Post Graduate Department of Computer Sciences,
The University of Kashmir,
Srinagar - 190006

Curriculum and Evaluation Scheme for Master of Technology in Computer Science

2018 – 2020

Structure of Curriculum for M. Tech. in Computer Science

Semester-I (24 Credit unit Semester)						
Course Code	**Course name**	**Category**	**Hours / Week**			**Credits**
			L	T	P	
CORE SUBJECTS						
CSE511	Database Management Systems	Core	4	0	0	4
CSE512	Lab Database Management Systems	Core	0	0	4	2
CSE513	Data Structures using C++	Core	4	0	0	4
CSE514	Lab Data Structures using C++	Core	0	0	4	2
CSE515	Artificial Intelligence	Core	4	0	0	4
ELECTIVE SUBJECTS						
CSE516x	Elective 1	Elective	4	0	0	4
CSE516x	Elective 2	Elective	4	0	0	4

List of Elective Subjects:

i) CSE5161 Data Communications

ii) CSE5162 Embedded Systems

iii) CSE5163 Engineering Mathematics

Semester-II (24 Credit unit Semester)						
Course Code	**Course name**	**Category**	**Hours / Week**			**Credits**
			L	T	P	
CORE SUBJECTS						
CSE521	Network Protocols and Security	Core	4	0	0	4
CSE522	Lab Network Protocols and Security	Core	0	0	4	2
CSE523	Image Processing	Core	4	0	0	4
CSE524	Lab Image Processing	Core	0	0	4	2
CSE525	Machine Learning	Core	4	0	0	4
ELECTIVE SUBJECTS						
CSE526x	Elective 1	Elective	4	0	0	4
CSE526x	Elective 2	Elective	4	0	0	4

List of Elective Subjects:

i) CSE5261 Algorithms and Complexity

ii) CSE5262 Software Reliability Engineering

iii) CSE5263 Optimization Techniques

Semester-III (24 Credit unit Semester)						
Course Code	**Course name**	**Category**	**Hours / Week**			**Credits**
			L	T	P	
CORE SUBJECTS						
CSE531	Minor Project	Core	0	4	0	4
CSE532	Parallel and Distributed Algorithms	Core	4	0	0	4
CSE533	Real Time Operating Systems	Core	4	0	0	4
CSE534	Wireless and Mobile Computing	Core	4	0	0	4
ELECTIVE SUBJECTS						
CSE535x	Elective 1	Elective	4	0	0	4
CSE535x	Elective 2	Elective	4	0	0	4

List of Elective Subjects:

i) CSE5351 Cloud Computing

ii) CSE5352 Network Security

iii) CSE5353 Natural Language Processing

Semester-IV (24 Credit unit Semester)						
Course Code	**Course name**	**Category**	**Hours / Week**			**Credits**
			L	T	P	
CORE SUBJECTS						
CSE541	Major Project Problem Identification	Core	0	2	0	2
CSE542	Major Project Problem Analysis	Core	0	4	0	4
CSE543	Major Project Software Development	Core	0	6	0	6
CSE544	Major Project Research Component	Core	0	6	0	6
CSE545	Major Project Dissertation	Core	0	6	0	6

Semester - I

Subject Code: CSE511
Subject Name: Database Management System

UNIT I

Database System Applications, Purpose of Database Systems, OLAP v/s OLTP, Architectures, Data Models, Database Languages –, Data Storage and Querying, Database Architecture, Database Users and Administrators, ER Diagrams, Relational Algebra, Data Integrity, Normalization, Codds Rules.

UNIT II

SQL - Introduction to Structured Query Language, Data Definition Language, Data Manipulation Language, Transaction Control Language, View, Synonym, Sequence and Index, Data Constraints.

UNIT III

PL SQL – Programming using PL SQL, Exception Handling, Cursors, Triggers, Functions and Packages.

Transaction Management: The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock Based Concurrency Control, Deadlocks, Serializability.

Query Optimization – Query Parsing and Translation, Approaches to Query Processing, Distributed Query Processing Architecture.

UNIT IV

Distributed databases: Introduction to distributed databases, Distributed DBMS architectures
Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Clustered Indexes, Primary and Secondary Indexes, Tree based Indexing.

Text Books:

1. Elmarsi, Navathe, Somayajulu, Gupta, “Fundamentals of Database Systems”, 4th Edition, Pearson Education, 2007
2. Garcia, Ullman, Widom, “Database Systems, The complete book”, Pearson Education, 2007
3. R. Ramakrishnan, “Database Management Systems”, McGraw Hill International Editions, 1998

Reference Books:

1. Date, Kannan, Swaminathan, “An Introduction to Database Systems”, 8th Edition Pearson Education, 2007
2. Singh S.K., “Database System Concepts, design and application”, Pearson Education, 2006.
3. Silberscatz, Korth, Sudarshan, “Database System Concepts”, Mcgraw Hill, 6th Edition, 2006
4. D. Maier, “The Theory of Relational Databases”, 1993, Computer Science Press, Rokville, Maryland
5. Ullman, J. D., “Principals of database systems”, Galgotia publications, 1999
6. Oracle Xi Reference Manual

Subject Code: CSE512
Subject Name: Lab Database Management System

SQL commands based on Data Definition Language
SQL commands based on Data Manipulation Language
SQL commands based on Transaction Control Language
SQL commands to implement Data Integrity on database tables?
SQL command using various operators
SQL commands for SQL Functions like Date, Numeric, Character, Conversion, Miscellaneous
SQL Commands to implement Group functions like Count, Group by Clause, Having Clause
SQL Command to Implement Set Operators and Joins
SQL command to implement View, Synonym, Indexes and Partitioning
SQL commands to implement various types of Locks and Privileges
Basic PL/SQL Programs
Various PL/SQL Control Structures
PL/SQL Code to implement Exception Handling
PL/SQL Code to implement Database Cursors
PL/SQL Code to implement Triggers
PL/SQL Code to implement Subprograms
PL/SQL Code to implement Functions
PL/SQL Code to implement Subprograms and Functions with in and out parameters
PL/SQL Code to implement Packages.

