DETAILED SYLLABUS
M.Tech (CORE COURSES)

Course: MT 701Combinotorics and Graph Theory
Course Prerequisites: First level course on Discrete Mathematics.
Course Objectives: Combinatorics and Graph Theory is one of the areas of mathematics that every computer science student should be familiar with. Most of the algorithms used in computer science are combinatorial in nature and are often based on graph theory concepts.
The intension of this course is to introduce the subject of Combinatorics and Graph Theory in a thorough way.

Course Contents: Graph, Sub Graph, Connected component , spanning trees , Shortest path algorithm, Cut-sets and Cut-Vertices: Cut-Sets, Properties of Cut-sets, All Cut-sets in a Graph, Fundamental Circuits and Cut-Sets, Connectivity and Separability, Network flows, 1-isomorphism, 2-isomorphism. Combinatorial Vs. Geometric Graphs, Planar Graphs, Kuratowski's Two Graphs, Different Representations of a Planar Graph, Detection of planarity, Geometric Dual, Combinatorial Dual, Matrix Representation of Graphs.

Chromatic Number, Chromatic Partitioning, Chromatic, Polynomial, Vertex Cover, Matchings, Pathcover, Connectivity, Hamiltonicity, Vertex Coloring, Edge Coloring, Four Color Problem and Other Coloring Problems.

Basic combinatorial numbers, recurrences, generating functions, Latin squares, partitions, partially orders sets, Types of Enumeration, Counting Labeled Trees, Counting Unlabeled Trees, Polya's Counting Theorem, Graph Enumeration with Polya's Theorem.

Main Reading:
1. Graph Theory with Applications to Engineering and Computer Science, Narasingh Deo, PHI.

Additional References:
1. Graph Theory and Combinatorics, Dr. D.S. Chandrasekharaiah, Prism, 2005.
2. Introduction to Graph Theory, Chartrand Zhang, TMH, 2006.
3. Graph Theory Modeling, Applications, and Algorithms, Geir Agnarsson & Raymond Geenlaw,Pearson Prentice Hall, 2007.
4. A Walk Through Combinatorics by Miklos Bona, World Scientific Publishing Company June 15, 2002.
5. Concrete Mathematics: A Foundation for Computer Science, by Ronald Graham, Donald Knuth, and Oren Patashnik.
6. A Course in Combinatorics, J. H. van Lint, R. M. Wilson Cambridge University Press January 29, 1993.
7. Combinatorial Methods with Computer Applications Jonathan L. Gross.
8. Graph Theory and Its Applications, Second Edition Jonathan L. Gross, Jay Yellen.

Course: CS 702 Advanced Data Structures & Algorithms
Course Prerequisites: First level course on Data Structures and Algorithms is desirable.
Course Objectives: To study efficient algorithms for a number of fundamental problems, learn techniques for designing algorithms using appropriate data structures.

Course Contents: Revision of Algorithm Analysis: Mathematical Background, Big-O notation, Running Time computation, different strategies of algorithm design – Divide and Conquer, Greedy, Dynamic Programming etc.

Amortized complexity, Introduction to external sorting, Selection trees & k-way merging, Double-ended priority queues, Interval heaps. Leftist trees, Binomial heaps, Fibonacci heaps, Fibonacci Analysis, Pairing heaps.

Dictionaries, Optimal Binary Search Trees, AVL trees, Red-black trees, B-trees, B*-trees. Splay trees, Binary Tries, Compressed Binary Tries. Tries and Packet Forwarding, High-order Tries, Suffix Trees, Bloom Filters, Segment Trees, Interval Trees, Priority Search Trees, Multidimensional Search Trees, k-d Trees, Quad Trees, BSP Trees, R-Trees.

Revision of basic graph traversal and search technique, Backtracking, Branch and Bound, NP-Hard and NP-Complete problems.

Approximation algorithms Vertex Cover, Set Cover, TSP.

Randomized Algorithms, Expected v/s Average time, pseudorandom generation, Numerical probabilistic algorithms, Monte Carlo algorithms, Las Vegas algorithms.

Main Reading:

1. Data Structures, Algorithms, and Applications in C++, McGraw Hill, NY, 2005 2nd ed.
2. Algorithm Design, Jon Kleinberg , Eva Tardos, Pearson
3. T. H Cormen, C.E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms ", Prentice Hall of India, 2001.

Additional References:

1. Fundamentals of Computer Algorithms 2nd ed. Horowitz, Sahni and Rajasekaran University Press
2. Fundamentals of Data Computer Algorithms
3. G. Brassard and Bratley, Fundamentals of Algorithmic, Prentice. Hall 1996.
4. Michael Garey and David Johnson, Computers and Intractability, A guide to the theory of NP-Completeness, W.H. Freeman and Company, New York, 1999

Course: MT 703 Stochastic Modeling and Analysis

Course Prerequisites: First level course on Probability & Statistics.

Course Objectives: An introduction to probability theory and stochastic models, as they apply to computer science. Key terms are random variables, probability distributions, sampling theory, random samples, etc. It will also consider Markov chains, a particular stochastic process that is frequently applied in stochastic modeling of computer and communication systems.

Course Contents: Probability Preliminary: Axiomatic approach of probability, Random variable- characteristics-mean, Variance, distribution function, E and V- operators, moment generating function (MGF) and characteristic function, function of multi-dimensional random variable.

Probability distributions: Discrete distributions: Binomial, Pascal, and Poisson- establishment and analysis Continuous distributions: Exponential, normal, lognormal, gamma and Weibull distributions and analysis-properties and limiting form, approximations.

Sampling Theory, Random Samples, Sampling Distributions, Estimation of parameters, Test of hypotheses on the Mean, Type I error, Type II Error, Test of Hypothesis on the equality of Two Means, Test of Hypothesis on a variance, Test of Hypothesis on the Equality of Two variances, Goodness of fit test

Pure birth process, Assumptions, derivation; birth and death queuing models- single and multiple Server queuing models- queues with finite waiting- finite source models, steady state measures Markov Chains – Introduction, Transition Probabilities, Homogeneous Markov Chains, Transition Probability Matrix, Initial Distribution, Absorbing States, Communication between States, Irreducible Markov Chains, Steady State Vector. Limitations of Markov process, Semi-Markov chains- establishment, transformation, system effectiveness prediction, Hidden Markov models (conceptual treatment) with selected applications restricted to Engg.

Main Reading:

1. William W. Hines & Doughlas C. Montgomery (2002), Probability and statistics in Engg and management science, John Wiley & Sons, 4th edition.
2. Kishor S. Trivedi (2000), Probability and Statistics with Reliability, Queuing and Computer Science Applications, Prentice Hall of India.
3. Sheldon M. Ross (2007), Introduction to Stochastic processes, Academic Press, USA, 9th edition.

Course Code: CS 704 Machine Learning
Course Prerequisites: First Course on Probability & Statistics.
Course Objectives: This course provides a broad introduction to machine learning and statistical pattern recognition.

Course Contents: Overview and Introduction to Bayes Decision Theory: Machine Intelligence and Applications, Pattern Recognition concepts, Classification, Regression, Feature Selection, Supervised Learning, Class conditional probability distributions, Examples of classifiers, Bayes optimal classifier and error, Learning classification approaches.

Linear machines: General and Linear Discriminants, Decision regions, Single layer neural network, Linear separability, general position, number of dichotomies, General gradient descent, Perceptron learning algorithm Mean square criterion and Widrow-Hoff learning algorithm.

Multi-Layer Perceptrons: Introduction to Neural Networks, Two-Layers Universal approximators, Backpropagation learning, on-line, off-line Error surface, important parameters.

Learning decision trees: Inference model, general domains, symbolic, Decision trees, consistency, Learning trees from training examples Entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm, Continuous test nodes, confidence, Pruning, Learning with incomplete data.

Instance-based Learning: Nearest neighbor classification, k-Nearest neighbor, Nearest Neighbor error probability, proof Simplification, Editing Example: Document retrieval, Case-based reasoning Example: learning graphical structures.

Machine learning concepts and limitations: Fundamental algorithmic-independent concepts, Hypothesis class, Target class, Inductive bias, Occam's razor, Empirical risk, Limitations of inference machines, Approximation and estimation errors, Tradeoff

Machine learning assessment and Improvement: Statistical Model Selection, Structural Risk Minimization, Practical methods for risk assessment based on re-sampling, Jackknife, Bootstrap, Improving accuracy of general algorithms, Bagging, Boosting.

Learning Theory: Formal model of the learnable, Sample complexity, Learning in zero-Bayes and realizable case, Growth function, VC-dimension, VC-dimension of Vector space of functions, proof, Empirical Risk Minimization over finite classes, sample complexity, proof, Empirical Risk Minimization over infinite classes, risk upper bound, proof Lower bound on sample complexity

Support Vector Machines: Margin of a classifier, Dual Perceptron algorithm, Learning non-linear hypotheses with perceptron, Kernel functions, implicit non-linear feature space, Theory: zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, Maximal Margin classifier, Learning support vector machines as a dual-optimization problem.

Unsupervised learning: Clustering, K-means, EM. Mixture of Gaussians, Factor analysis, PCA (Principal components analysis), ICA (Independent components analysis)

Reinforcement learning and control: MDPs. Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), LQG, Q-learning, Value function approximation, Policy search. Reinforce, POMDPs.

Main Reading:

1. The Elements of Statistical Learning: Data Mining, Inference and Prediction, Hastie.T, Tibshirani.R., and Friedman.J. Springer [2001].

Additional References:

1. Pattern Classification, Duda.R.O., Hart.P.E., and Stork.D.G., John Wiley and Sons (2001).
2. Pattern Recognition and Machine Learning, Bishop, Christopher M., Springer (2006).
3. An Introduction to Support Vector Machines, Shawe-Taylor J. and Cristianini N., Cambridge University Press (2000).
4. Kernel Methods for Pattern Analysis, Shawe-Taylor.J, and Cristianini N., Cambridge University Press (2004).

600 – Computer Graphic & Animation

Course Contents:

Basic background : 2D and 3D Transformations, Cyrus-Beck line clipping algorithm, Polygon clipping.

3D Viewing : Viewing pipeline, Parallel and Perspective projections, view volumes, clipping

Representing Curves and Surfaces: Parametric, curves, continuity conditions, cubic splines, Hermite interpolation, Bezier curves and surfaces, B-spline Curves- uniform nonrational, cubic periodic, open uniform, uniform, nonuniform rational types (NURBS), Subdividing curves, Displaying spline curves using forward difference scheme, parametric bicubic surfaces.

Solid Modelling: Sweep representation, Constructive solid geometry methods, representation through Octrees, Binary Space Partitioning trees.

Visible Surface Determination: Issues in Visible surface determination Coherence, perspective view, extents and bounding volume, backface culling, Z-Buffer and A-Buffer Algorithms, use of Binary Space Partitioning trees, representing 3D data using Octrees, Boolean operations on Octrees, marching cubes, Visible surface ray tracing.

Illumination Models & Rendering: Diffuse and Specular illumination model, reflection vector computation, Shading models for polygons – polygon mesh shading, Gouraud and Phong Shading, problems with interpolated shading, Bumpd mapping, Transparency, shadows, Ray tracing.

Introduction to Animation: Perception, Animation production, use in film and videos, orientation representation and interpolation – Euler angle representation, motion display considerations.

Animation – Low Level Control: Motion along a curve – computing are length, speed control – sine interpolatio User specified distance time functions, path following, key-frame systems – shape interpolation, free-form deformations, Morphing – 2D object warping.

Animation – High Level Control : Hierarchical modeling and Kinematics – inverse kinematics, Jacobian, rigid body simulation, collision detection, Particle systems – particle generation, attributes, termination, rendering, Flocking behavior – interacting with other members, leader, collision avoidance, modeling water, fire, explosions, waves, clouds.

Main Reading:

1. Foley, Van Dam, Feiner, Hughes, Computer Graphics – Principles and Practices 2nd edition, 1997, Addison Wesley.
2. Rick Parent, "Computer Animation: Algorithms and Techniques, 2001,, Morgan-Kaufman,
3. Hearn & Baker, Computer Graphics, 2nd Edition., 2003, Prentice Hall of India.

Supplementary Reading:

1. Woo, Neider, Davis, Shreiner,"Open GL Programming Guide" 3rd edition, 2000, Pearson Education.
2. D.A. Rogers, Procedural Elements for Computer Graphics, 2001, 2nd Edition, Tata MsGraw Hill.
3. Alan Watt and Mark Watt, "Advanced animation and Rendering techniques", 1992, Addison – Wesley.

601- Advanced Computer Graphics

Course Prerequisites: Knowledge of computer graphics fundamentals and ability to program in C/C++.

