker and Paul Massiglia: "Storage Area Network Essentials a CompleteGuide to understanding and Implementing SANs", Wiley India, 2006.

COMP 8.3.5 WEB SERVICES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.3.5	Web Services	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To learn and understand the various concepts of Web Services.
2. To learn basics of XML which is the basic prerequisite to understand how the different documents of the respective protocols are designed.

3. To learn the different protocols used in web services and their role and importance in designing a web service.

Course Outcomes:

The student after undergoing this course will be able to learn:

1. How information is exchanged between applications within a distributed environment. (SOAP).
2. How the web services are described to the world over internet (WSDL).
3. How the web service is published and made known to the world over the internet. (UDDI).
4. How to explain the conversation pattern that a web service is expecting to engage in. (WSCL)
5. How workflow systems automate business processes. (Workflow).
6. Advantages and Disadvantages of Web Services.
7. Transactions and the transaction protocols used in web service.
8. Security issues in Web Services.

UNIT - 1 (14 Hours)

Web Service and SOA fundamentals: Introduction, Concept of Software as a Service(SaaS), Web services versus Web based applications, Characteristics of Web services, Service interface and implementation, The Service Oriented Architecture(SOA), Quality of service (QoS), Web service interoperability, Web services versus components, RESTful services , Impact and shortcomings of Web services.

Web Services Architecture: Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services, developing web services enabled applications.

UNIT - 2 (12 Hours)

Extensible Markup Language (XML): XML Fundamentals. XML, XML Documents, XML Namespaces. XML Schema, Processing XML.
XML Parsing: SAX, COM, JAXB. Xpath, XQuery.

UNIT - 3 (14 Hours)

SOAP: Simple Object Access Protocol, Inter-application communication and wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAP

communication model, Building SOAP Web Services, developing SOAP Web Services using Java, Error handling in SOAP, Advantages and disadvantages of SOAP.

Describing and Discovering Web Services: WSDL in the world of Web Services, Web Services life cycle, anatomy of WSDL definition document, WSDL bindings, WSDL Tools, limitations of WSDL, Service discovery, role of service discovery in a SOA, service discovery mechanisms, UDDI – UDDI Registries, uses of UDDI Registry, Programming with UDDI, UDDI data structures, support for categorization in UDDI Registries, Publishing API, Publishing information to a UDDI Registry, searching information in a UDDI Registry, deleting information in a UDDI Registry, limitations of UDDI.

UNIT - 4 (12 Hours)

Conversations: Web service conversation Language, WSCL Interface component, Relationship between WSCL and WSDL.
Workflow: Business Process Management, Workflow and workflow Management systems, Business Process Execution Language (BPEL).
Security: Everyday Security Basics, Security Is An End-to-End Process, Web Service Security Issues, Types of Security Attacks and Threats, Web Services Security Roadmap, WS-Security.

Recommended Readings:

1. Michael P. Papazoglou; Web Services & SOA: Principles and Technology; Pearson Education , 2/e,.
2. Harvey M.Dietel & Paul J.Dietel ; Web Services: A Technical Introduction; Prentice Hall PTR, ISBN: 0130461350
3. Sandeep Chatterjee, James Webber; Developing Enterprise Web Services – An Architect's Guide; Pearson Education ISBN: 0-13-140160-2.
4. Stephen Potts, Mike Kopack; Sams Teach Yourself Web Services in 24 Hours; Sams Publications ISBN:13:978-0672325151.
5. R. Nagappan, R. Skoczylas, R.P. Sriganesh; Developing Java Web Services; Wiley India.

List of Experiments in Web Services:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. To implement XML Schema and File
2. To study and implement XML inheritance.

3. To study and implement SOAP and WSDL.
4. To study and implement DOM.
5. To implement XML encryption
6. To implement XML query
7. Creating web service using JAVA
8. Creating web service using .NET
9. Case study on XPath, XJAXB

COMP 8.4.1 GENETIC ALGORITHMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.4,1	Genetic Algorithms	3	1	2	3	100	25	--	-	25	**150**

Course Objectives:

1. To learn and understand the various concepts of Genetic Algorithms.
2. To learn basics of GA Algorithms and their industrial applications

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain the mathematical foundation of Genetic Algorithms,
2. Define fitness function for various events,
3. Implement GA models for applications.