Subject Code: CSE513
Subject Name: Data Structures Using C++

Unit I

Elementary Data Structures: Arrays, Operations on Arrays, Strings, Stacks, Queues, Evaluation Postfix and Prefix Expressions.

Linked List: Operations on Singly and Doubly Linked lists, Circular linked lists, Implementation of Stacks and Queues using Linked Lists.

Unit II

Searching and Sorting: Linear and Binary Search, Bubble Sort, Insertion Sort, shell Sort, Radix Sort, Heap Sort, Merge Sort, Quick Sort and Simple external Sorting.

Unit III

Trees: Trees and traversal of trees, Operations and Characteristics, Binary Trees and Binary search trees, Concepts of AVL Trees, Splay Trees and B-Trees, Balanced Search Trees, Binary Heaps, Red Black Trees and Properties.

Hashing: Hashing Functions, collision Resolution Techniques

Unit IV

Graphs: Representation, Type of Graphs, Paths and Circuits: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Planar Graphs Representation and Implementation, Searching of a Graph, Applications of BFS and DFS.

Data Structure of Sets: Disjoint Set and Union – find problem and implementation.

References

Aaron M. Tanenbaum, "Data structures using C and C++", Pearson Education, 2011.
Data Structure, Algorithm and OOP, Gregory L. Heileman (Tata Mc Graw Hill Edition).
Data Structures, Algorithms and Applications in C++,Sartaj Sahni,Mc Graw-Hill International Edition.

Subject Code: CSE514
Subject Name: Lab Data Structures Using C++

Write a Program using C++ to Insert, Delete and Update Contents of an Array?
Write a Program using C++ to implement Stacks using array?
Write a Program using C++ to implement Queues using array?
Write a Program using C++ to implement the evolution of various expressions (Prefix, Infix, Postfix)?
Write a Program using C++ to implement Singly Linked List?
Write a Program using C++ to implement Circular Linked List?
Write a Program using C++ to implement Stacks using Linked List?
Write a Program using C++ to implement Queues using Linked List?
Write a Program using C++ to implement Doubly Linked List?
Write a Program using C++ to implement Linear and Binary Search?
Write a Program using C++ to Implement Bubble Sort Algorithm?
Write a Program using C++ to Implement Insertion Sort Algorithm?
Write a Program using C++ to Implement Selection Sort Algorithm?
Write a Program using C++ to Implement Radix Sort Algorithm?
Write a Program using C++ to Implement Quick Sort Algorithm?
Write a Program using C++ to Implement Merge Sort Algorithm?
Write a Program using C++ to implement various operations on Binary Trees?
Write a Program using C++ to implement various operations on Binary Search Trees?
Write a Program using C++ to implement various operations on AVL Trees?
Write a Program using C++ to implement various Hashing Techniques?
Write a Program using C++ to Implement Euler Graphs?
Write a Program using C++ to Implement Hamiltonian Graphs?
Write a Program using C++ to Planner Graphs?
Write a Program to Implement BFS?
Write a Program to Implement DFS?

Subject Code: CSE515
Subject Name: Artificial Intelligence

UNIT I

Introduction to biological neural networks. Artificial neural networks (ANN). Analogy between biological and artificial neural networks. Neuron as a basic building element of an ANN. Activation functions. Perceptron. Learning with a perceptron. Limitations of a perceptron. Multilayer neural networks. Learning with a multilayer perceptron. Backpropagation algorithm. Synergistic neural networks. Distributed neural networks. Distributed and synergistic neural networks. Applications of ANNs.

UNIT II

Inductive learning algorithms. Categories of inductive learning algorithms. Rule extraction with inductive learning algorithms. ID3 algorithm. AQ algorithm. RULES algorithms. SAFARI algorithm. Applications of inductive learning algorithms.

UNIT III

Fuzzy logic and uncertainty. Fuzzification. Linguistic terms. Fuzzy sets. Hedges. Fuzzy Hedge Operations. Fuzzy set operations. Fuzzy vector matrix multiplication. Fuzzy Max-Min inferencing. Fuzzy Max-Product inferencing. Multiple premise fuzzy inferencing. Fuzzy multiple rule aggregation. De-fuzzification. Applications of fuzzy logic.

UNIT IV

Emerging topics in artificial intelligence.

Text Books and Reference Material:

1. Artificial Intelligence: A Modern Approach by Stuart Russell.
2. Artificial Intelligence: A Guide to Intelligent Systems by Michael Negnevitsky
3. Machine Learning by Tom Mitchell
4. Selected Journal and Conference Papers

Subject Code: CSE5161
Subject Name: Data Communications

Unit I
Bandwidth and Channel Capacity. Quantifying Channel Capacity for noiseless channel(Nyquist Law) and noisy channel(Shannon's Law). Example of a digital telephone system to explain basic concepts of analog signals, digital signals, sampling. Data Rate versus Baud Rate. Nyquist Criterion for Sampling. Data transmission concepts. Characteristics of signals(amplitude, frequency, period, wavelength). Signal-to-Noise ratio. Local area network(LAN) concepts and characteristics.