Course Objectives: This course will study advanced topics in computer graphics. The focus will be on learning recent methods in rendering, modeling, and animation.

Course Contents:

Rendering concepts, lighting, reflectance, Global Illumination, rendering equation, Monte Carlo Path Tracing, Radiosity, form factors, solution methods, meshing

Visibility & Textures: Visibility events, discontinuity meshing, texture mapping, resampling

Image-Based Modeling and Rendering: Managing Scene Complexity, Occlusion culling, detail elision, imposters, plenoptic function, image-based representations

3D Modeling: Object Representations, Mesh Representations,: mesh data structures, simplification, Triangle meshes, Multi-resolution meshes, progressive meshes, view-dependent simplification, Mesh Processing, Compression, streaming

Surface Modeling: Parametric surfaces, splines, piecewise polynomial surfaces, Subdivision of surfaces, subdivision schemes

Volumetric Modeling: Implicit surfaces, blobby models, skeletons, variational implicit surfaces, Volumetric Representations, voxels, volume graphics

Kinematics: Articulated figures, inverse kinematics, space-time constraints, Motion Capture, processing motion capture data, retargeting motion

Dynamics: Passive Dynamics, particle systems, spring-mass systems, Active Dynamics, controllers, learning, planning

Main Reading:

1. Alan Watt and Mark Watt, Advanced Animation and Rendering Techniques: Theory and Practice, Addison-Wesley,

Supplementary Reading:

1. Tom McReynolds and David Blythe, Advanced Graphics Programming using OpenGL, Elsevier
2. Peter Shirley and Steve Marschner and other, Computer Graphics, Cengage Learning
3. T. Theoharis, G. Papaioannou, N. Platis and N. Patrikalakis, Graphics and Visualization, A K Peters.

Website Links:

http://www.cs.princeton.edu/courses/archive/fall02/cs526/

602 - Elements of Computational Geometry and Geometric Modeling

Course Prerequisites: Algorithms & Data Structures.

Course Objectives: This course will cover topics in 2D and 3D geometry and its transformations, differential geometry of curves and surfaces, 3D geometry and coordinate transformations, curves and surface design, solid modeling, meshing and computational geometry data structures and algorithms.

Course Contents:

Basics in 2D and 3D geometry and transformations: Plane co-ordinate geometry, equations of lines and plane curves, parametric equations of lines and curves, intersection of parametric lines and curves, polar coordinates, vector representation of a point, line, plane, curve, continuity, tangent and curvature

Differential Geometry of curves and surfaces: Arc length and tangent vector, Principal normal and curvature, Binomial vector and torsion, Frenet-Serret formulae, tangent plane and surface normal, first fundamental form, second fundamental form, principal curvatures, Gaussian and mean curvature, Euler's theorem and Dupin's indicatrix

3D Geometry and Coordinate Transformations: Translation, rotation about arbitrary axis, scaling, reflection, shear and composite transformation, homogenous coordinates, projections parallel and perspective, taxonomy of projections

Curves and surface design: Parametric space of curves, blending functions, Spline curves, Bezier curves, B-Spline curves, rational polynomials, cylindrical surface, rules surface, surface of revolution, conic surfaces, composite surfaces, Bezier surface, B-spline surface

Solid modeling: Parametric space of solid, topology of closed path, piecewise flat surfaces, topology of closed curved surfaces, generalized concept of a boundary, set theory, Boolean operation operators, Euler operators, solid modeling representations cell decomposition and spatial occupancy enumeration, sweep representation, CSG

Meshes: Polygonal mesh representation, Basic mesh descriptions, Mesh topology, Triangulations and Tessellations, Winged edge data structures for meshes, Operations on meshes like Fairing, Smoothing, Remeshing etc.

Computational geometry data structures and algorithms: Line segment intersection, orthogonal range searching, Voronoi diagrams and Delaunay triangulations, convex hull, Quadtree, orthogonal range searching kD-tree, and binary space partitioning

Main Reading:

1. Patrikalakis, N. M., T. Maekawa, and W. Cho. Shape Interrogation for Computer Aided Design and Manufacturing. New York, NY: Springer Verlag, 2010.

Supplementary Reading:

1. de Berg, van Kreveld, Overmars, and Schwarzkopf. Computational Geometry: Algorithms and Applications,' by (2nd ed, Springer Verlag, 2000).
2. Farin, G. E. Curves and Surfaces for Computer Aided Geometric Design. 3rd ed. Academic Press, 1993.
3. Faux, I. D., and M. Pratt. Computational Geometry for Design and Manufacture. Halsted Press,1979.
4. Lawrence, J. D. A Catalog of Special Plane Curves. Dover, 1972.
5. Mortensen, M. E. Geometric Modeling. J. Wiley, 1985.
6. Mantyla M. An Introduction to Solid Modeling, Computer Science Press, 1988.

603 - Computer Vision

Course Prerequisites: Machine Learning

Course Objectives: To be able to understand and apply a series of probabilistic models of images and objects in computer vision systems.

Course Contents:

Two-dimensional visual geometry: 2D transformation family, Homography, Estimating 2D transformations, Image panoramas

3D image geometry: The projective camera, Camera calibration, recovering pose to a plane

Multiple Cameras: The fundamental and essential matrices, Sparse stereo methods, Rectification, Building 3D models, Shape from silhouette

Vision at a single pixel: Background subtraction and color segmentations problems, Parametric, non-parametric and semi-parametric techniques, Fitting models with hidden variables

Connecting pixels: Dynamic programming for stereo vision, Markov random fields, MCMC methods, Graph cuts

Texture: Texture synthesis, super-resolution and denoising, image inpainting The epitome of an image

Dense Object Recognition: Modelling covariances of pixel regions, Factor analysis and principle components analysis

Sparse Object Recognition: Bag of words, latent dirilecht allocation, probabilistic latent semantic analysis

Face Recognition: Probabilistic approaches to identity recognition, Face recognition in disparate viewing conditions

Shape Analysis: Point distribution models, active shape models, active appearance models

Tracking: The Kalman filter, the Condensation algorithm

Main Reading:

1. Computer Vision: Models, Learning, and Inference, Simon J.D. Prince, Cambridge University Press

Supplementary Reading:

1. Computer vision: algorithms and applications by Richard Szeliski.
2. Bayesian reasoning and machine learning by David Barber
3. Multiple view geometry in computer vision by Richard Hartley and Andrew Zisserman
4. Information theory, inference and learning algorithms by David MacKay
5. Feature extraction and image processing by Mark S. Nixon and Alberto S. Aguado
6. Pattern recognition and machine learning by Christopher M. Bishop

604 - Digital Image Processing

Course Prerequisites: - C/C++ programming skills

Course Objectives: The course will cover techniques and tools for digital image processing, and finally also introduce image analysis techniques in the form of image segmentation.

Course Contents:

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

Spatial Domain Filtering: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian

Filtering in the Frequency domain: Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering

Image Restoration: Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections

Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

Wavelet based Image Compression: Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

Morphological Image Processing: Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

Image Segmentation
Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

Main Reading:

1. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods Publisher: Pearson Education.

Supplementary Reading:

1. Fundamentals of Digital Image Processing By Anil K Jain.

Website Links:
http://www.ece.arizona.edu/~dial/

605 - Data Visualization

Course Prerequisites: - C/C++ programming skills

Course Objectives: To study important approaches in the field of Data Visualization and its techniques.

Course Contents:

What is Visualization, the visualization process, Data Foundations, types of data – continuous data, sampled data, discrete datasets, Human Perception and Information Processing, Visualization Foundations

Visualization Techniques for Spatial Data: 1D, 2D and 3D, Dynamic Data, Geospatial Data, Visualizing Point, Line and Area Data, Visualization Techniques for Multivariate Data, Visualization Pipeline

Visualization Techniques Graphs, Text and Document: Visualizing Trees, Graphs, and Networks, Displaying Hierarchical Structures, Arbitrary Graphs/Network, Levels of Text Representation, the Vector Space Model, Single Document Visualization, Document Collection Visualization,

Scientific Visualization: Scalar, Vector, Tensor Visualization, Domain Modeling Technique, Image and Volume Visualization

Interaction Concepts: Interaction Operators, Operands and Spaces, Interaction Techniques – Screen Space/Object Space, Data Space, Attribute Space, Animating Transformations, Designing Effective Visualizations Comparing and Evaluating Visualization Techniques, Visualization Systems

Main Reading:

1. Mathew Ward, Georges Grinstein, Daniel Keim, Intercative Data Visualization Foundation, Techniques and Applications, A K Peters 2010

Supplementary Reading:

1. Alexandru Telea, Data Visualization Principles and Practices, A K Peters 2010
2. Visualization Design and Analysis: Abstractions, Principles, and Methods by Tamara Munzner.

606 - Visual Computing

Course Prerequisites: - C/C++ programming skills

Course Objectives: The recent advances in the field of Visual Computing thrives on inputs from multiple disciplines, which are traditionally taught in separate courses in the University such as Computer Graphics, Computer Vision and Image Processing. This course on Visual Computing will attempt to provide a unified perspective to the underlying algorithms and data structure involved in modeling shape of the objects, its interactions with the light source in synthesizing imagery and retrieving 3D information from 2D images.

Course Contents:

Overview of Visual Computing: Visual computing and its relationship to traditional discipline like Computer Graphics, Computer Vision, Image Processing and Computational Geometry

Image synthesis: Understand the concepts - Captured image in 2D v/s synthesized image via modeling & rendering. Capturing of 3D data using scanning technology and reverse engineering the shape of the object

Geometric modeling: Data structures for object representation, Volume representation, Sweep representation, Cell decomposition, CSG, Boundary representation, Euler Operators, Beizier & B-Spline curves and surfaces

Meshes: Polygonal mesh representation, Basic mesh descriptions, Mesh topology, Triangulations and Tessellations, Winged edge data structures for meshes, Operations on meshes like Fairing, Smoothing, Remeshing etc.

Coordinate pipeline: Transformation principles, Geometry pipeline, Graphics pipeline, Vision pipeline, Advanced Coordinate pipeline

Image geometry: Sampling and Quantization, Region and edges, Image filtering, Edge detection, Contours, Textures, Warping and morphing of images, Interpolations, Colors, Half-toning and Dithering, High-dynamic range imaging, Image pyramids

Motion capture:Motion tracking, randomized incremental algorithms, computational geometry algorithms Delaunay triangulations, Voronoi diagrams, kD-trees, Clustering by kMeans

Main Reading:

1. Visual Computing: Geometry, Graphics and Vision by Frank Nielsen

Supplementary Reading:

1. Computer vision: algorithms and applications by Richard Szeliski.
2. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods Publisher: Pearson Education

607 – Image Processing and Computer Vision

Course Contents:

Introduction: Image formation model, representation, spatial and Gray Level resolution, Colour models- RGB, CMY and HIS models

Image Enhancement In Spatial Domain: Piecewise linear transformation, Histogram equalization, Histogram specification, image averaging, spatial filters – smoothing and sharpening, Laplacian filter, sobel operator, Canny edge detector.

Image Enhancement In Frequency Domain: 2D Discrete Fourier transform and its inverse, filtering in frequency domain, Ideal and Gaussian Low pass filters, high pass filtering, separability property 0f 2D Fourier transform, Fast Fourier Transform.

Image Segmentation: Line detection, Edge detection, Edge linking and boundary detection, Hough Transform, Thresholding, Region based segmentation

Morphological Image Processing: Logic operations involving binary images, Dilation and Erosion, Opening and closing, Applications to Boundary extraction, region filling, connected component extraction.

Image Compression: Coding redundancy- Huffman coding, LZW coding, run length coding, Lossy compression – Lossy predictive coding, transform coding- DCT, bit allocation, Compression standards – JPEG, video Compression.

Image Representation: Boundary description, Shape numbers, Fourier descriptors, Texture, principal Components based description.

3D Vision: Projective geometry, single perspective camera, stereopsis, the fundamental matrix – its estimation from image point correspondences, applications of epipolar geometry in vision, correlation based and feature based stereo correspondence, shape from motion, optical flow.

Main Reading:

1. Gonzalez and Woods, "Digital Image Processing"' 2002, Pearson education, Asia.
2. Sonka, Hlavac and Boyle Brooks/Cole, "Image Processing, Analysis, and Machine Vision", 1999, Thomson Asia Pte Ltd Singapore.

Supplementary Reading:

1. Jain and Rangachar, "Machine Vision", 1999, McGraw Hill International Edition.
2. Schalkoff, John Wiley and Sons, "Digital Image Processing & Computer
3. Vision", 1989, John Wiley and Sons.