UNIT - 1 (12 Hours)

Introduction to Genetic Algorithms**:** Robustness of traditional optimization and search techniques, Goals of optimization, Similarity Templates. Mathematical Foundations: Fundamental theorem, Schema Processing, Problem solving-2 armed and K armed bandit

problem, Building block hypothesis, Minimal deceptive problem, Similarity templates as hyper planes,

UNIT - 2 (12 Hours)

COMPUTER Implementation Of Genetic Algorithms**,** Data structure, reproduction, crossover and mutation**,** Mapping objective functions to fitness form**,** Fitness scaling, discretization and constraints. Applications Of Genetic Algorithms , DeJong and Function optimization structural optimization via genetic algorithm. Medical image registration with genetic algorithms**,** Iterated prisoner's dilemma problem..

UNIT - 3 (12 Hours)

Advanced Operators And Techniques In Genetic Algorithm Search: Dominance, Diploidy and abeyance, Inversion and other re-ordering operators, Macro operators, niche and special speciation, Multi objective optimization, Knowledge based techniques, Genetic Algorithms and Parallel processors, Genetic Based machine learning, Classifier systems

UNIT - 4 (12 Hours)

Industrial Application Of Genetic Algorithms: Data mining using genetic Algorithms Search in data mining, Genetic algorithms for game playing eg TIC TAC TOE, DNA Sequence Processing using Geneti Algorithms, Clustering using Genetic Algorithm

Genetic Algorithm Performance Analysis with Different Techniques: Sequential Techniques
Statistical Techniques, Data Mining Techniques, Machine Learning Techniques

List of Experiments:

1. Implementation of a procedure that receives two binary strings and a crossing site value, performs simple crossover to return two offspring strings.
2. Implementation of pseudorandom integer generator using specified lower limit and upper limit.
3. Implement a coding routine to implement a floating point code with specified mantissa and exponent.
4. Implementation and testing a routine to perform mutation.
5. Develop a multipoint crossover procedure similar to De Jong's with parameter crossover points.
6. Compare and Contrast alternative scaling schemes.
7. Compare and contrast alternative ranking procedures.
8. Implementation of inversion operator that treats a permutation as a circular string.
9. Implementation of genetic algorithm with diploidy, dominance and the triallelic dominance map.
10. Implementation of Genetic Algorithm Performance Analysis using Different Techniques

TEXT BOOKS:

1. Genetic Algorithms in search, optimization machine leaning - David Goldberg 6th edition , ISBN No-81-7808-130-X
2. Industrial applications of Genetic Algorithms- Charles L Karr and L.Michael Freeman, CRC Press, ISBN No-0-8493-9801-0
3. Data Mining concepts and Techniques - Jiawei Han, Micheline Kamber and Jian Pei, 3 rd Edition.
4. Machine Learning - Tom M. Mitchell - 2nd Edition.

REFERENCE BOOKS

1. Handbook of Genetic Algorithms -Davis, Lawrence, ISBN:0-442-00173-8
2. An Introduction to Genetic Algorithms- Melanie Mitchell, ISBN:81-203-1358-5
3. Introduction to Data Mining - **Pang-Ning Tan, Michael Steinbach, Vipin Kumar.**
4. Statistical Techniques for Data Analysis,John K. Taylor, Cheryl Cihon - Second Edition.

COMP 8.4.2 REAL TIME SYSTEMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	ThDuration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.4.2	Real Time Systems	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To introduce students to the concepts, and approaches in the design and analysis of real-time systems.
2. To study issues related to the design and analysis of systems with real-time constraints.
3. To study and analyze scheduling in Real Time Systems.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand fundamental principles of real time systems with time and resource limitations
2. Describe the reference model of real time systems.
3. Understand Real-time scheduling and schedulability analysis on uniprocessor systems.
4. Understand the Real Time System model on Multiprocessor and Distributed systems.