Unit II
Wide area networks(WANs). WAN technologies (traditional packet and circuit switching, Frame Relay, ATM). ISDN(narrowband) concepts and services. Overview of the OSI model. Transmission media – factors affecting distance and data rate. Guided transmission media: Twisted-Pair, Co-axial Cable. Principles and advantages of optical networks. Types of optical fibers and lasers.

Unit III
Unguided transmission media: Terrestrial Microwave & Satellite Microwave systems and applications. Data encoding. Difference between modulation and encoding. NRZ-L, NRZ-I encoding. Multilevel Binary and Biphase Coding techniques and their implementations. ASK,FSK,PSK and QPSK. PCM concepts: sampling, quantization. Amplitude Modulation.

Unit IV
Reliable transmission of data: Asynchronous and Synchronous transmission. Error detection: Parity-based, CRC-based. FCS computation. Error control and recovery techniques. Concept of ARQ standard and its versions. Concept of Multiplexing. FDM. Synchronous and Statistical TDM.

Reference Books:
William Stallings, "Data and Computer Communications", 8th Edition, Pearson Education.
Behrouz Fourouzan " Data Communications & Networking", 4th Edition, TMH.
Andrew Tanenbaum, "Computer Networks", Pearson Education 4/e.
Ulysses Black, "Principles of Data Communications ", PHI.
Morley, Gelber, "The Emerging Digital Future", Addison-Wesley.

Subject Code: CSE5162
Course Name: Embedded Systems

Unit I: Introduction.

Embedded systems and Cyber Physical Systems: Definition, Characteristics, Design Challenges, Classification, Application areas. **(4 Lectures)**

Embedded Hardware Architecture: General Purpose Processor, Microprocessor Design Options, Microcontroller, Digital Signal Processor, ASIC, PLDs, COTS; Embedded Systems Memory; Other Hardware Components: I/O Subsystem, Timers and counters, Interrupt Subsystem, UART, PWM and Analog-Digital Conversion, Sensors and Actuators. **(6 Lectures)**

Embedded Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue Scheduling, Real-time Operating System (RTOS); Programming Languages and Tools; Embedded IDE; Debugging. **(5 Lectures)**

Unit II: The 8051 Microcontroller.

Microcontroller: Introduction, Criteria for choosing a microcontroller; Overview of 8051 Microcontroller family: Architecture, Memory Organization of 8051, SFRs, I/O Ports, Addressing modes. **(5 Lectures)**

Basic Assembly Language programming concepts: 8051 Instruction set, Assembler Directives, Subroutine, Stack. **(5 Lectures)**

Time delay generations and calculations, Programming of 8051 Timers, Counter Programming, Watch Dog Timer, Real Time clock. **(5 Lectures)**

Unit III: 8051 Communication and Interrupts.

Basics of Communication: Overview of RS-232, I^2C Bus, UART, USB; Communication with 8051: Using I/O Ports, 8051 Serial Port, 8051 connections to RS-232. **(5 Lectures)**

8051 interrupts: Interrupt vectors and interrupt processing, Level triggered and edge triggered, Masking and priorities; Programming of 8051 Timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts. **(5 Lectures)**

Unit IV: 8051 Interfacing.

Basic Concepts of Interfacing: Introduction; 8051 Interfacing to external memory and Accessing External data Memory and External Code Memory. **(5 Lectures)**

Interfacing to LCD/Keyboard, DAC/ADC, Sensors, Stepper Motor, 8255. **(5 Lectures)**

Text Books:

1. Shibu K V. *Introduction to Embedded Systems*, TMH.
2. M.A. Mazidi and J. G. Mazidi. *The 8051 Microcontroller and Embedded Systems*, PHI.
3. Raj Kamal. *Embedded Systems*, TMH.

Subject Code: CSE5163
Subject Name: Engineering Mathematics

Unit I
Linear Algebra –Basic Concepts , Matrices , multiplication , operation and properties, Identity matrices , diagonal matrices, Transpose matrices , Symmetric matrices , Trace , Linear Independence and Rank , Inverse and Orthogonal matrices, Range and Nullspace of a matrix, Determinant, Quadratic forms and Positive SemiDefinite Matrices, Eigenvalue and Eigen Vectors, The Gradient, Hessian , Gradient and Hessian of linear and Quadratic functions. Least Squares, Gradient of the Determinant, Eigen Values as Optimization.

Unit II
Elements of Probability, Random Variables, Cumulative Distribution functions, Probability mass function, Probability density function, Expectation, Variance, Two random variables, Conditional distributions, Bayes Rule, Independence, Expectation and co-variance, Multiple Random variables, Random vectors.

Unit III
Gaussian Processes, Multivariate Gaussian, Binary Linear Regression, The squared exponential Kernel, Gaussian Process regression, Multivariate Gaussian Distribution. The co-variance matrix, The diagonal co-variance matrix, Iso-contours, Linear Transformation interpretation.

Unit IV
Convex sets, Convex functions, Jensen's Inequality, Sublevel sets, Convex Optimization Problems, Special Cases. Lagrange Duality, Lagrangian, Primal and Dual Problems, Complementary slackness, The KKT Conditions.