608 – Multimedia Technologies

Course contents:

Fundamentals of Multimedia: What is multimedia? Components of multimedia, Overview of multimedia applications and multimedia authoring tools

Graphics and Image Representation: Fundamentals of image formation and data representations, Sampling and quantization, Contrast & brightness, Histogram methods, Simple image processing operations: Point processing,

Spatial filtering, Edge detection, Popular file formats: BMP, GIF, JPG, PNG etc.

Color Science and Color Models: Human vision, Camera systems, Gamma correction, Color matching, CIE Chromaticity, different Color models – RGB, CYMK, YUV, YIQ, Transformations among color model

Fundamental of Video: Different types of video signals – component, composite and S-video, Analog TV transmission systems - NTSC, PAL, Chroma sub-sampling, Display technology fundamentals – interlacing & progressing scanning, Digital video - HDTV

Fundamentals of Audio: Digitization of sound, Psychoacostics – frequency & temporal masking, Unit of sound measurement - Signal-to-Noise Ratio (SNR), Linear and non-linear quantization, Audio filtering and transmission, Coding of audio – PCM, DPCM, ADPCM, Audio quality versus data rate, Synthetic sounds, Popular file formats – MIDI system, WAV, MPEG etc.

Multimedia Data Compression: General data compression scheme – lossy v/s lossless, Modeling v/s encoding, Basics of information theory, Lossless compression algorithms – Run-Length Encoding (RLE), Variable-Length Coding (VLC) – Huffman Coding, Dictionary-based coding – LZW, Arithmetic Coding, Differential coding of images, Lossless JPEG, Lossy compression algorithms – Distortion Measure, Transform coding, Discrete Cosine Transform (DCT), Video compression, Image and video compression standards.

Multimedia Information Management – Multimedia database design, Content based information retrieval: image retrieval, video retrieval etc.

Main Reading:

1. Fundamentals of Multimedia by Ze-Nian Li & Mark S Drew published by Pearson Education International Edition
2. Supplementary Reading
3. R. Steinmetz and K. Nahrstedt, "Multimedia: Computing, Communications & Applications", by Pearson Education International Edition
4. Sayood Khalid “Title: Introduction To Data Compression” 3rd Edition, Publisher: Morgan Kaufmann Publishers Inc

609 - Game Programming

The video game development is currently a big business, bigger than the movie industry. Today, some of the highly paid programmers work in gaming industry. There is a high demand for people who know about various aspects of game programming. No Universities in India are currently offering a course on game programming. Teaching a course on game programming is a challenge because it's an ultimate course, integrating all the concepts learnt in Computer Science & Software Engineering. This course will be offered by practicing game developer who has over 10 years experience in Game development with some of the titles such as X-Men Legends, Star Wars: Jedi Knight, Doom 3 and Quake IV. The course will have lab associated with it and it will be a hands-on course.

Course Contents:

Introduction to Game Development: History of Computer Games, Input Devices and User Interfaces, Commercial Game Systems, Software Tools and Technology, Modeling, Simulation, Graphics , Game Main Loop, Programming and Common APIs, Games and Society, Future of Games

Game Engines: 2D/3D Game engines and the underlying technologies, Development of game using game engines, Typical functionality provided by a game engine, Hardware abstraction and Middleware, Console programming

Mathematics & Geometry: Vectors, Matrices, Transformations, Homogeneous Coordinates, Triangle Mathematics, Intersection Issues, Fixed-point Real Numbers, Parametric Curves

Computer Graphics: Basic Graphics systems, 3D Viewing, Synthetic Camera, RGB Color Model, Basics of rendering, Rendering Transformations, Rendering Pipeline

Game Physics: Rigid body motion, Collision Detection and Resolution, Deformable bodies

Character Motion: Inverse Kinematics, Character Animation, Key framing , Principles of Traditional Animation
Motion Capture, Motion Blending, Motion Retargeting

Terrain Modeling & Scene Management: Ground / Building / Static models / Dynamic models, Polygon mesh, Grids-2D, Quadtree, Height map, Procedural height map, Terrain Formats, Triangular mesh, Procedurally generated, Created by artists, Culling, Level of detail, Draw order, Off-screen rendering, Paging

Game Control System & AI: Search, Path Finding, Finite State Machines, Steering Behavior, Blind search, Heuristic search, A* search, Adversary search, Minmax search

Network Gaming : Multiplayer Games, Networking Models & Topologies,Topology: Client-Server vs. P2P, Computing Model: Distributed Object vs. Message Passing, Protocol: TCP vs. UDP, Socket-Level programming, Bandwidth / Latency tradeoffs

Current Issues: Consistency, Cheating in Games, Cheat Proofing, Massive Multiplayer Online Games (MMOGs)

Main Reading:

1. 3D Games: Volume 1: Real-Time Rendering and Software Technology, Alan Watt and Fabio Policarpo, Addison-Wesley.
2. 3D Games, Volume 2: Animation and Advanced Real-time Rendering, Alan Watt and Fabio Policarpo, Addison-Wesley.
3. Advanced Game Development with Programmable Graphics Hardware, Alan Watt and Fabio Policarpo, A K Peters.
4. Game Programming Gems 1-6, Mark DeLoura, Charles River Media.
5. AI Game Programming Wisdom 1-3, Steve Rabin, Charles River Media.

611 - Natural Language Processing

Course Prerequisites:

1. A previous course on Artificial Intelligence will help.
2. Courses of Data Structures and Algorithms should have been done.
3. Exposure to Linguistics is useful, though not mandatory.

Course Objectives: To study fundamental concepts of Natural Language Processing and to introduce the basics of Language processing from algorithmic viewpoint.

Course Contents:

Introduction, Machine Learning and NLP, ArgMax Computation, Word Sense Disambiguation: WordNet, Wordnet; Application in Query Expansion, Measures of WordNet Similarity.

Resnick's work on WordNet Similarity, Parsing Algorithms, Evidence for Deeper Structure; Top Down Parsing Algorithms, Noun Structure; Top Down Parsing Algorithms, Non-noun Structure and Parsing Algorithms.

Probabilistic parsing; Sequence labelling, PCFG, Probabilistic parsing: Training issues, Arguments and Adjuncts, Probabilistic parsing; inside-outside probabilities.

Speech : Phonetics, Hidden Markov Model, Morphology, Graphical Models for Sequence Labelling in NLP, Consonants (place and manner of articulation) and Vowels.

Forward Backward probability; Viterbi Algorithm, Phonology, Sentiment Analysis and Opinions on the Web, Machine Translation and MT Tools - GIZA++ and Moses, Text Alignment, POS Tagging.

Phonology; ASR, Speech Synthesis, Hidden Markov Model and Viterbi, Precision, Recall , F-score, Map, Semantic Relations; UNL; Towards Dependency Parsing.

Universal Networking Language, Semantic Role Extraction, Baum Welch Algorithm; HMM training.

Main Reading:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical
5. Natural Language Processing, MIT Press, 1999.

Supplementary Reading:

1. Radford, Andrew et. al .,Linguistics, An Introduction, Cambridge University Press, 1999.
2. Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine, Translation, Artificial Intelligence.
3. Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics(COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Annual Meeting of the Special Interest Group in Information Retrieval (SIGIR), Human Language Technology (HLT), International Conference on Natural Language Processing (ICON).

Website Links:

http://nptel.iitm.ac.in/courses/106101007/

612 - Computational Linguistics

Course Prerequisites:

1. A previous course on Artificial Intelligence will help.
2. Courses on Natural Language Processing should have been done.
3. Exposure to Linguistics is useful, though not mandatory.

Course Objectives: To introduce the advanced concepts in computational linguistics, modern grammar formalisms, Natural Language generation, etc.

Course Contents:

Tree Adjoining Grammars-Dependency Grammars-Statistical Parsing-Introduction to Semantic Processing-Semantic Knowledge Representation, Deep Structure and Logical
Form-Compositional Semantic Interpretation-Semantic Grammars-Case Frames and Case
Frame based Parsing.

Natural Language Generation-Problems in NL Generation-Basic Generation Techniques Hard Problems in NLP-Speech Understanding and Translation-Discourse Processing.

Lexical Functional Grammar: Active-Passive and Dative Constructions-Wh-movement in Questions-Overview of LFG-LFG Formalism-Well-formedness Conditions-Handling Wh movement in Questions-Computational Aspects.

Morphology and Finite State Transducers-Inflectional Morphology-Derivational
Morphology-Finite State Morphological Parsing-The Lexicon and Morphotactics Morphological Parsing with Finite State Transducers-Orthographic Rules and Finite-State
Transducers-Combining an FST Lexicon and Rules-Lexicon-Free FSTs.

Main Reading:

1. Alexander Clark, Chris Fox, and Shalom Lappin (Editors):The Handbook of Computational Linguistics and Natural Language Processing (Blackwell Handbooks in Linguistics).
2. Akshar Bharathi, Vineet Chaitanya, and Rajeev Sangal: Natural Language Processing: A Paninian Perspective. Prentice Hall of India.
3. James Allen: Natural Language Understanding. Benjamin/ Cummins.

Supplementary Reading:

1. Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine, Translation, Artificial Intelligence.
2. Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics(COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Annual Meeting of the Special Interest Group in Information Retrieval (SIGIR), Human Language Technology (HLT), International Conference on Natural Language Processing (ICON).

613 - Speech Processing

Course Prerequisites:

1. A previous course on Artificial Intelligence will help.
2. Courses of Data Communication and Digital Signal Processing should have been done.

Course Objectives: To study the fundamental concepts of Speech processing.

Course Contents:

Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production, Digital models for speech signals.

Introduction, Window considerations, Short time energy and average magnitude Short time average zero crossing rate, Speech vs. silence discrimination using energy and zero crossing, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Pitch Detection and using LPC Parameters.

Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, Mel frequency cepstrum computation.

Nature of interfering sounds, Speech enhancement techniques: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter.

Basic pattern recognition approaches, Parametric representation of speech, Evaluating the similarity of speech patterns, Isolated digit Recognition System, Continuous digit Recognition System.

Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMs, Adapting to variability in speech (DTW), Language models.

Issues in speaker recognition and speech synthesis of different speakers. Text to speech conversion, Calculating acoustic parameters, synthesized speech output performance and characteristics of text to speech, Voice processing hardware and software architectures.

Main Reading:

1. Digital processing of speech signals - L.R Rabiner and S.W. Schafer. Pearson Education.
2. Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd ed., IEEE Press.
3. Fundamentals of Speech Recognition. L.R Rabinar and B.H. Juang.

Supplementary Reading:

1. Discrete Time Speech Signal Processing: Principles and Practice - Thomas F. Quateri 1st ed., PE.
2. Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1 ed., Wiley.
3. Speech Recognition - Claudio Becchetti and Lucio Prina Ricotti, Wiley

614 - Sentiment analysis

Course Prerequisites: A previous course on Artificial Intelligence and Natural Language Processing will help.

Course Objectives: The objective is to study concepts of Sentiment analysis and opinion mining. Sentiment analysis and opinion mining is the field of study that analyzes people's opinions, sentiments, evaluations, attitudes, and emotions from written language. It is one of the most active research areas in natural language processing and is also widely studied in data mining, Web mining, and text mining.

Course Contents:

Sentiment Analysis Applications, Sentiment Analysis Research, Sentiment Analysis Research, and Opinion Spam Detection.
Problem of Sentiment Analysis: Problem Definitions, Opinion Summarization, Different Types of Opinions, Subjectivity and Emotion, Author and Reader Standing Point.

Sentiment Classification Using Supervised Learning, Sentiment Classification Using Unsupervised Learning, Sentiment Rating Prediction, Cross-Domain Sentiment Classification, Cross-Language Sentiment Classification
Sentence Subjectivity: Subjectivity Classification, Sentiment Classification, Dealing with Conditional Sentences, Dealing with Sarcastic Sentences, Cross-language Subjectivity and Sentiment Classification, Using Discourse Information for Sentiment Classification.

Basic Rules of Opinions and Compositional Semantics, Aspect Extraction, Identifying Resource Usage Aspect, Simultaneous Opinion Lexicon Expansion and Aspect Extraction, Grouping Aspects into Categories, Entity, Opinion Holder and Time Extraction, Word Sense Disambiguation.

Problem Definitions, Identify Comparative Sentences, Identifying Preferred Entities.

Web Search vs. Opinion Search, Existing Opinion Retrieval Techniques

Types of Spam and Spamming, Supervised Spam Detection, Unsupervised Spam Detection, Group Spam Detection.

Quality as Regression Problem, Other Methods.

Main Reading:

1. Sentiment Analysis and Opinion Mining, Bing Liu.

Supplementary Reading:

1. Journals: Computational Linguistics, Natural Language Engineering, Artificial Intelligence.
2. Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics(COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Human Language Technology (HLT), International Conference on Natural Language Processing (ICON).