UNIT -1 (11 Hours)

Introduction: A Car and Driver Example, Issues in Real Time Computing, Structure of a Real Time system, Task Classes

Hard Versus Soft Real-Time Systems: Jobs and Processors, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real Time systems, Soft Real Time Systems

A Reference Model of Real Time Systems: Processors and Resources, Temporal Parameters of Real –Time Workload, Period Task Model, Precedence Constraints and Data Dependency, Other Types of Dependencies, Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Scheduling Hierarchy

Characterizing Real- Time systems and Task: Introduction, Performance Measures for Real-Time Systems, Estimating Program Run Times.

UNIT - 2 (14 Hours)

Clock Driven Scheduling: Notation and Assumptions, Static Timer-Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response time of Aperiodic Jobs, Scheduling Sporadic jobs, Practical considerations and Generalizations, Pros and Cons of Clock Driven Scheduling

Priority Driven Scheduling of Periodic Tasks: Static Assumptions, Fixed priority versus Dynamic Priority Algorithms, Maximum Schedulable Utilizations, Optimality of RM and DM algorithms, A schedulability test for Fixed Priority Tasks with Short Response times, Schedulability test for Fixed Priority Tasks with Arbitrary Response times, Sufficient Schedulability conditions for the RM and DM algorithms.

UNIT - 3 (13 Hours)

Scheduling Aperiodic and Sporadic Jobs in Priority Driven Systems: Assumptions and Approaches, Deferrable Servers, Sporadic servers, Constant Utilization, Total Bandwidth and Weighted Fair Queuing Servers, Scheduling of Sporadic jobs.

Resource and Resource Access Control: Assumptions on Resources and their usage, Effects of Resource Contention and Resource Access Control, Nonpreemtive Critical Sections, Basic Priority Inheritance Protocol, Basic Priority Ceiling protocol

UNIT - 4 (11 Hours)

Task Assignment and Scheduling: Task Assignment, Mode Changes

Multiprocessor Scheduling, Resource Access control and Synchronization: Model of Multiprocessor and Distributed systems, Task assignment, Multiprocessor priority ceiling protocol, Elements of Scheduling Algorithms for End to End Periodic tasks, End to End tasks in heterogeneous systems.

Recommended Readings:

1. Jane W. S. Liu; Real-Time Systems; Pearson Education; ISBN: 978-81-7758-575-9
2. C. M. Krishna and K. G. Shin; Real-Time Systems; TMH; ISBN: 0-07-114243-6.
3. Williams Rob; Real Time Systems Development; **ISBN:** 978-81-3121-520-3
4. Alan Burns; Real- Time Systems and Programming Languages; **ISBN:** 0-201-72988-1
5. Laplante P.A.; Real – Time Systems Design and Analysis; **ISBN:** 81-265-0830-2

List of Experiments in Real Time Systems:

1. Thread Programming.
2. Implementation of Clock Driven Scheduler.
3. Implementation of Table Driven cyclic executive.
4. Implementation of cyclic executive with sporadic and aperiodic job scheduling.

5. Implementation of RM Algorithm.
6. Implementation of DM Algorithm.
7. Implementation of EDF Algorithm
8. Implementation of LST Algorithm.
9. Implementation of FIFO Algorithm
10. Implementation of LIFO Algorithm.

COMP 8.4.3 MOBILE COMPUTING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.4.3	Mobile Computing	3	1	2	3	100	25	-	-	25	**150**

Course Objectives:

1. To understand the basic concepts of mobile computing
2. To be familiar with the network protocol stack
3. To learn the basics of mobile telecommunication system
4. To be exposed to Ad-Hoc networks
5. To gain knowledge about different mobile platforms and application development

Course Outcomes:

The student after undergoing this course will be able to:

1. Explain the basics of mobile telecommunication system
2. Choose the required functionality at each layer for given application
3. Identify solution for each functionality at each layer
4. Use simulator tools and design Ad hoc networks
5. Develop a mobile application.