References Books
Linear Algebra and its applications by David C. Lay , Addison Wesley.
Probability Theory and Stochastic Processes with applications by Oliver Knill –Overseas Press.
Applied Multivariate Statistical Analysis by Richard A. Johnson and Dean W. Wichern – PHI
Multivariate Data Analysis by Joseph F. Hair, William C. Black , babin and Anderson – Pearson
Convex Optimization Theory by Dimitri P. Bertsekas
Combinatorial Optimization Algorithms and Complexity by Papadimitrion and Kenneth Steiglitz

Semester – II

Subject Code: CSE521
Subject Name: Network Protocols & Security

Unit I:
Goals and applications of networks. LAN, MAN & WAN architectures. Ethernet, Wireless LANS, Virtual LANS. FRAME RELAY. Overview of existing networks. OSI Reference Model Architecture, TCP/IP Model and their comparison.

Unit II:
Internetworking concept and architectural model. Connection-oriented and connection-less approaches. Concept of Autonomous systems and Internetwork Routing. Classful IP addresses. Subnetting, IP Multicasting. Internet Protocol (IP): connectionless delivery of datagrams (MTU, fragmentation, reassembly).

Unit III:
Internet control protocols: ICMP, ARP and RARP. Routing algorithms: RIP, Interior (OSPF), Exterior (BGP). Transport Layer. Process to process delivery: UDP, TCP and SCTP concepts.

Unit IV:
Socket API for Network Programming,Client-Server application development using TCP & UDP sockets. Basic Server Architectures. TELNET, SMTP, FTP, HTTP

Reference Books:
1.AndrewTanenbaum, ”Computer Networks”,4th Edition by Pearson.
2.Douglas Comer, ”Internetworking with TCP/IP, Volume 1”, Pearson.
3.W.Richard Stevens, “UNIX Network Programming”, Pearson.
4.Maufer, “IP Fundamentals”, Pearson.
5. Douglas Comer, “Client-Server Programming with TCP/IP, Volume 3”,Pearson.

Subject Code: CSE522
Subject Name: Lab Network Protocols & Security

Experiment 1: Get Familiar with Packet Tracer Simulation tool. (Establishing connections, Adding devices and assigning IP addresses)

Experiment 2: Configure Internet connection and Use Network Configuration Commands to debug the network issues

- ping
- PathPing
- Traceroute
- Nslookup

Experiment 3: Performing an Initial Switch and Router Configuration usingPacket Tracer Software

Experiment 4: Configure a Network Topology (Bus and Star) using Packet Tracer Software

Experiment 5: Configure a Network Topology using Distance Vector Routing Protocol

- RIP

Experiment 6: Configure a Network Topology using Link State Vector Routing Protocol

- OSPF

Experiment 7: Simulateusing Packet Tracer Software a four-node point-to-point network and connect the link as follows: Apply a TCP agent between n0 to n3 and apply a UDP agent between n1 and n3. Apply relevant applications over TCP and UDP agents changing the parameters and determine the number of packets sent by two agents

Experiment 8: Simulateusing Packet Tracer Software the different types of Internet traffic such as FTP, TELNET over a network and analyze the throughput.

Experiment 9: Simulateusing Packet Tracer Software an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source/destination.

Experiment 10: Simulate using Packet Tracer Softwarean Ethernet LAN using N nodes and set multiple traffic nodes and determine collisions across different nodes.

Experiment 11: Simulate using Packet Tracer Softwarean Ethernet LAN using N nodes (6-10), change error rate and data rate and compare throughput.

Experiment 12: Using TCP/IP sockets, write a program to establish connection between a client and a Server.

Experiment 13: Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.

Subject Code: CSE523
Subject Name: Image Processing

Unit I: Introduction.
Introduction Digital Image processing, Origins of DIP, Examples, Fundamental steps in DIP, Components of DIP. Fundamentals Elements of visual perception: brightness, contrast, hue, saturation, Mach-band effect; Light and the electromagnetic spectrum. [4 Lectures]
Image formation and digitization concepts; Image Sensing and acquisition; Image sampling and quantization. [4 Lectures]
Basic relationships between pixels: Neighbours of pixel adjacency connectivity, regions and boundaries, Distance measures. [4 Lectures]

Unit II: Image Enhancement.
Image enhancement in the spatial domain: Background; Point and arithmetic/ logic operations; Some basic grey level transformations; Histogram processing: Equalization, Matching. [4 Lectures]
Mechanics of spatial filtering: Correlation, Convolution; Smoothing spatial filters: Averaging and Weighted-Averaging Filters, Gaussian Filter; Sharpening spatial filters: First and Second Derivatives, Laplacian, Unsharp Masking and High Boost Filtering. [4 Lectures]
Image enhancement in the frequency domain: Background, Introduction to the Fourier transform and the frequency domain, Smoothing Frequency-Domain filters, Sharpening Frequency Domain filters. [4 Lectures]

Unit III: Image Restoration and Morphological Processing.
Model of image degradation/restoration process: Noise models; Restoration by spatial filtering: Mean Filters, Order-Statistics Filters; Restoration by frequency domain filtering: Bandreject Filters, Bandpass Filters. [4 Lectures]
Morphological Processing: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, thinning, thickening, skeletons, pruning. [4 Lectures]
Color Image Processing: Color Fundamentals, Color Models: RGB, CMY and CMYK, HIS, Conversion from RGB to HSI and vice versa [4 Lectures]
Unit IV: Edge Detection and Segmentation.