615 - Machine Translation

Course Prerequisites:

1. A previous course on Artificial Intelligence and Natural Language Processing will help.
2. Knowledge on Machine Learning.
3. Exposure to Linguistics is useful, though not mandatory.

Course Objectives: To study important approaches to the automatic translation between natural languages.

Course Contents:

History-Translation process-Approaches-Rule-based-Statistical-Example based-Hybrid MT Major issues-Disambiguation-Named entities-Applications-Evaluation.

Language Similarities and Differences-The Transfer Metaphor-Syntactic Transformations Lexical Transfer.

The Interlingua Idea: Using Meaning-Direct Translation-Using Statistical Techniques Quantifying Fluency-Quantifying Faithfulness.

Statistical MT-Basis-Benefits-Word based translation-Phrase based translation- Syntax based translation-Challenges with statistical machine translation-Compound words- Idioms Morphology-Different word orders-Syntax-Out of vocabulary (OOV) words.

Main Reading:

1. Hutchins, W.John; and Harold L. Somers. An Introduction to Machine Translation London: Academic Press. 1992.
2. Allen, James: Natural Language Understanding. Benjamin/Cummins. 1995.
3. C.D. Manning and H. Schutze: Foundations of Statistical Natural Language Processing, MIT Press 2001.

Supplementary Reading:

1. Journals: Machine Learning, Machine, Translation, Artificial Intelligence.
2. Conferences: The Association for Machine Translation in the Americas(AMTA), Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics(COLING), International Conference on Natural Language Processing (ICON).

Website Links:

http://www.statmt.org/

616 – Compiler Design

Course Content:

Introduction to Compilers: Lexical analysis, Regular Expressions, Finite automation. N.F.A., N.F.A. to D.F.A. conversion, D.F.A., minimization of D.F.A., Lex tool.

Context Free Grammar: Derivations & Parse trees, Syntax analysis: Parsing, Top Down Parser, Recursive descent Parser, Predictive parsing, LL(1) Parsing table, Bottom Up Parsing, Shift Reduce parsing, Operator precedence parsing, LR Parsing methods, SLR, LRDL, LALR, YACC tool.

Syntax directed translation: Syntax directed translation schemes, Implementation of syntax directed translation schemes, Intermediate codes, Post fix notation parse trees & syntax trees, three address codes, quadruples, triples, Translation of assignment statements, Boolean expression, statements that after flow of control, Post fix translation, Translation with Up down parsing.

Error detection & recovery: Errors, lexical phase errors, Syntactic phase errors, semantic errors.

Code Optimization : Loop optimization, DAG representation of basic block, value numbers & algebraic laws, Global data flow analysis, Dominators, Reducible flow graph, Depth first search, Loop invariant computation, Induction variable elimination.

Data flow Analysis : Reaching definition, Available Expression , copy propagation, Backward flow problems, Very busy expression & code hoisting code.

Code Generation : A simple code generation, code generation from DAG & labeled trees.

Register allocation : Coloring by implication, coalescing, graph coloring implementation, Register allocation for Trees.

Main Reading:

1. Alfred V. Aho, Jeffreys D. Ullman & Ravi Sethi, “Principles of Computer Design“ Narosa Publication.
2. Trembley et al, “ Theory & Practice of Compiler Writing “, McGraw Publication.
3. Andrew W. Appel, “ Modern Compilers Implementation in Java”.
4. Dhamdhere “ Compiler Principles”.

617 – Theory of Computation

Course Contents:

Automata and Language Theory: Finite automata, regular expressions, push-down automata, context free grammars, pumping lemmas.

Computability Theory: Turing machines, Church-Turing thesis, decidability, halting problem, reducibility, recursion theorem.

Complexity Theory: Time and space measures, hierarchy theorems, complexity classes P, NP, L, NL, PSPACE, BPP and IP, complete problems, P versus NP conjecture, quantiers and games, provably hard problems, relativized computation and oracles, probabilistic computation, interactive proof systems.

Main Reading:

1. Sipser Michael. “Introduction to the Theory of Computation”. Thomson/Course Technology, 1996.

621 - Instructional Design for e-Learning

Course Objectives:

1. Apply the Understanding by Design framework to course design.
2. Investigate modern computer-based design tools.
3. Explore instructional methods and principles of design

Course Contents:

Personal Learning Environments, Instructional Design Foundations, Learning Outcomes Assessment
Content Creation: graphics
Cognitive Load Theory
Content Creation: audio and podcasting
Evaluation of Tools and Methods
Content Creation: video
Learning Management Systems, Designing for Accessibility
Content Creation: web-based tools

Main Reading:

1. Dick, W., Carey, L., & Carey, J. O. (2009). The systematic design of instruction (7th ed.). Boston: Allyn and Bacon.
2. Wiggins, G. P., & McTighe, J. (2005). Understanding by design (2nd ed., p. 370). Alexandria, VA: Association for Supervision and Curriculum Development.
3. Christensen, C. M., Horn, M. B., & Johnson, C. W. (2008). Disrupting class: How disruptive innovation will change the way the world learns. New York: McGraw-Hill.

622- Educational Technology

Course Objectives: This course is an introduction to the classroom applications of educational technologies. The course includes a survey of educational hardware and software.

Course Contents:

Technology in Education: Meaning, Evolution and Development

Traditional Educational Technology/Materials: Cone of Experiences: Direct and Purposeful (Games & Experiments), Contrived Experiences (Three Dimensional, Mock up, Diorama), Dramatized Experiences(Pageant, Socio-Drama), Demonstration Boards (chalkboard, peg board etc.), Field Trips, Exhibits, Still Pictures(drawings, graphs, cartoon, etc.)

Trends in Educational Technology: Projected materials, Audio Materials, Interactive Materials

ICT in Education: Computer, Internet, Multimedia/Hypermedia

Educational Technology in Instructional Planning: Multiple Intelligence, Learning Styles, Blooms Taxonomy

Technology and Student Assessment: Rubrics, Checklist, Blogs

Main Reading:

1. Teachers Discovering Computers, Integrating Technology in the Classroom, Second Edition by Shelly Cashman Gunter, (ISBN: 0-7895-6492-0).
2. Integrating Educational Technology into Teaching, Student Value Edition (6th Edition), M. D. Roblyer, Aaron H. Doering, Publisher: Pearson; 6 edition (February 25, 2012) ISBN-10: 013289680X, ISBN-13: 978-0132896801.

623 - Educational Game Design

Course Objectives: Understand Game design and to apply it for e-Learning.

Course Contents:

What is Gamification? : Introduction, Gamification defined, Why study gamification? History of gamification, Categories and examples

Games: Gamification in context, What is a game? Games and Play, Video games

Game Thinking: Why Gamify, Thinking Like a Game Designer, Design rules, Tapping the Emotions, Anatomy of Fun, Finding the Fun

Game Elements: Breaking Games Down, The pyramid of elements, The PBL Triad, Limitation of Elements, Bing Gordon interview

Psychology and Motivation: I: Behaviorism :-Gamification as motivational design, Behaviorism, Behaviorism in gamification, Reward structures, Reward schedules; Beyond Behaviorism :- Limits of behaviorism, Dangers of behaviorism, Extrinsic and intrinsic rewards, How rewards can de-motivate, Self-determination theory

Gamification Design Framework: Design Thinking, Business objectives/target behaviors, Players, Activity loops, Don't forget the fun and deploy

Design Choices: Two approaches to gamification, Is Gamification right for me?, Designing for collective good, Designing for happiness

Applying gamification for learning domains: declarative knowledge, conceptual knowledge, rules-based knowledge, procedural knowledge, soft skills, affetve domain, psychomotor domain
Social Good and Behavior Change: Gamification for good? Social good applications, Social good techniques, Behavior change

Critiques and Risks: Pointsification, Exploitationware, Gaming the game, Legal issues, Regulatory issues

Beyond the Basics: Going beyond the basics, Inducement prizes, Virtual economies, Collective action, The future of gamification

Main Reading:

1. For the Win: How Game Thinking Can Revolutionize Your Business, Kevin Werbach , Dan Hunter, Wharton Digital Press, ISBN-10: 1613630239, ISBN-13: 978-1613630235
2. The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education, Pfiefer Pub.

631- Distributed Databases

Course Objectives: This course will introduce principles and foundations of distributed databases, including architecture, design issues, integrity control, query processing and optimization, transactions, and concurrency control.

Course Contents:

Features of Distributed versus Centralized Databases, Principles Of Distributed Databases , Levels Of Distribution Transparency, Reference Architecture for Distributed Databases , Types of Data Fragmentation, Integrity Constraints in Distributed Databases.

Translation of Global Queries to Fragment Queries, Equivalence Transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.

Optimization of Access Strategies, a Framework for Query Optimization, Join Queries, General Queries.

The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions.

Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.

Reliability, Basic Concepts, Nonblocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection.

Architectural Issues, Alternative Client/Server Architectures, Cache Consistency Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution , Transaction Management, Transaction Management in Object DBMSs , Transactions as Objects.

Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues. Transaction Management Transaction and Computation Model Multidatabase Concurrency Control, Multidatabase Recovery, Object Orientation And Interoperability Object Management Architecture CORBA and Database Interoperability Distributed Component Model COM/OLE and Database Interoperability, PUSH-Based Technologies

Main Reading:

1. Principles of Distributed Database Systems, M.Tamer Ozsu, Patrick Valduriez - Pearson Education.

Supplementary Reading:

1. Distributed Database Principles & Systems, Stefano Ceri, Giuseppe Pelagatti McGraw-Hill.

632 - Design Of Distributed Systems

Course Objectives: This course will introduce principles and foundations of distributed systems, including architecture, functional models, distributed operating systems, distributed resource management, introduction to distributed algorithms, and resource security and protection.

Course Contents:

Introduction – Examples of Distributed Systems – Resource Sharing and the Web – Challenges- System Models - Introduction – Architectural Models – Functional Models- Characterization of Distributed Systems – Client-Server Communication – Distributed Objects and Remote Invocation – Communication Between Distributed Objects – Remote Procedure Call – Events and Notifications.

Distributed Operating Systems - Introduction – Issues – Communication Primitives – Inherent Limitations - Lamport's Logical Clock; Vector Clock; Causal Ordering; Global State; Cuts; Termination Detection. Distributed Mutual Exclusion – Non-Token Based Algorithms – Lamport's Algorithm - Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm – Distributed Deadlock Detection – Issues – Centralized Deadlock-Detection Algorithms - Distributed Deadlock-Detection Algorithms. Agreement Protocols – Classification - Solutions –Applications.

Distributed Resource Management - Distributed File systems – Architecture – Mechanisms – Design Issues – Distributed Shared Memory – Architecture – Algorithm – Protocols – Design Issues. Distributed Scheduling – Issues – Components – Algorithms.

Introduction to Distributed Algorithms, Kinds of Distributed Algorithm, Timing Models. Synchronous Network Algorithms: Synchronous Network Model, Leader Election in a synchronous Ring, Algorithms in a General Synchronous Networks, Distributed Consensus with Link Failures, Distributed Consensus with Process failures, More Consensus problems.

Resource Security and Protection - Introduction – The Access Matrix Model – Implementation of Access Matrix Model – Safety in the Access Matrix Model – Advanced Models of protection – Data Security.

Main Reading:

1. George Coulouris, Jean Dellimore and Tim KIndberg, "Distributed Systems Concepts and Design", Pearson Education, 4th Edition, 2005 [Unit-I].
2. Mukesh Singhal and N. G. Shivaratri, "Advanced Concepts in Operating Systems", McGraw-Hill, 2001 [Units II - IV].
3. Joshy Joseph and Craig Fellenstein, "Grid Computing", IBM Press, 2004. [Unit –V].
4. Ajay D. Kshemkalyani and Mukesh Singhal, " Distributed Computing – Principles, Algorithms and Systems", Cambridge University Press, 2008.
5. Pradeep K. Sinha, Distributed Operating Systems, PHI, 2005.
6. Nancy A. Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, 2000.

633 - Systems Performance Evaluation

Course Objectives: The objective of this course to understand the fundamental concepts of computer system performance evaluation. This will include introduction to mathematical modelling techniques (Markov Chains, Queuing Theory and Networks of Queues), workload characterization, measurement of performance metrics, Linear Regression Models.

Course Contents:

The art of performance evaluation – Professional organizations, journals, and conferences - Performance Projects – Common Mistakes in Performance Evaluation – A systematic approach to Performance Evaluation – Selection of techniques – Performance metrics - Utility classification – Setting performance requirements.