UNIT - 1 (11 Hours)

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT - 2 (11 Hours)

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT - 3 (11 Hours)

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) –Universal Mobile Telecommunication System (UMTS).

UNIT - 4 (11 Hours)

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

Recommended Readings:

1. Prasant Kumar Pattnaik, Rajib Mall; Fundamentals of Mobile Computing; PHI Learning Pvt. Ltd, New Delhi; 2012.
2. Jochen H. Schiller; Mobile Communications - Second Edition; Pearson Education, New Delhi; 2007.
3. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober; Principles of Mobile Computing; Springer; 2003.

List of Experiments in Mobile Computing:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. To implement Aloha.
2. To implement slotted Aloha.
3. To implement CSMA.
4. To implement CSMA/CA.
5. To implement CDMA.
6. Case study on AODV.
7. Case study on DSR.
8. Case study on ABR.

COMP 8.4.4 MACHINE LEARNING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.4.4	Machine Learning	3	1	2	3	100	25	--	--	25	**150**

Course Objectives:

1. To understand basic concepts of computer machine vision system,
2. To study the design of algorithms for vision and learning

Course Outcomes:

Upon completion of this class, students should be able to:

1. Identify requirement of a computer learning system
2. Explain the concepts behind learning techniques.
3. Implement the learning algorithms for real time applications.

UNIT - 1 (11 Hours)

Learning problems, Designing a learning system, Issues in machine learning.
Concept Learning, Finding a maximally specific hypothesis, Version Spaces, candidate elimination algorithms, Inductive bias.
Decision Tree Representation, Decision Tree Learning Algorithms, hypothesis space search, Inductive bias and issues in decision tree learning. Evaluating Hypothesis.

,

UNIT - 2 (11 Hours)

Bayesian Learning, Concept learning through Bayes Theorem, Maximum Likelihood and Leasr squared error hypothesis, Minimum Description Length principle, Bayes Optimal classifier, Gibbs Algorithm, Naïve Bayes classifier, Bayesian belief network

UNIT - 3 (11 Hours)

Artificial Neural Networks, Perceptrons, Multilayer neural networks, back propagation algorithm, Instance based learning: k nearest neighbor algorithm, locally weighted regression,

UNIT - 4 (11 Hours)

Theoretical Approaches: inductive Inference , Grammatical Inference. PAC Learning . Complexity of Learning , polynomial learnability , VC-dimension. Instance based learning.
Application of Machine learning to data mining and knowledge discovery

List of Experiments:

1. Implementation of Candidate Elimination algorithm
2. Implementation of Decision Tree classifier
3. Implementation of Naïve Baye's classifier
4. Implementation of Gibb's sampling algorithm
5. Implementation of Artificial Neural Network
6. Implementation of K-Nearest Neighbours algorithm
7. Dataset preparation and feature-engineering
8. Implementation of NLP tasks

Recommended Reading

1: Tom Mitchell, Machine Learning, McGraw Hill Inc, 1997
2 Anthony ,M. and Biggs , N. ,Computational Learning Theory , Cambridge 1992.
3. Ross Q. J : Program for machine learning , Morgan Kaufmann 1997
4. Hastie, Tibshirani, Friedman The elements of Statistical Learning Springer Verlag.
5. Pattern recognition and machine learning by Christopher Bishop, Springer Verlag

COMP 8.4.5 DIGITAL SIGNAL PROCESSING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration(Hrs)	Marks					
						Th	S	TW	P	O	Total
COMP 8.4.5	Digital Signal Processing	3	1	2	3	100	25	-	-	25	**150**

Course Objectives:

1. Understand basic concepts and methodologies in Digital Signal Processing.
2. Understand the fundamental concepts of discrete transforms.
3. Study the applications of Z Transforms.
4. Study of digital filters and their applications.

