Post Graduate Department of Computer Sciences,

The University of Kashmir, Srinagar - 190006

Curriculum and Evaluation Scheme for Master of Technology in Computer Science

2016 – 2018

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
CSE517x	Elective 2	Elective	4	0	0	4

List of Elective 1 Subjects:
i) CSE5161 Engineering Mathematics

List of Elective 2 Subjects:
i) CSE5171 Data Communications

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
CSE527x	Elective 2	Elective	4	0	0	4

List of Elective 1 Subjects:
i) CSE5261 Optimization Techniques

List of Elective 2 Subjects:
i) CSE5271 Algorithms and Complexity

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
CSE536x	Elective 2	Elective	4	0	0	4

List of Elective 1 Subjects:
i) CSE5351 Cloud Computing

List of Elective 2 Subjects:
i) CSE5361 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

Subject Code: CSE 511
Subject Title: 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: CSE 512
Subject Title: 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: CSE 513
Subject Title: 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 Title: CSE 514

Subject Title: 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: CSE 515
Subject Title: 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: CSE 5161
Subject Title: 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

Subject Code: CSE 5171
Subject Title: Data Communication

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: CSE-521
Subject Title: Network Protocols & Security

Unit I

Goals and applications of networks. LAN, MAN & WAN architectures. Concept of WAN subnet. 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: Interior (OSPF), Exterior (BGP). Transport Layer: UDP and TCP concepts.
Socket API for Network Programming.

Unit IV
Client-Server application development using TCP & UDP sockets. Basic Server Architectures. Network Security: Firewalls and their components; Encryption techniques and examples of encryption standards.

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: CSE-521L
Subject Title: Lab Network Protocols & Security

Unit I

Use of ipconfig on Windows and ifconfig on LINUX to examine network configuration; extract IP environment information. Use of ping application to demonstrate use of the ICMP protocol and its capabilities. Use of traceroute on LINUX to gather packet routing data. Use of netstat in gathering network statistics. Setting up IIS5.x or similar HTTP server on Windows platform for web-hosting.

Unit II

Development of simple network client-server application using TCP-related Socket API functions on LINUX. Use of crypt utility to demonstrate basic cryptography. Implementation of some cryptographic algorithms in C/C++ . Exploration of Network Programming API provided by Java Networking Package.

Reference Books:

1.Daniel Minoli, ”IP Networking”, McGraw Hill Publishing.
2. Douglas Comer, ”Internetworking with TCP/IP, Volume 1”, Prentice Hall.
3. W.Richard Stevens, “UNIX Network Programming”, Prentice Hall.

Subject Code: CSE522
Subject Title: Image Processing

Unit I

Introduction Digital Image processing, Origins of DIP, Examples, Fundamental steps in DIP, Components of DIP. Fundamentals Elements of visual perception, Light and the electro magnetic spectrum, Image Sensing and acquisition, Image sampling and quantization, basic relationships between pixels

Unit II
Image Enhancement Background, some basic gray level transformation, Histogram processing, enhancement using arithmetic /Logic operation, Basics of Spatial filtering, smoothing spatial filters, sharpening spatial filters

Unit III
Image enhancement Background , Introduction to the Fourier transform and the frequency domain, smoothing frequency- domain filters, sharpening frequency domain filters, homomorphic filters & implementation

Unit IV
Image restoration Noise models, restoration in the presence of noise only – spatial filtering, Periodic noise reduction by frequency domain filtering. Inverse filtering Image compression Fundamentals. Image compression models, error free compression,lossy compression

Text Books
Digital Image Processing by Woods & Gonzalez
Reference Books
Digital Image Processing, Kenneth R Castleman, Pearson Education,1995.
Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education ,2009. Pvt Ltd, NewDelhi
Fundamentals of Digital image Processing, Anil Jain.K, Prentice Hall of India, 1989. 5. Image Processing, Sid Ahmed, McGraw Hill, New York, 1995.

Subject Code: CSE 524
Subject Title: Image Processing Lab

Basics of an Image Processing (reading an image to mat lab, display pixel operations, flipping and cropping).

Viewing digital images, bits and bytes, raster scan format, quantization
Scaling, translation and rotation, sums and differences
Histograms and stretches, convolutional filters
Fourier transforms and the frequency domain, filters
FFTs, Image filtering: smoothing and sharpening
2D convolution and correlation
Creating multiple image sequences for the project
Image enhancement.
Image compression
Color image processing
Image segmentation
Image Morphology
Image Restoration
Edge detection in an Image
Blurring 8 bit color versus monochrome
Object Reorganization like circles and triangles.

Subject Code: CSE525
Subject Title: 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: CSE 5261
Subject Title: Optimization Techniques

Unit I
Linear programming –formulation-Graphical and simplex methods-Big-M methodTwo 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.

Subject Code: CSE 5271
Subject Title:: 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: CSE 531
Subject Title: 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: CSE 532
Subject Title: 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: CSE 533
Subject Title: 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: CSE-534
Subject Title: 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: CSE 5351

Subject Title: 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: CSE 5361

Subject Title: 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.

Subject Code: CSE 541 to CSE 545
Subject Title: 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.