Types of workloads – Instruction mixes – Kernels – Synthetic Programs – Application Benchmarks – Art of Workload selection - services exercised – level of detail – Representativeness – Timeliness – Other considerations in Workload selection - Workload Characterization Techniques – Terminology – Averaging – Specifying Dispersion – Single Parameter and Multi parameter Histograms – Principal-Component Analysis – Markov models – Clustering.

Monitors – Terminology – Classifications – Software and Hardware Monitors – Firmware and Hybrid Monitors – Distributed-System Monitors – Program Execution Monitors – Accounting Logs – Analysis and Interpretation of log data – Capacity Planning and Benchmarking – Load Drivers – Remote-Terminal Emulation –Art of Data Representation – Guidelines for preparing good graphical charts – Gantt Charts – Kiviat Charts – Schumacher Charts.

Summarizing Measured Data – Basic Probability and Statistics Concepts – Geometric Mean – Harmonic Mean – Mean of a Ratio – Index of Dispersion – Determining Distribution of Data - Sample versus Population – Confidence Interval for the Mean – Testing for a Zero mean - Hypothesis Testing versus Confidence Intervals – Confidence Intervals for Proportions – Determining Sample Size.

Linear Regression Models – Distributions: Bernoulli, Binomial, Chi-Square, Exponential, Geometric, Normal, Pareto, Poisson, Student's t, Continuous and Discrete Uniform – Relationships among distributions – Queuing Theory – Notation – Rules – Little's Law Birth-Death Processes – M/M/1, M/M/m, M/M/m/B queues – Queuing Network Models for Computer Systems.

Main Reading:

1. R.K.Jain, "The Art of Computer Systems Performance Analysis – Techniques for Experimental Design, Measurement, Simulation, and Modeling", Wiley-India, 2008.
2. R.Pannerselvam, "Research Methodology", PHI, 2004.

634 - Cloud And Utility Computing

Course Objectives: To study important approaches in the field of Cloud and Utility Computing.

Course Contents:

Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-aService – Platform-as-a-Service – Software-as-a Service – Building Cloud Network.

Federation in the Cloud - Presence in the Cloud - Privacy and its Relation to Cloud-Based Information Systems – Security in the Cloud - Common Standards in the Cloud – End-User Access to the Cloud Computing.

Introduction - Advancing towards a Utility Model – Evolving IT infrastructure – Evolving Software Applications – Continuum of Utilities- Standards and Working Groups – Standards Bodies and Working Groups – Service Oriented Architecture – Business Process Execution Language – Interoperability Standards for Data Center Management - Utility Computing Technology – Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment - Data Center Challenges and Solutions - Automating the Data Center.

Software Utility Application Architecture - Characteristics of an SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework - Common Enablers – Conceptual view to Reality – Business Profits - Implementing Database Systems for Multitenant Architecture.

Other Design Considerations - Design of a Web Services Metering Interface - Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service - Application Transformation Program - Business Model Scenarios - Virtual Services for Organizations - The Future.

Main Reading:

1. John W. Rittinghouse and ames F. Ransome, “Cloud Computing Implementation, Management and Security”, CRC Press, Taylor & Francis Group, Boca Raton London New York. 2010 [Unit 1 and Unit 2].
2. Alfredo Mendoza, “Utility Computing Technologies, Standards, and Strategies”, Artech House INC, 2007 . [Unit 3 to Unit 5].
3. Guy Bunker and Darren Thomson, “Delivering Utility Computing”, John Wiley & Sons Ltd, 2006.

635 - Data Analytics

Course Objectives: To Learn about the most effective data analytics methods to solve problems and achieve insight.

Course Contents:

Data: types of data, data quality, data preprocessing, measures of similarity and dissimilarity, Exploring data: Iris dataset, summary statistics, visualization.

Data Warehousing and OALP; Aggregation Operations, models for data Warehousing, star schema, fact and dimension tables Life cycle of data warehouse development, data warehouse architecture, efficient methods of data cube computation, relationship between data warehouse and data mining.

Association Analysis: Frequent itemset generation, rule generation, compact representation of frequent itemsets, FP-growth algorithm, evaluation of association patterns.

Association Analysis: advanced topics: handling categorical and continuous attributes, Handling concept hierarchy, sequential patterns, subgraph patterns, infrequent patterns.

Classification: general approach, decision tree induction, model overfitting, evaluating performance of a classifier, methods of comparing classifiers.

Classification: alternative techniques: rule based classifier, nearest neighbor classifier, Bayesian classifier, ANN, SVM, ensemble methods.

Cluster Analysis: K-means, agglomerative hierarchical clustering, DBSCAN, cluster evaluation, density based clustering, BIRCH, CURE.

Anomaly detection: statistical approaches, proxy-based outlier detection, density-based outlier detection, cluster based techniques.

Main Reading:

1. Peng-Ning Tan,Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education.
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques," 1st Edition Indian Reprint 2001, Harcourt India Private Limited, ISBN 1-55860-489-8.
3. Arun K Pujari, "Data Mining Techniques". Universities Press.

636 - Information Retrieval

Course Objectives: Basic and advanced techniques for text-based information systems: efficient text indexing; Boolean and vector based retrieval models; Web search including crawling.

Course Contents:

Overview of Information Retrieval: Function of an IR system, Kinds of IR systems, Components of an IR system, Problems in designing an IR system.The nature of unstructured and semi-structured text.

Text Analysis and Indexing: Preliminary stages of text analysis and document processing, tokenization, stemming, lemmatization, stop words, phrases, Indexing: Boolean IR models, inverted files, indexing, signature files, PAT trees, Positional indices. Vector-based IR models: TF/IDF term weighing, similarity measures, test collections and issues.

Index construction and Compression: Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Blocking. Extreme compression.

Query Processing: Query expansion: spelling correction and synonyms. Wild-card queries, permuterm indices, n-gram indices. Edit distance, soundex, language detection.

Matching techniques: Similarity between documents and queries, Parametric or fielded search. Document zones. The vector space retrieval model, tf.idf weighting. Scoring documents, vector space scoring, the cosine measure, efficiency considerations, reduced dimensionality approximations, Latent Semantic Indexing (LSI), random projection, Page Ranking and HITS.

Information Extraction: Information extraction, Named entity extraction, Question Answering. Summarization - Qualities of good summary, summary types, extract summary.

Evaluation of IR systems: Assessment of the performance of IR systems - Precision, Recall, F-Measure. Criteria for evaluation, measuring 'goodness', tests of IR systems. Presentation of search results, display of search results, manipulation of search results.

Relevance feedback: User modeling and information need: user profiling, Relevance judgments. Additional term selections to the system, Dynamic respond ally to judgments and selections, Personalization of search.

Taxonomy and Ontology: Creating domain specific ontology, Ontology life cycle.

Distributed and Parallel IR: Relationships between documents, Identify appropriate networked collections, Multiple distributed collections simultaneously.

Web Search Engines: Web crawlers, robot exclusion, Web data mining, Metacrawler, Collaborative filtering, Web agents (web shopping, bargain finder,..), Economic, ethical, legal and political issues.

Multimedia IR: Techniques to represent audio and visual document, Query databases of multimedia documents, Display the results of multimedia searches.

Main Reading:

1. Managing Gigabytes, by I. Witten, A. Moffat, and T. Bell.
2. Modern Information Retrieval, by R. Baeza-Yates and B. Ribeiro-Neto.
3. Information Retrieval: Algorithms and Heuristics by D. Grossman and O. Frieder

637 – Data Warehousing and Data Mining

Course Objectives: Data warehousing and data mining are the essential components of decision support systems for the modern day industry and business. These techniques enable the knowledge worker (analyst, manager, executive) to make better and faster decisions. The objective of this course is to introduce the student to various Data Ware housing and Data Mining concepts and techniques. A database perspective has to be used throughout the course to introduce principles, algorithms, architecture, design and implementation of data mining and data warehousing techniques.

Course Contents:

Introduction and Background: Introduction to the multidisciplinary field of data mining,. Discussion on the evolution of database technology that has led to the need for data warehousing and data mining. Stress on importance of its application potential. Introduction to the different key words and techniques.

Data Warehousing And OLAP: Insight of data warehouse and on-line analytical processing, Aggregation Operations, models for data Warehousing, star schema, fact and dimension tables Conceptualization of data warehouse and multidimensional databases. Life cycle of data warehouse development. Relationship between data warehouse and data mining.

Data Mining Primitives: Data preprocessing including data cleaning, data integration, data transformation. Definition and Specification of a generic data mining task. Description of Data mining query language with few example queries.

Association Analysis: Different methods(algorithms) for mining association rules in transaction based data bases. Illustration of confidence and support. Multidimensional and multilevel association rules. Classification of association rules. Discussion on few association rule algorithms e.g. Apriori, frequent pattern growth etc.

Classification and Predictions: Different Classification algorithm, including C4.5, CART etc., use of genie index, decision tree induction, Bayesian classification, neural network technique of back propagation, fuzzy set theory and genetic algorithms.

Clustering: Partition based clustering, Hierarchical clustering, model based clustering for continuous and discrete data. Discussion on scalability of clustering algorithms. Parallel approaches for clustering.

Web Mining: Web usage mining, web content mining, web log attributes. Use of web mining in efficient surfing and personalization

Mining Complex Type of Data: Data mining issues in object oriented data bases, spatial data bases and multimedia data bases, time series data bases, and text data bases.

Applications of Data Warehousing And Data Mining: Exploration of web sites on data ware housing and data mining applications including bibliography data bases, Corporate Houses and Research labs.

Main Reading:

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques," 1st Edition Indian Reprint 2001, Harcourt India Private Limited, ISBN 1-55860-489-8.
2. Margaret Dunham, "Data Mining: Introductory and Advanced Topics," 1st Edition, 2003, Prentice Hall (Pearson Publication), ISBN 0-13-088892-3.
3. Arun K Pujari, "Data Mining Techniques". Universities Press.

Supplementary Reading

1. T. Mitchell, "Machine Learning", 1997, McGraw Hill.
2. S.M. Weiss and N. Indurkhya, "Predictive Data Mining", 1998, Morgan Kaufmann.
3. M. Jarke, M. Lenzerni, Y. Vassiliou, and P. Vassiladis, "Fundamentals of Data Warehouses", 2000, Springer Verlag, Isbn 3-540-65365-1.

638 – Geographical Information Systems

Course Objective: This course will provide introduction to Geographical Information Systems from the point of view of software developers. The underlying technology and how to apply GIS in decision making will be discussed. At the end of the course, the Learner should be able to understand the spatial terminology and build applications using open source GIS tools.

Course Contents:

Introduction to GIS: GIS definition, key components, functions of GIS, benefits, relationship with other disciplines, issues, application areas.

Spatial Data Structures: spatial data models- Raster and vector data models, Quad-tree, R-tree- searching, insertions, deletion algorithms. Topology and topological models- 9 Intersection model.

Spatial data base fundamentals: Extended ER diagram for spatial entities. Spatial data model, object relational mode, ex. Oracle spatial data model

spatial data models: ISO 19101 data model, geometry classes, basic element types, SDO-GEOMETRY structure and operations

Spatial indexing: principles, benefits, index types, implementation in Oracle.

Spatial SQL: (operators and functions) terminology, principles, set based operations, topological operations. Spatial joins. Spatial functions.

Network modelling: motivation, general network concepts, Network data model and metadata, spatial indexes on NM, shortest path and other functions. Directed and undirected networks, Traveling salesperson problem, reachability analysis, spanning tree

spatial data infrastructure and OpenGIS: introduction, components of SDI. Standards.

Main Reading:

1. Geographic Information Systems and Science, Longley, Goodchild, Rhind, Wiley & Sons
2. The Design and Analysis of Spatial Data Structures by Hanan Samet, Addison Wesley
3. Spatial Databases- A Tour by Shekhar Chawla, Upper Saddle River, NJ, USA, Prentice Hall.
4. Pro Oracle Spatial, R. Kothuri & Beinat, E, APRESS, USA.