Edge detection: Basic Formulation: Detecting Points and Lines, Edge Models; Gradient and its Properties; Gradient Operators: Roberts, Prewitt, Sobel; Canny Edge Detector; Thresholding: Basic Global Thresholding, Basic Adaptive Thresholding. [6 Lectures]
Region based segmentation: Basic Formulation, Region growing, Region splitting and Merging; Segmentation by morphological watersheds: Basic concepts, Dam construction, Watershed Algorithm. [6 Lectures]
Text Books:
1. Rafael C. Gonzalez, Richard E. Woods. Digital Image Processing, Pearson, Second Edition, 2004.
2. Anil K. Jain. Fundamentals of Digital Image Processing, Pearson 2002.

Subject Code: CSE524 Subject Name: Lab Image Processing

Week 1:
Create two 4 x 4 matrices X and Y in MATLAB and perform the following operations on them.
o Transpose
o Multiplication and Division by a scalar x
o Array Multiplication and Division between the two matrices
o Matrix Multiplication and Division between the two matrices·

Week 2:
Create an M-file containing a function which takes as input a vector with values within a specific tinuous range and returns a discretized/quantized mapping of the values.
o The output range and number of levels are also provided as input to the function.·

Week 3: Read an RGB image from the disk [use imread()] and perform the following operations on it:
o convert it into grayscale
o extract a sub-image from it
o display its histogram [use imhist()]
o perform contrast stretching on it [use imadjust()]
o perform log transformation on the previous result
o save the resulting image to the disk [use imwrite()]·

Week 4: Read an image and perform the following operations on it:
o Display the image and its histogram
o Perform histogram equalization on it (use histeq()) and display the resulting image an histogram
o Perform histogram Matching on it [use histeq()] and display the resulting image an histogram
o Perform adaptive histogram equalization on it [use adapthisteq()] and display the resulting image an histogram·

Week 5:
·Use fspecial() to generate any three 3 x 3 spatial filters and display them
· Read an image in grayscale and using imfilter() perform the following operations on it:
o Smoothen the image
o Sharpen the image·

Week 6:
· Read an image in grayscale and salt & pepper noise to it using imnoise() and display the image
· Use ordfilt2() to perform min and max filtering on the noise induced image and display the resulting images.
· Use medfilt2() on the noise induced image and document the effect of using a median filter to reduce the salt & pepper noise.

Week 7:
· Calculate the Discrete Fourier Transform of a grayscale image [use fft2()] and display its Fourier spectrum [use abs() on fft2()]
· Display the effect of shifting the DFT of an image using fftshift()
· Shift back the shifted DFT using ifftshift() and display the result
· Compute the inverse Discrete Fourier Transform from the previous result using ifft2() and display its real part using real().
· Comment on the observations you make.

Week 8:
· Generate the following frequency domain filters from spatial domain filters created in week 5 using freqz2()
o Lowpass filter
o Highpass filter [use 1 - Lowpass]
· Create Meshgrid Arrays for Use in direct implementation of Frequency Domain Filters
o Use them to generate the distance matrix using hypot()
o Use the distance matrix to generate the following filters
oBandpass o Bandreject
Reference: pages 140, 144 and 154 "Digital Image processing using MATLAB"·
Week 9:
· Model of image degradation/ restoration process: Noise models
· Restoration by spatial filtering: Mean Filters
· Order-Statistics Filters
· Problem/Numerical: Specifying the PDF of bipolar salt and pepper noise
· Problem/Numerical: Problems on removing/reducing noise using spatial filtering·
Week 10:
· Demonstrate basic Morphological Processing techniques on a binary image using various structuring elements:
o Dilation: imdilate()
o Erosion: imerode()
o Opening: imopen()
o Closing: imclose()
o Hit-or-Miss Transformation: bwhitmiss()
o Other BW morphological techniques: bwmorph()
NOTE: Use the strel() function to generate various structuring elements wherever necessary.·
Week 11: Create an M-function which implements all the steps for filtering in the Frequency Domain
o Read the image to grayscale
o Obtain a frequency domain filter H from week 8]
o Obtain the FFT of the padded input
o Perform the filtering by multiplying the FFT with H
o Obtain the inverse transform of the result
o Crop to original image
o Display the result
NOTE: Image and the filter have to be of the same dimension and use float type during processing·
Week 12:
· Use a specific point-detection filter for identifying isolated points in an image
o Use spatial filtering and thresholding to achieve your goal
· Use the edge() function to detect edges in an input image by the following filters
o Sobel
o Prewitt
o Roberts
o Canny·
Week 13:
· Demonstrate the use of the following Toolbox Hough Functions to detect Lines in an input image
o hough()
o houghpeaks()
o houghlines()
· Demonstrate the use of watershed() function for identifying segments in an image.·

Subject Code: CSE525
Subject Name: Machine Learning

Unit 1

Clustering Algorithms, Euclidean and Mahalanobis Distances, Basic Sequential Algorithm Scheme, K-Means Algorithm, Fuzzy C-Means Clustering, Clustering with Gaussian Probability Density Function. Cluster Validity index. Compactness Cluster Measure, Distinctness Cluster Measure, Validity Index Using Standard Deviation, Point Density Based Validity Index, Validity index using Local and Global Data Spread,

Unit 2

Support Vector Machines. Binary Linear Support Vector Machines, Optimal Hyperplane, Canonical Form, Kernel Functions, Solving Non-linear Classification problems with Linear Classifier. Multiclass Suport Vector Machines, Directed Acyclic Graph Support Vector Machines. Application of Support Vector Machines.