Course Outcomes

Upon completion of this class, students should be able to:

1. Explain the concepts of signals and systems and the basic operations on them.
2. Analyse the behaviour of periodic and aperiodic signals in frequency domain using the Fourier Series and Fourier Transforms.
3. Describe the concept and characteristics of Z Transforms and its use in the analysis and applications of systems.
4. Explain the techniques of designing of Infinite Impulse Response (IIR) filters and Finite Impulse Response (FIR) filters.

UNIT -1 (12 Hours)

Digital Signal Processing and Its Benefits. Application Areas. Key DSP Operations. Digital Signal Processors. Overview of Real-world Applications of DSP. Telecommunications Applications of DSP. DFT and its Inverse. Properties of the DFT. Computational Complexity of the DFT. The Decimation-in-Time Fast Fourier Transform Algorithm. Inverse Fast Fourier Transform. Implementation of the FFT. Other Discrete Transforms. An Application of the DCT: Image Compression.

UNIT -2 (12 Hours)

Discrete-Time Signals and Systems. The Z-Transform, The Inverse Z-Transform. Properties of the Z-Transform. Some Applications of the Z-Transform in Signal Processing. Correlation and Convolution. Correlation Description. Convolution Description. Implementation of Correlation and Convolution. Application Examples.

UNIT -3 (12 Hours)

Introduction to Digital Filters. Types of Digital Filters: FIR and IIR Filters. Choosing Between FIR and IIR Filters. Filter Design Steps. Introduction. FIR Filter Design. FIR Filter Specifications. FIR Coefficient Calculation Methods. Window Method. The Optimal Method. Frequency Sampling Method. Comparison of the Window, Optimum and Frequency Sampling Methods. Special FIR Filter Design Topics. Realization Structures for FIR Filters. Finite Wordlength Effects in FIR Digital Filters. FIR Implementation Techniques. Design Example. Application Examples of FIR Filters.

UNIT -4 (12 Hours)

Design of Infinite Impulse Response (IIR) Digital Filters: Summary of the Basic Features of IIR Filters. Design Stages for Digital IIR Filters. Performance Specification. Coefficient Calculation Methods for IIR Filters. Pole-Zero Placement Method of Coefficient Calculation. Impulse Variant Method of Coefficient Calculation. Matched Z-Transform (MZT) Method of Coefficient Calculation. Bilinear Z-Transform (BZT) Method of Coefficient Calculation. Use of BZT and Classical Analog Filters to Design IIR Filters. Calculating IIR Filter Coefficients by Mapping S-Plane Poles and Zeros. Using IIR Filter Design Programs. Choice of Coefficient Calculation Methods for IIR Filters. Realization Structures for IIR Digital Filters. Finite Wordlength Effects in IIR Filters. Implementation of IIR Filters. A Detailed Design Example of an IIR Digital Filter.

Recommended Readings:

1. Digital Signal Processing – by Emmanuel C..Ifeachor, &Barrie.W.Jervis, Second edition, Pearson Education / Prentice Hall, 2002.
2. Digital Signal Processing: Principles, Algorithms, and Applications, by John G. Proakis and Dimitris G. Manolakis, Prentice Hall, 1996
3. Discrete-Time Signal Processing, by Alan V. Oppenheim, Ronald W. Schafer, Prentice Hall, ISBN:0-13-216292-X
4. Digital Signal Processing, A Computer Based approach, by S.K. Mitra, Tata McGraw Hill, 1998
5. Digital Signal Processing by Ramesh Babu, Scitech India publications Limited, Fourth Edition,2007

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)

1. Defining and plotting Discrete Time Signals
2. Implementation ofLinear Difference Equation.
3. Implementation of Linear Convolution.
4. Implementation of Circular Convolution.
5. Implementation of Overlap Save method of Convolution
6. Implementation of Overlap Add method of Convolution
7. Implementation of Discrete Fourier Transform.
8. Implementation of Inverse Discrete Fourier Transform.
9. Implementation of Z Transform.
10. Implementation of Inverse Z Transform.