640 - Programming Paradigms

Course Contents:

Introduction : Principles of Language Design, Programming Paradigms and Application Domains, Pragmatic Considerations, A Brief History of Programming Languages, Programming Language Qualities, What's in a Name? Goals of This Study

Syntax: Formal Methods and Language Processing, Syntactic Analysis, Linking Syntax and Semantics

Type Systems and Semantics: Type Systems, Semantic Domains and State Transformation, Operational Semantics, Axiomatic Semantics, Denotational Semantics

Imperative Programming: Von Neumann Machines and Imperative Programming, Naming and Variables, Elementary Types, Values and Expressions, Syntax and Semantics of Statements in Real Languages, Scope, Visibility, and Lifetime, Syntax and Type System for Methods and Parameters

Object-Oriented Programming: Data Abstraction and Modular Programming, The Object-Oriented Model, Example: Expression Evaluation, Concordance, Backtracking, Correctness

Functional Programming: Functions and the Lambda Calculus, Scheme: An Overview, Debugging, Example: Scheme Applications, Program Correctness, Applications of Functional Programming Languages

Logic Programming: Logic, Predicates, and Horn Clauses, Prolog: Facts, Variables, and Queries, Lists, Practical Aspects of Prolog,

Event-Driven Programming: Foundations: The Event Model, The Event-Driven Programming Paradigm, Applets, Event Handling

Concurrent Programming: Concepts, Communication, Deadlocks and Unfairness, Semaphores, Monitors, Java Threads, Synchronization in Java

Main Reading:

1. Programming Languages: Principles and Paradigms by Allen Tucker & Robert Noonan, McGraw Hill.
2. Programming Languages: Design and Implementation by Terrence W.Pratt, Marvin V Zelkowitz

641 - Programming using Python (2 credits)

Course Contents:

Overview Python Language: Lexical Conventions and Syntax, Types and Objects, Operators and Expressions, Flow Control and Exceptions, Modules

Python's Programming Paradigms: Imperative/Procedural/Scripting, Functional Programming, Object Oriented Programming Working with Python: Tools and Environment

The Python Library: String and Text Handling, Data Structures and Algorithms, Threading, Networking, Web Programming, Graphical Programming, Database Access

Main Reading:

1. John Zelle, Python Programming: An Introduction to Computer Science, (SECOND EDITION), Franklin, Beedle & Associates Inc.
2. Wesley J. Chun, Core Python Programming, 2/E
3. Michael Dawson, Programming with Python: A User's Book

642 – Parallel Programming

Course Contents:

Processes and processors Shared memory, fork join constructs, Basic parallel programming techniques, loop splitting, spin locks, contention barrier and row conditions.
Variations in splitting self and indirect scheduling. Data dependency, forward and backward block scheduling.
Linear recurrence relations, backward dependency, Performance tuning overhead with number of processes, effective use of cache.
Parallel programming examples, Average, mean squared deviation, curve fitting, numerical integration, travelling salesman problem, gaussian elimination, Discrete event time simulation.
Parallel Programming constructs in HPF, FORTRAN 95, Parallel programming under UNIX.

Main Reading:

1. Brawer S, Introduction to parallel programming, Academic Press, New York, 1989.

643 – Java Programming

Course Contents:

An overview of object oriented programming and Terminology : Abstraction variable and methods, encapsulation interfaces, messages : object communicating with objects, modularity, classification, inheritance.

Overview of JAVA Language, Java development environment, Language fundamental: How Java differs from C: Programs structure and environment, name space: Packages, classes and members, commands, no pre-processor, Unicode and character escape, primitive data types, reference data types objects, array, strings, operators, statement, exceptions and exception handling.

Classes and Objects in Java : Introduction to Class and Objects, object creation, class variables class methods, object destruction, subclass and inheritance overriding methods, data hiding and encapsulation, abstract class and interface.

String and Arrays : Strings arrays and Utility classes.

Input/Output : Streams standard system streams. IO streams, filtered stream.

Abstract windowing toolkit : AWT overview, graphics, fonts, colors, images, java controls, layout components, new AWT features.

Applets Introduction to Applets: Applet designing basics, drawing graphics, handling events, reading applet parameters, images and sounds, JAR files, applet security restriction, signed applet-weaving Applet into web pages.

Threads : Using thread in applets, creating threaded objects, threaded attributes, thread priority, multithreaded programs.

Events : Java 1.0 Event model, Java 1.1 Event model.

Object serialization, Java beans, Internalization, reflection.

Main Reading:

1. A complete reference for Java " Herbert Schmidt.
2. Java in Nutshell" David Flanagan, - O'Reillyo
3. Java Programming, Balaguruswamy

644 - Learning Computer Programming by Building Android Apps (2 credits)

Course Description:
Students will learn programming and fundamentals of app development by building a series of Android apps during this course. The class will be project based, and will employ a "learning by doing" approach. Students will work on apps using the App Inventor visual programming platform originally developed by Google and now hosted and maintained by MIT Media Labs. Class projects will include development of apps based on the embedded TinyDB database, and location sensitive apps based on GPS inputs. The class will culminate in group projects involving the development of apps of local relevance.

Course Contents:

Introduction to App Inventor: The architecture of a smartphone app. Event handlers and event driven programming.

Animation and creating smart phone games: Programming with canvases, sprites and timers. Making use of location sensors. Responding to SMS and scanning barcodes.

Creating apps with data and forms : Storing and retrieving persistent data in an app.

Main Reading:

1. App Inventor: Create Your Own Android Apps, by David Wolber

650 - Human Computer Interaction

Course Objectives: To build human-centered design skills, so that you have the principles and methods to create excellent interfaces with any technology.

Course Contents:

Introduction: Human-Computer Interaction, The Power of Prototyping, Evaluating Designs, The Birth of HCI

Needfinding: Participant Observation, Interviewing, Additional Needfinding

Rapid Prototyping: Paper Prototyping and Mockups, Video Prototyping, Creating and Comparing Alternatives

Heuristic Evaluation: Heuristic Evaluation — Why and How? Design Heuristics

Direct Manipulation and Representations: Direct Manipulation, Mental Models, Representations Matters, Distributing Cognition

Visual Design and Information Design: Visual Design, Typography, Grids and Alignment, Reading and Navigating

Designing experiments: Designing Studies That You Can Learn From, Assigning Participants To Conditions, In-Person Experiments, Running Web Experiments, Comparing Rates.

Main Reading:

1. Alan Dix, Janet Finlay, Gregory D. Abowd, and Russell Beale, Human-Computer Interaction (3rd Edition), Pearson, 2004.
2. Ben Shneiderman and Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition), 5th ed., Pearson Addison-Wesley, 2009
3. Donald A. Norman, The Design of Everyday Things, Basic Books, 2002

651 - Agile Software Engineering

Course Objectives: The objective of the course is to provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.

Course Contents:

Introduction to Agile Software Development: Understanding how traditional software development works and it's problems; Role of Agile practices in the world of software development & Tools used

Agile Project Planning And Management: Requirement Analysis, Estimation techniques, Iteration planning, Introduction to development practices:TDD : Test Driven Development & Pair Programming, Introduction to QA Practices:Fail Fast & Automated functional testing, Introduction to Continuous Integration

Coding and testing practices: Practicing TDD and pair programming as alternative to traditional documentation; Configuring Continuous Integration tools; Automated function testing in detail, Source Control

Agile Software development and deployment: Iterative and incremental software development, Automated and scripted deployment strategies, Handling change requests

Main Reading:

1. Agile Software Development with Scrum, Ken Schwaber, Mike Beedle, Prentice Hall
2. Agile Estimating and Planning by Mike Cohn, Prentice Hall PTR
3. Continuous Integration: Improving Software Quality and Reducing Risk, Paul M. Duvall, Steve Matys, Andrew Glover, Addison Wesley
4. Leading Lean Software Development: Results Are not the Point Mary Poppendieck , Tom Poppendieck

652 – Software Architecture, Design Patterns and Frameworks

Course Contents:

Principles of good OO design: Inheritance versus delegation, program to an interface.

Design patterns: Motivation, reusability, extendibility, cataloging patterns, "GoF" patterns

Software architecture: Definition, advantages, components and connectors, views, documenting, evaluating, mining

Architectural patterns: Layered, pipe & filter, MVC, broker, microkernel, broker, peer to peer, plug-in, event bases software, SOA, middleware architectures

Frameworks: Enterprise frameworks, EJBs

Software product lines: Economies of scope, product line development, product development

Model driven architecture: PIM, PSM, transformation, software factories

Anti-patterns: Case studies

Main Reading:

1. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Pearson Education
2. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, Pearson Education
3. Frank Buchmann, Regine Munier, Hans Rohnert, Peter Sommerland, Michael Stahl, Pattern Oriented Software Architecture-I, Pearson Education
4. Christine Hofmeister, Robert Nord, Dilip Soni, Applied software architecture, Pearson Education
5. Jack Greenfield, Keith Short , Software Factories, Wiley DreamTech

653 – Software Project Management

Course Contents:

Managerial Issues in Software Projects: Introduction to software markets, Planning of software projects, Size and Cost Estimations, Project Scheduling, Measurement of software quality and productivity, ISO and Capability, Maturity, Models for organizational growth, Project Management and Practice.

Managing the systems life cycle, requirements determination, logical design, physical design, testing implementation, system and database Integration issues, metrics for project management and systems performance evaluation, managing expectations, superiors users, team members and other related to the project: determining skill requirements and staffing the project, cost effectiveness analysis: reporting and presentation techniques and effective management of both behavioral and technical aspects of the project.

Main Reading:

1. Gilb T, " Principles of Software Engineering Management", Addison Wesley, Reading MA, 1988.
2. Putnam L.H., Myers W, " Industrial Strength Software - effective Management using measurement", IEEE C.S. Press, 1997.
3. Thayer R.H., " Software Engineering Project Management", IEEE C.S. Press, 1997.

654 – Software Testing

Objective :
To provide a detailed study of testing software and automated tools.

Course Contents:

Testing fundamentals: Software testing – Levels of software testing – Test activities – Testing Life Cycle – Test Organization – White Box testing – Basis Path Testing – Control Structure testing – Black Box Testing.

Functional testing: Equivalence Class Partitioning - Boundary Value Analysis – Cause-effect Graphing - Special cases. Performance Testing – Stress testing – Configuration Testing – Security Testing – Recovery Testing – Integration Testing – Regression Testing – Acceptance Testing.

Object oriented testing methods: Testing Methods at Class level – Interclass test case design- Testing for Specific Environment, architecture, and application - Testing patterns.

Testing process: Comparison of different techniques- Test Plan – Test case Design Procedure Specification – Test Case Execution and Analysis - Test Documentation - Reporting test results - Final test reporting, Test Driven Development & Refactoring

Testing Web Application: Testing concepts for web apps – Content Testing – User Interface Testing – Component Level Testing – Navigation Testing – Configuration Testing – Security Testing – Performance Testing.

Testing Tools: Need for automated testing tools - Selection of testing tool – Tools used at various phases.

Main Reading :

1. Srinivasan Desikan, Gopalswamy Ramesh , "Software Testing : Principles and Practices", Pearson Education, 2006
2. Software Testing in the Real World, by E. Kit (1995)
3. The Web Testing Handbook, by S. Splaine and S. Jaskiel
4. Testing Applications on the Web, by H. Nguyen, R. Johnson, and M. Hackett
5. Software Testing and Continuous Quality Improvement, by W. Lewis, et al
6. How to Break Software Security, by J. Whittaker, et al
7. Web resources: http://www.softwareqatest.com

655 – Middleware Technology

Course Contents:

Fundamentals of middleware: Introduction to middleware, MW definition, styles of MW, key players;

Distributed systems characteristics; System models-architectural and fundamental models. RPC, Distributed objects-RNI, .NET Remoting, Name services-DNS, Time and global states, synchronization, Coordination and agreement, distributed transactions and recovery, Consistency & Replication, Fault Tolerance, Security.

Asynchronous communication and Event based systems: Notifications, message Queuing systems, peer to peer systems

Middleware and enterprise services in J2EE: Servlets and EJBs.

SOA & Web services: XML, SOAP, WSDL, UDDI & other protocols;

Reflective middleware : Introduction to reflective middleware, Middleware oriented architectural patterns for enterprise systems.

Main Reading

1. Distributed Systems- Cocepts and Design: George Couloris, Jean Dollimore, Tim Kindberg, Tim Kindberg, Third Edition, Pearson Education, Addison Wesley

656 – Component Technology

Course Contents:

Motivation for components: Introduction covering experience from software development - market vs. technology standards.

Foundation: Definition of a component, important issues: components, interface and re-entrance; polymorphism, objects vs. class composition; Scale and granularity of components- architecture (patterns and frameworks) ;

Component Technologies: Wiring standards (how to connect components); Approaches: OMG CORBA, Microsoft .NET, Sun: Javabeans, J2EE & EJBs, ;

Service Oriented Architecture and web services: Component architecture, component frameworks, component development ,component distribution and acquisition , component assembly

Main Reading:

1. Component Software (Beyond Object-Oriented Programming): Clemens Szyperski, ACM Press Addison Wesley, 2nd Edition, 2002

660 – Advanced Computer Architecture

Objective
This course is designed for students who are already familiar with the fundamentals of the working principle of a Digital Computer and the various sub-units. The main objective of the course is to expose the students to the working of current high performance processors and systems.

Course Contents:

Introduction and Review : Fundamentals of digital computer and organization.