Unit 3

Dimensionality Reduction, Principal Component Analysis, Fisher Linear Discriminant, Multiple Discriminant Analysis. Watershed Based Clustering. Sub-Space Grid Based Approach. Coarse and Fie Rule Extraction using Sub-Space Grid Based Approach for Clustering.

Unit 4

Emerging Topics in Machine Learning

Reference Books and Material

Machine Learning by Tom M. Mitchel, McGraw-Hill publication
Pattern Classification by Duda and Hart. John Wiley publication
The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer.
Learning From Data, Yaser S. Abu-Mostafa, Hsuan-Tien Lin, Malik Magdon-Ismail, AML Book.
Introduction to Machine Learning by EthemAlpaydin, The MIT Press.
Machine Learning: An Algorithmic Perspective by Stephen Marsland, Chapman and Hall/CRC.
Selected Journal and Conference Papers

Subject Code: CSE5261
Subject Name: Algorithms and Complexity

Unit I

Algorithms, Pseudo-code Conventions , Analysis of Algorithms, Designing Algorithms , Growth of Functions , Asymptotic notations , Some operations on O-notation. Recurrences, Substitution method , Iteration method , Recursion trees , The Master Method . Time and Space Complexity, Amortized analysis.

Unit II

Randomized Algorithms: Description, Identifying the repeated element, Primality testing, Advantages and Disadvantages. Divide and Conquer, General method, Binary search, Max and Min, Merge sort, Quick sort. Greedy Method, General method, optimal storage on tapes, Knapsack problem, Job sequencing, Huffman codes

Unit III

Dynamic programming, General methods, Multistage graphs, Matrix chain multiplication, longest common subsequences, All pair shortest paths

Backtracking, General method, 8-Queen problem, Generalized Algorithm for N-Queen Problem, Sum of subsets, Knapsack problem. Branch and Bound, General method, Basic Concepts of BFS and DFS, Least Cost Branch and Bound, 8_Queen Problem, Traveling salesperson problem.

Unit IV

Lower boundary theory , comparison trees for sorting and searching. Oracles and adversary arguments , Lower bound theory through reductions , P and NP problems. NP hard and NP complete problems _ basic concepts. Need for developing approximate algorithms. Approximate Algorithms , The vertex cover Problem , The traveling salesman problem , The set veering problem , The subset sum problem. Parallel Algorithms. Parallel Computation Model. Parallelism_ PRAM and other Models. Effect on Parallelism on Efficiency. Illustrations of problems suitable for Parallel Implementation.

Reference Books:

Horowitz, Sahni, " Fundamentals of Computer Algorithms", Galgotia Publications
Coremen, Leiserson, Rivest,Stein, "Introduction to Algorithms", Second Edition, PHI.
Brassard and Bratley, "Fundamentals of Algorithms", Pearson Education .
Sedgewick, " Algorithms in C", Pearson Education.
Baase "Computer Algorithms", Introduction to Design and Analysis", 3rd Ed, Pearson
Aho, Hopcroft and Ullman, " The Design and Analysis of Computer Algorithms", Pearson.
M.T.Goodrich, R.Tomassia, "Algorithm design", John Wiley, 2002

Subject Code: CSE5262
Subject Name: Software Reliability Engineering

UNIT-I: BASIC RELIABILITY CONCEPTS: Reliability Measures (Definition of reliability, Mean time to failure (MTTF), Failure rate function, Maintainability and availability) ,
Common Techniques in Reliability Analysis (Reliability block diagram, Network diagram, Fault tree analysis, Monte Carlo simulation),
UNIT-II: Markov Process Fundamentals (Stochastic processes, Standard Markov models, General procedure of Markov modeling),
Nonhomogeneous Poisson Process (NHPP) Models (General formulation, Reliability measures and properties, Parameter estimation)
UNIT-III: MODELS FOR SOFTWARE RELIABILITY: Basic Markov Model (Model description, Parameter estimation), Imperfect debugging models (Monotonous death process, Birth-death process, Imperfect debugging model considering multi-type failure),
Modular Software Systems : The Littlewood semi-Markov model, Some other modular software models-User-oriented model-Task-oriented model-Multi-type failure model in modular software,
UNIT-IV: Software NHPP Models: The Goel-Okumoto (GO) model, S-shaped NHPP models: Delayed S-shaped NHPP model-Inflected S-shaped NHPP model, Some other NHPP models: Duane model-Log-power model-Musa-Okumoto model

References:

1. Musa, Iannino, Okumoto, “Software Reliability: Measurement, Prediction, Application”, McGraw-Hill, 1987.
2. Min Xie Yuan-Shun Dai and Kim-Leng Poh, “Computing System Reliability: Models and Analysis “ KLUWER ACADEMIC PUBLISHERS, 2004
3. P. K. Kapur, H. Pham, A. Gupta, P. C. Jha,“Software Reliability Assessment withOR Applications”, Springer-Verlag London Limited 2011
4. Hoang Pham, “system software reliability”, Springer, 2006
5. Michael R. Lyu, “Handbook of software reliability engineering-IEEE Computer Society Press_ McGraw Hill (1996)”.
6. M. Lyu, ed. ”Handbook of Software Reliability Engineering”, McGraw-Hill and IEEE Computer Society Press, 1996
7. Pham, H. (2000). ‘Software Reliability’, Springer-Verlag, Singapore.