Pipelining: Linear pipeline processor: Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch handling techniques, Arithmetic Pipeline design: Computer arithmetic principles, Static arithmetic pipelines, Multifunctional arithmetic pipelines

Storage and Memory Hierarchy: Register file, Virtual memory, Cache memories, Cache memory working principles, Cache coherence issues, Cache performance analysis, High bandwidth memories.

I/O Organization: High bandwidth I/O, Disk I/O, Bus specifications and Standards.

Instruction Level Parallelism: Super-scalar processors, VLIW architecture

Parallel Computer Models and Program Parallelism: Classifications of Machines, SISD and MIMD, condition of parallelism, data and resource dependencies, hardware and software parallelism program partitioning and scheduling, grain size latency, program flow mechanism, control flow versus data flow, data flow architecture, demand driven mechanisms, comparison of flow mechanisms.

Vector Processor And Synchronous Parallel Processing: Vector instruction types, vector-access memory schemes, vector and symbolic processors, SIMD architecture and programming principles: SIMD parallel algorithms, SIMD computers and performance enhancement.

System Interconnect Architectures: Network properties and routing, staric interconnection networks, dynamic interconnection networks, multiprocessor system interconnects: Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

Main Reading:

1. Hennessay & D.A. Patterson, "Computer Architecture: A Quantitative approach", International Student Edition, 3rd Edition, 2002, Morgan Kaufmann Publisher.
2. Michael J. Flynn,"Computer Architecture: Pipelined and Parallel Processor Design"' 1995, Jones and Barlett, Boston.

Supplementary Reading:

1. Kai Hwang, "Advanced computer architecture", 1993, TMH
2. R.K. Ghose, Rajan Moona & Phalguni Gupta, "Foundation of Parallel Processing"; Narosa Publication.
3. D.Sima, T.Fountain, P.Kasuk, "Advanced Computer Architecture-A Design space
4. Approach", 1997, Addison Wesley.

661 – Advanced Operating Systems

Course Contents:

Overview: Design approaches, synchnonization, mechanisms, axiomatic verification of parallel programs.

Process Deadlocks: Models of deadlocks, models of resources, Graph theoretic model of a system, state, systems with single-unit resources, consumable resources, reusable resources.

Architectures of Distributed systems: Types, issues ,communication primitive, limitations of a distributed system, lamport's logical clock, vector clocks.

Distributed Mutual Exclusion: Classification of algorithms, solution to ME, token and non-token based algorithms, comparisons

Distributed deadlock Detection: Resource versus communication Deadlocks, deadlock handling strategies, centralized and distributed deadlock detection algorithms.

Distributed file systems: Mechanisms for building DFS, Design issues, case studies.Distributed shared Memory – algorithms, coherence protocols, design issues.

Distributed scheduling: Issues in load distribution, load distribution, load Distribution algorithms.

Failure Recovery and Fault Tolerance: Backward and forward error recovery, checkpointing, recovery in distributed database system.

Protection and Security: Access and Flow Control,

Case studies: Amoeba, Andrew, Unix,

Main Reading:

1. Advanced concepts in 0perating systems – Singhal and Shivaratri - Tata McGraw Hill
2. Distributed 0perating Systems – Andrew Tanenbawn ,Prentice Hall

662 – Network Programming

Course Contents:

Basic UNIX programming: Unix processes. Creating and terminating Processes. Background and Foreground Processes. Executing new programs. Unix Signals and Signal Handling. Systems calls related to process, user and signal Management. File descriptors and inheritance. Named and unnamed pipes and related system calls.

Elementary Socket Programming: Berkley Sockets Overview, Introduction to sockets, Socket addresses, Basic Socket system calls, Error hadling. Concept of Reserved ports, Elementary TCP and UDP socket programming. Socket options. Name and Address Conversion functions. Interface Operations using 'ioctl'.

I/O Operations: Synchronous vs. Asyncronous I/O. I/O Multiplexing using 'select' and 'pselect'., Sockets and signals, Signal driven I/O. Nonblocking I/O: Nonblocked 'accept' and 'connect'. Broadcasting and Multicasting. Sending and Receiving Out of Band data using 'select' and signals. Advance I/O functions.

Miscellaneous: Daemon processes and *Inetd* Super Server, Unix Domain Sockets. Passing file descriptors using UNIX domain sockets.

Winsock programming: Introduction to Win32 programming. Difference between UNIX and MSWindows sockets. Introduction MSWindow socket API. MSWindows extension to socket API. MSWindows and blocking Socket calls. Implementing server functionality using multithreading. Synchronization using event objects. Using 'EventSelect' and 'AsyncSelect' calls. Asynchronous I/O: Overlapped I/O with scatter and gather. Creating Win32 services.

Programming applications : Time and date routine, Ping, Trivial file transfer protocol.

Main Reading:

1. Steven W.R., Unix Network Programming, Prentice Hall of India.
2. Napper Lewis, Winsock 2.0, COMDEX Computer Publishing.
3. Steven W R, Advanced Programming in UNIX Environment, Addison Wesley.

Supplementary Reading:

1. Microsoft Software Developers Network Documentation.
2. Davis R., Win32 Network Programming, Addison Wesley

663 – Advanced Unix Programming

Course Contents:

Introduction: Organization of UNIX interface, Programmer interfaces. System call API , Error handling. UNIX standardization. UNIX implementations. Relationship of standards and implementation.

File I/O and Directories : File descriptor and basic file I/O calls. Duplicating file descriptors. File Types, File access permissions, Set-user-id and set-group-id bits. Setting file permissions. Changing file ownership. Soft and hard links. Reading directories. Synchronising file contents. Standard I/O library.

Process : Environment of UNIX process. Command Line arguments. Environment variables. Memory allocation. Process relationship, Process groups, sessions, Controlling Terminal, Process related system calls. Foreground, Background Processes and Job control. Orphaned process groups.

Signals: Signal concept, Reliable and unreliable signals, Signal sets, Signal related system calls. Non local jumps. Job control using signals.

Terminal I/O: Special Input Characters. Canonical and Non canonical modes. Terminal Option flags. Getting and setting terminal attributes. Pseudo terminals. Opening and using pseudo Terminals.

Advanced I/O: Nonbloking I/O, Record locking. Stream, I/O multiplexing, Memory mapped I/O, Asynchronous I/O.

Inter-process communication: Pipes, Message queues, Semaphores and shared memory.

Main Reading:

1. Steven W R, Advanced Programming in UNIX Environment, Addison Wesley.

Supplementary Reading:

1. Unix man pages and Standard C library (libc) Documentation

664 - Biomechanics (2 credits)

Course Information:
Basic Biomechanics is a first course in undergraduate biomechanics that provides background in muskuloskeletal anatomy and principles of biomechanics. The course applies and builds on the concepts of Statics and, Dynamics for human activities, and Mechanics of Materials and tissues.

Course Objective :
The course provides an overview of musculoskeletal anatomy, the mechanical properties and structural behavior of biological tissues, and biodynamics. The course is meant to provide basic background in biomechanics for science, engineering and biotechnology students fields, and for those planning to attend graduate school in biomedical engineering. For those interested in industrial positions, this course provides a foundation for careers as design engineers in medical device companies and exercise equipment companies, as laboratory/testing technician in research facilities, and as a clinical engineer in the hospital environment. While these positions are available with a Bachelor's degree, most companies (or positions) will require continued training to improve skills in specific areas.

Course Contents:

Introduction to Biomechanics: Force Vector, Moment and Torque Vectors, Statics: Systems in Equilibrium, Applications of Statics to Biomechanics

Introduction to Dynamics: Linear Kinematics, Linear Kinetics, Angular Kinematics, Angular Kinetics, Impulse and Momentum

Introduction to Deformable Body Mechanics: Stress & Strain , Multiaxial Deformations & Stress Analyses, Mechanical Properties of Biological Tissues

Main Reading:
1. Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation
2. by Nihat Özkaya, Margareta Nordin, Dawn Leger, Publisher: Springer

Supplementary reading:
1. Fundamentals of Biomechanics by Knudson, Duane, Publisher: Springer
2. Biomechanics: Mechanical Properties of Living Tissues, by Fung , Publisher: Springer
3. Computational Biomechanics: Theoretical Background and Biological/Biomedical Problems Series: A First Course in "In Silico Medicine", Vol. 3, Publisher: Springer
4. Biomechanics by Fung, 2nd Ed. Y.C. Publisher: Springer

665 – Internet Technologies

Course Contents:

Introduction: Internet Architecture : Client-Server Architecture, How Domain Name Service works. How routers work.

Internet Protocols: Layered Protocol Architecture, TCP/IP, ICMP, SMTP, FTP, HTTP.

Internetworking with TCP/IP: Internet addressing, DHCP and static IP addressing, Address classes, IP subnets, IP supernets, Classless IP addressing, Routing Protocols : RIP, OSPF, IGRP. ARP and RARP protocols. Mobile IP.

IP Network QOS and Multimedia Applications: RTP, RTCP, RSVP, MPLS, VOIP, MGCP

IP Multicasting: Reverse path forwarding, Multicast addressing, Internet Group Management Protocol, Multicast Source discovery Protocol. DVMRP, CBT.

Internet Management and Security: SNMP, Proxy servers, Firewalls, VPN, How cookies Passports and Web tracking works. Cryptography, privacy and Digital certificates, Parental controls on internet.

Internet Multimedia Technologies: Multimedia: Definition, requirements, Inherited constraint of Internet Audio and Video on internet, Standardized data format for multimedia, multimedia compression JPEG, MPEG, Streamed data transfer, Multicast IP and Mbone,

Main Reading:

1. Behrouz Forouzan, "TCP/IP Protocol Suite", 2nd edition, Tata MCGraw-Hill.
2. Douglas E Comaer, "Computer Networks and Internet", 2nd edition, Pearson Education Pvt. Ltd.
3. Request For Comments (RFC) Documents (Web Site : http://www.rfc-editor.org/rfc.html)

666 - Physical Computing (2 credits)

Course Contents:

Introduction to programming in Processing: Loops, conditionals, variables & data structures, and mouse interaction. An overview of microcontrollers.

The fundamentals and use of basic electronic components: Use of resistors, diodes, LEDs, switches, relays and a variety of sensors to implement systems for physical computing. Digital and analog input and output. Serial input and output, including MIDI.

Fundamentals of serial communication: Including data representation, ASCII and basics of protocols. Programming with interrupts and timers. Data acquisition and web-interfacing.

Main Reading:

1. Physical Computing: Sensing and Controlling the Physical World with Computers, Dan O'Sullivan and Tom Igoe, Thomson Course Technology
2. Making Things Talk, Tom Igoe, O'Reilly

668 - Ethical Hacking and Countermeasures

Course Contents:

Introduction: The importance of security, The various phases involved in hacking, An overview of attacks and exploit categories, The legal implications.

Footprinting: Introduced to footprinting, Information gathering methodology, Tools used for the reconnaissance phase, countermeasures.

Scanning: Detecting 'live' systems on target network, Discovering services running/ listening on target systems, port scanning techniques, active and passive fingerprinting, Automated discovery tools.

Enumeration: Identifying valid user accounts or poorly protected resource shares, active connections to systems and directed queries, Null Session, NetBIOS Enumeration, SNMP enumeration, Applications and banners.

System Hacking: Remote password guessing, Eavesdropping, Denial of Service, Buffer overflows, Privilege escalation, Password cracking, keystroke loggers, sniffers, Remote control and backdoors, Port re direction, Covering tracks, Hiding files

Trojans and Backdoors: Defining Trojans and Backdoors, Understanding the various backdoor genre, Trojan tools, Prevention methods and countermeasures, Anti-Trojan software.

Sniffers: Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing and Spoofing.

Denial of Service: DOS and Distributed DOS Attacks, Types of denial of service attacks, Tools for running DOS attacks, Tools for running DDOS attacks, Denial of Service Countermeasures

Social Engineering: Common Types of Attacks, Online Social Engineering, Reverse Social Engineering, Policies and Procedures, Employee awareness.

Session Hijacking: Spoofing Vs Hijacking, Types of session hijacking, TCP/IP concepts, Performing Sequence prediction, ACK Storms, Session Hijacking Tools.

Web Server Hacking: Web Servers and Common Vulnerabilities, Apache Web Server Security, IIS Server Security, Attacks against Web Servers, Countermeasures

Web Application Vulnerabilities: Common Web Application Security Vulnerabilities, Penetration Methodologies, Input Manipulation, Authentication And Session Management, Tools and Countermeasures

Password cracking: HTTP Authentication Basic & Digest, NTLM Authentication, Certificate Based Authentication, Forms Based Authentication, Password Guessing, Password cracking Tools.