Subject Code: CSE5263
Subject Name: Optimization Techniques

Unit I
Linear programming –formulation-Graphical and simplex methods-Big-M method Two phase method-Dual simplex method-Primal Dual problems.

Unit II
Unconstrained one dimensional optimization techniques -Necessary and sufficient conditions – Unrestricted search methods-Fibonacci and golden section method Quadratic Interpolation methods, cubic interpolation and direct root methods.

Unit III
Unconstrained n dimensional optimization techniques – direct search methods – Random search – pattern search and Rosen brooch's hill claiming method- Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

Unit IV
Constrained optimization Techniques- Necessary and sufficient conditions – Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method .

Text Book
1. Ashok D. Belegundu, Tirupathi R. Chandrupatla, "Optimization Concepts and Applications in Engineering", Cambridge University Press.

References
1. Rao,S.S.,"Optimization :Theory and Application" Wiley Eastern Press, 2nd edition 1984.
2. Taha,H.A., Operations Research –An Introduction,Prentice Hall of India,2003.
3. Fox, R.L., „Optimization methods for Engineering Design", Addition Welsey, 1971.

Semester - III

Subject Code: CSE531
Subject Name: Minor Project

Minor project to be completed under the supervision of assigned faculty member on a topic to be selected in consultation with the supervisor.

Subject Code: CSE532
Subject Name: Parallel and Distributed Algorithms

Unit I
Introduction to Parallel and Distributed Programming (definitions, taxonomies, trends), Parallel Computing Architectures, Paradigms, Issues, & Technologies (architectures, topologies, organizations) Parallel Programming (performance, programming paradigms, applications)

Unit II
Parallel Programming Using Shared Memory I (basics of shared memory programming, memory coherence, race conditions and deadlock detection, synchronization), Parallel Programming Using Shared Memory II (multithreaded programming, OpenMP, pthreads, Java threads), Parallel Programming using Message Passing - I (basics of message passing techniques, synchronous/ asynchronous messaging, partitioning and load-balancing)

Unit III
Parallel Programming using Message Passing - II (MPI), Parallel Programming – Advanced Topics (accelerators, CUDA, OpenCL, PGAS), Introduction to Distributed Programming (architectures, programming models), Distributed Programming Issues/Algorithms (fundamental issues and concepts - synchronization, mutual exclusion, termination detection, clocks, event ordering, locking)

Unit IV
Distributed Computing Tools & Technologies I (CORBA, JavaRMI), Distributed Computing Tools & Technologies II (Web Services, shared spaces), Distributed Computing Tools & Technologies III (Map-Reduce, Hadoop), Parallel and Distributed Computing – Trends and Visions (Cloud and Grid Computing, P2P Computing, Autonomic Computing)

Textbook: Peter Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
References:
Hariri and Parashar (Ed.), Tools and Environments for Parallel & Distributed Computing, John Wiley, 2004.
David Kirk, Wen-Mei W. Hwu, Wen-mei Hwu, Programming massively parallel processors: a handson approach, Morgan Kaufmann, 2010.
Kay Hwang, Jack Dongarra and Geoffrey C. Fox (Ed.), Distributed and Cloud Computing, Morgan Kaufmann, 2011.

Subject Code: CSE533
Subject Name: Real-Time Operating Systems

Unit I – Introduction
Basic OS Principles and Structures review; Real-Time Systems – Basic Model, Characteristics, Hard vs. Soft, Applications; Real-Time Reference Model – Tasks and Types; Software Architectures – Petri nets, RTOS Architecture, Real-Time Kernels.

Unit II – Real Time Task Scheduling
Classification of Real-Time Scheduling Algorithms; Common Approaches; Clock Driven; Priority Driven – Earliest Deadline First, Rate Monotonic, Deadline Monotonic; Overview of Real-Time Multiprocessor Scheduling.

Unit III – Real-Time Resource Sharing/Synchronization
Resource Sharing among Real-Time Tasks – Contention and Control; Priority Inversion; Priority Inheritance Protocol; Highest Locker Protocol; Priority Ceiling Protocol.

Unit IV – Real World RTOSs
Features of RTOSs; UNIX and Windows as RTOSs – Pros and; POSIX Standard; Survey of Contemporary RTOSs – Case Study of any one, Porting to a Target; RTOS Benchmarking; RTOS Application Domains.

References
Andrew S. Tanenbaum, *Modern Operating Systems (Third Edition)*, Pearson Education.
David E. Simon, *An Embedded Software Primer*, Pearson Education.
Laplante, P., *Real-Time Systems Design and Analysis* (Third Edition), IEEE/Wiley Interscience.
Rajib Mall, *Real-Time Systems: Theory and Practice (Second Edition)*, Pearson Education.
Jane W.S. Liu, *Real-Time Systems (Sixth Edition)*, Pearson Education.
Raj Kamal, *Embedded Systems: Architecture, Programming and Design (Third Edition)*, Tata McGraw-Hill Education
Additional Reading
µC/OS II Reference manual, Programmers manual.
VXworks Programmers manual.
Getting started with RT-Linux, FSM Labs., Inc.

Subject Code: CSE534
Subject Name: Wireless & Mobile Computing

Unit I

Classification and types of Wireless telephones. Introduction to Cordless, Fixed Wireless(WLL), Wireless with limited mobility(WLL-M) and (Fully)Mobile Wireless phones. Introduction to various generations of mobile phone technologies and future trends. Wireline vs. Wireless portion of mobile communication networks. Mobile-Originated vs. Mobile-Terminated calls. Mobile-Phone numbers vs. Fixed-Phone numbers.

Unit II

Concept of cells, sectorization, coverage area, frequency reuse, cellular networks & handoffs. Wireless Transmission concepts; types of antennas; concepts of signal propagation, blocking, reflection, scattering & multipath propagation. Comparison of multiple access techniques FDM, TDM and CDM. Concept of Spread Spectrum(SS) techniques; Frequency Hopping SS . Direct Sequence SS and concept of chip-sequence.

Unit III

Concept of Forward and Reverse CDMA channel for a cell/sector. Concept/derivation of Walsh codes & Code Channels within a CDMA Channel. Simplified illustration of IS-95 CDMA using chip sequences. Purpose of Pilot, Sync, Paging, Forward Traffic Channels. Purpose of Access & Reverse TCs.

Unit IV

GSM reference architecture and components of Mobile Networks: MS, BTS, BSC, MSC; their basic functions and characteristics. Use of HLR and VLR in mobile networks. Handoff scenarios in GSM.

References Books:

K.Pahlavan, P.Krishnamurthy, “Principles of Wireless Networks”, PHI.
T. Rappaport, “Wireless Communications, Principles and Practice (2nd Edition)”,Pearson.
Andy Dornan, “The Essential Guide to Wireless Communications Applications”, Pearson.
Jochen Schiller, “Mobile Communications”, Pearson.

Subject Code: CSE5351
Subject Name: Cloud Computing

UNIT I
CLOUD COMPUTING FUNDAMENTALS (8 hours) 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 II
CLOUD APPLICATIONS (6 hours) Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

UNIT III
MANAGEMENT OF CLOUD SERVICES (12 hours) 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 IV
APPLICATION DEVELOPMENT (10 hours) Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

REFERENCES
Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 9780521137355], 2010.
Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.
Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 1 edition [ISBN: 1439834539],2010.

Subject Code: CSE5352
Subject Name: Network Security

Unit 1:
Part 1:Need for Security; Security Attack – Threats, Vulnerabilities, and Controls, Types of Threats (Attacks).[4L]
Part 2: Security Services – Confidentiality, Integrity, Availability; Information Security. Cryptology, cryptography and cryptanalysis [4L]
Part 3: Introduction to Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality. Random and Pseudorandom Numbers [4L]

Unit 2:
Part 1: Types of Encryption Systems – Based on Key, Based on Block; Confusion and Diffusion; [4L]
Part 2: Public-Key Cryptography and RSA. Classical Encryption techniques, Substitution and Transposition ciphers, one time pad, [4L]
Part 3: Block Ciphers and Data Encryption Standard. Advanced Encryption Standard, Block Cipher Modes of operation, Stream Ciphers and RC4 [4L]

Unit 3:
Part 1: Key Management, Diffie-Hellman Key Exchange, Stream ciphers, linear feedback shift register, Non-linear filter [4L]
Part 2: Digital Signatures, The RSA signature scheme, DSA algorithm [4L]
Part 3: Message Authentication and Hash Functions, MAC Algorithms, SHA-1, HMAC [4L]

Unit 4:
Part 1: Network Security: Electronic Mail Security, System Security: Intruders, Malicious Software [4L]
Part 2: The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Location [3L]
Part 2: Web Security Considerations, Secure Socket Layer and Transport Layer Security [5L]

References

- Paar, Christof, and Jan Pelzl. *Understanding cryptography: a textbook for students and practitioners*. Springer Science & Business Media, 2009.
- William, S., and Cryptography Stalling. "Network Security, 4/E." Prentice Hall. (2006).
- Forouzan, Behrouz A., and Debdeep Mukhopadhyay. *Cryptography and network security (Sie)*. McGraw-Hill Education, 2011.

Subject Code: CSE5353
Subject Name: Natural Language Processing

Unit I

Introduction to Natural Language Processing, Applications of NLP, Different levels of Language Analysis, Representation and Understanding, Linguistic Background, Grammar and sentence structure, Top down parser, Bottom up chart parser, Transition Network Grammars, Finite state Models and Morphological Processing. Feature Systems and Augmented Grammars, Morphological Analysis and Lexicon.

Unit II

Grammars for Natural Language, Encoding uncertainty : Shift Reduce Parsers, A deterministic parser, Partial Parsing, Ambiguity resolution , Part of speech tagging, Probabilistic Context free grammars, Best first parsing.

Unit III

Semantics and logical form, word sense and ambiguity, Speech acts and embedded sentences, defining semantic structure Semantic Interpretation an compositionality, A simple grammar and lexicon with semantic interpretation, Lexicalized semantic interpretation and semantic roles, Semantic interpretation using feature unification.

Unit IV

Selectional restrictions, Semantic filtering, semantic networks, statistical word sense disambiguation, statistical semantic preferences, Combining approaches to disambiguation. Grammatical relations, Semantic grammars, template matching, semantically driven parsing techniques, scooping phenomenon, co-reference and binding constraints.

REFERENCES

Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming.
Charniack, Eugene, Statistical Language Learning, MIT Press,.
Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press.

Semester – IV

Subject Code: CSE 541 to CSE 545
Subject Name: Major Project

Major project to be completed under the supervision of assigned faculty member on a topic to be selected in consultation with the supervisor.