SQL injection: Exploiting the weakness of Server Side Scripting, Using SQL Injection techniques to gain access to a system, SQL Injection Scripts, Prevention and Countermeasures

Buffer Overflow: What is a Buffer Overflow, Exploitation, CPU / OS Dependency, Understanding Stacks, Stack Based Buffer Overflow, Defense against Buffer Overflows

Hacking wireless networks: Introduction to 802.1, WEP, Cracking WEP Keys, WLAN Scanners, WLAN Sniffers, Securing Wireless Networks.

Viruses: Types of viruses, virus signatures, Anti-virus software, few examples.

Linux Hacking: Scanning and mapping Networks, Password Cracking in Linux, Sniffing, Session Hijacking, Linux Rootkits, IP Chains and IP Tables, Linux Security Countermeasures

Evading Firewalls, IDS and Honeypots: Intrusion Detection System, Integrity Verifiers, Intrusions Detection, Anomaly Detection, Signature Recognition, Protocol Stack Verification, Application Protocol Verification, Hacking Through Firewalls, Honey Pots

Main Reading

1. "Hacking Exposed", Osborne/ Mc Graw Hill.
2. "Hacking Exposed: Network Security Secrets and solutions", Osborne/ Mc Graw Hill.
3. "Hacking Exposed: Linux Security Secrets and Solutions", Mc Graw Hill.
4. "Hacking Exposed: Windows Security Secrets and Solutions", Mc Graw Hill.
5. "Hacking Exposed: Web Application Security Secrets and Solutions", Mc Graw Hill/Osborne.

Supplementary Reading

1. Shon Harris, Allen Harper, Criss Eagle, Jonathan Ness , "Gray at Hacking – The Ethical Hacker's Handbook" , Mc Graw Hill.
2. Ryan Russel, Elias Levy, Jeremy Ruch & others, "Hack Proofing Your Network – Internet TradeCraft", SYNGRESS.
3. Mike Schiffman, "Hacker's Challenge: Test your Incident response Skills using twenty scenarios", Osborne/ Mc Graw Hill.

669 – Embedded Systems (Software)

Course Contents:

Introduction to embedded system: A First Look at Embedded systems- Examples of Embedded systems-applications area-categories of embedded system – recent trends in embedded system:

Design challenge: ptimizing design metrics Common design metrics- Processor technology- General-purpose processors – software - Single-purpose processors – hardware- Application-specific processor- IC technology

Architecture of embedded system: Hardware architecture –software architecture - Programming for embedded system.

The process of embedded system development: Interrupts-Microprocessor-Architecture-Interrupt Basics-The Shared-Data Problem-Interrupt Latency-shared data problems- survey of software architecture -Round-Robin-Round-Robin with Interrupts-Interrupt Latency –RTOS.

RTOS: Architecture of kernel –task and task scheduler-interrupt service routines- semaphores-message queues- mail boxes-pipes –events-timer – memory management –interrupt routines in RTOS Environment-overview of embedded /real time operating system .

Embedded Software Development Tools: Host and Target Machines-Linker/Locators for Embedded Software-Getting Embedded Software into the Target System.

Debugging Techniques: Testing on Your Host Machine-Instruction Set Simulators-The assert Macro-Using Laboratory Tools

An Example System: What the Program Does-Environment in which the Program Operates

Task Image creation: Operating system software –target image creation for windows XP embedded-porting RTOS on a micro-controller based development board.

Representative embedded systems: Programming in Linux-programming in RTLinux-Development of Navigation System –Development of protocol converter-mobile Java applications.

State machine and concurrent process models: Introduction- Models vs. languages, text vs. graphics-Models vs. languages- Textual languages versus graphical languages-An introductory example- A basic state machine model: finite-state machines (FSM)- Finite-state machines with data path model: FSMD-Using state machines- Describing a system as a state machine-Comparing the state machine and sequential program model- Capturing a state machine model in a sequential programming language-Hierarchical/Concurrent state machine model (HCFSM) and the State charts language

Program-state machine model (PSM) : The role of an appropriate model and language
Concurrent process model: Use of Esteral language for embedded software development.

Main Reading:

1. Embedded software primer by David Simon – Pearson
2. Art of embedded system by Jack Ganssle
3. Embedded systems Architecture by Tammy Noergaard – Elsevier publications
4. Embedded /Real time systems – by DR.K.V.K.K.Prasad. – Dreamtech
5. Esterel language by Gerard Berry (web site reference)
6. Embedded system design by Arnold S.Berger
7. model checking by Edmund M.clark
8. Embedded Systems Building Blocks by Jean LaBrosse
9. Embedded Systems Design by Arnold Berger
10. The Art of Programming Embedded Systems, Jack Ganssle

681 – Managerial Economics

Course contents:

Nature and scope of managerial economics. Objectives of the firm, Managerial and behavioral theories of the firm.
Concepts of opportunity cost, incremental, time perspective Principles of discounting and equimargins, Demand analysis - purpose and concepts. Elasticity of demand, Methods of demand forecasting.
Product and cost analysis, short run and long run, average cost curve.
Law of supply, Economics and diseconomies of scale, Law of variable proportions.
Production function - single output isoquants.
Pricing Prescriptive approach, Price determination under perfect competition, Monopoly, oligopoly and monopolistic competition. Full cost pricing, product line pricing, Pricing strategies.
Profits : Nature and measurement, policy, Break-even analysis, Case study.

Main Reading:

1. Dean, J, "Managerial Economics", Prentice Hall of India, New Delhi,1982.
2. Mote V.L. et.al, " Managerial Economics", Concepts and cases" Tata McGraw Hill, New Delhi, 1980.

682 – Corporate Planning

Course contents:

Significance of Planning, Types, Need Requites, Corporate planning, system approach, Role of the planner, Corporate planning and budgeting.
Social responsibility, Scope, contents, corporation and society, consumers, corporation and democracy, community and government, Social responsibility versus profitability and productivity, growth Professionalism as a means of social behavior.
Mission and purpose, Business definitions - objectives and goals, Environment appraisal, Concepts, components - Scanning and appraising the environment.
Organization appraisal, Dynamics, capability factors, Considerations, Methods and techniques, Structuring, Planning gaps analysis Manager Audit, significance of gaps.

Main Reading:

1. Kazni A., " Business Policy", Tata McGraw Hill, New Delhi, 1992.
2. Johnson G. et al. 3rd edition, " Exploring corporate Strategy", Prentice Hall of India, New Delhi, 1994.

683 – Investment Technology

Course Contents:

Source of investment information
Valuation of debt securities. Debt prices and interest rate risk. Default risk and purchasing power risk. Market interest rates and term structure of interest rates. Valuation of warrants and convertibles. Options pricing models.
Valuation of equity; Dividends and valuation. MMS arguments, fundamentals analysis, Earning multipliers. Timing of purchase and sale of equity shares, estimating earnings and risk.
Portfolio theory. Efficient investments and diversification. Markowit graphical portfolio analysis. Capital market theory. Portfolio performances evaluation - Sharpe, Treynor, Jenson, Measures. Mutual funds – kinds and valuation. Behavior of share prices - technical analysis. The efficient markets Hypothesis-random walk and martingale methods.

Main Reading:

1. Clark J.J. et al, " Financial Management A capital Market Approach ", Helbrook, 1976.
2. Sharpe W.F, " Investments", Prentice Hall of India, new Delhi, 1996.

684 – Business Finance

Course Contents:

Financial and economic development, Intermediation, role and Patterns, Functions of money and capital market, Interest rates Determination, term structure.
Primary capital market, new issues, growth and trends, Financial Intermediaries, merchant bankers, managers, brokers, underwriters Secondary market - organization and functioning. Trading and Settlement. Problems relating to membership, commission, margins, arbitration and off-floor trading. Reforming the markets SEBI.
Market for government securities - the discount and finance house. Operation and managerial problems of commercial banks, Inter-bank call money market. Non-banking financial institutions, leading policies, schemes, composition and quantum of assistance of IDBI, IFCI, ICICI, UTI, LIC, GIC and state level financial corporations.
Credit rating information, Parameters, Role Agencies, CRISIL, Regulatory framework for financial markets and institutions, regulations versus deregulation, Role of RBI, Bank rate, open market operation policies.

Main Reading:

1. Copeland T.E. et al, " Financial theory and Corporate Policy", Addison Wesley, Reading MA, 1988.
2. Uppal J.S, " Public Financial Institution s in India", Mac Milan, New York, 1984.

685 – Management Information Systems

Course Contents:

The course will discuss a variety of framework for identifying information technology applications. The scope of IT applications would cover Management Information System, Decision Support System, Executive Information System and Expert System.

Provide a broad understanding of the types of benefits information technology applications can provide in an organization through transaction processing management and operational control, decision support system, office automation, organizational communication and group work support.

Socio-economic environment and information technology theoretical in social analysis of computing role of information systems in organization and the impact of information system on organizations markets, frameworks for information system planning information systems and competitive advantages, the new strategic role of information system, methodologies for evaluating investments in IT, framework and methodologies should be discussed and illustrated with case studies.

Design reporting system including of discussion of principles in indicator design, managing information support activity in organization, concept of the business process reengineering (BPR) an how IY can enable BPR.

Critical success factor in implementing IT applications including the need for managing the process of change illustrated through case students of successful/failed IT projects. Critical role of security in implementing IT applications should be discussed.

686 – Electronic Commerce

Course Contents:

Introduction to electronic commerce, Internet as a network infrastructure for electronic commerce, Business and advertising on the Internet.
Network security and firewalls, Electronic payment, Business to business (B2B) transaction and EDI, Value added networks, Consumer oriented business transactions (B2C)
E-Commerce applications: On-line education, digital library etc. Technology underneath E-Commerce: Multimedia and digital video, Broadband telecommunications, Mobile and wireless computing, Software agents.

Main Reading:

1. Ravi Kalakota and Andrew Whinston, " Frontiers of Electronic Commerce" . Addison-Wesley, 1999.
2. Kamlesh Agarwala et.al, " Business on the net" An Introduction to the What and How of E-Commerce" .

687 – Organizational Behaviour

Course Contents:

Introduction to Organizations and Individuals:
What is an organization, components of organization, nature and variety of organization (in terms of objectives, structure etc.) models of analyzing organization, phenomena, organizational and business variables, organizations in the Indian context, institutions and structures, basic roles in an organization etc. perception, attitudes, motives, (achievement, power and affiliation), commitment, values creativity and other personality factors, profile of a manager and an entrepreneur.
Interpersonal and Group Processes:
Interpersonal trust, understanding the other person from his/her point of view, interpersonal communication, listening, feedback, counselling, transactional analysis, self-fulfilling, prophecy, etc. leadership, motivation, people, working as a member of a team, team functioning, team decision-making, team conflict resolution, team problem solving.
Organizational Structure and Integrating Interpersonal and Group Dynamics:
Elements of structure, functions of structure, determinants of structures, dys-functionality's of structures, structure technology- environment-people relationships, principles underlying design of organizations, organizational culture, organizational politics, issues of power and authority, organizational communications, organizational change, integrating cases(s).

Case method and lectures should be supplemented with a variety of other methodologies such as feedback on questionnaires and tests, role plays, and behaviour simulation exercise.

Main Reading

1. Arnold, John, Robertson, Ivan T. and Cooper, Cary L., " Work Psychology : Understanding Human Behavior in the Workplace", Macmillan India Ltd., Delhi, 1996.
2. Dwivedi, R.S. " Human Relations and Organizational Behavior, " A Global Perspective", Macmillan India Ltd., Delhi, 1995.
3. French and Bell (4th ed.), " organizational Development : Behavioral Science Interventions for Organization Improvement", Prentice Hall of India Pvt. Ltd., New Delhi, 1994.
4. Hellriegel, Slocum and Woodman, "Organizational Behavior" West Publishing Co.USA,1986.
5. Hersey and Blanchard (6th ed.), " Management of Organizational Behavior Utilizing Human Resources", Prentice Hall of India Pvt. Ltd., New Delhi, 1996.
6. Prasad Kesho, " Organizational Development of Excellence", Macmillan India Ltd. New Delhi, 1996.
7. Robbins (4th ed.), " Essentials of Organizational Behavior", Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
8. Scehrmerhorn, Hunt and Osborn, "Managing Organization Behavior", John Willey & Sons, USA 1982.
9. Weston Mergers, "Restructuring and Corporate Control", Prentice Hall of India Pvt. Ltd., New Delhi, 1995.

688 – System Analysis and Simulation

Course Contents:

Rule of Modelling in Systems Analysis, Computer Simulation of Stochastic System. Generation of Pseudo-Random Numbers and Stochastic Variants using the computer.
Simulation of Queuing Systems. Using special purpose languages for simulation of queuing systems. GPSS and / or SLAM system Dynamics.
Simulation of System with feedback : using DYNAMO in System Dynamics. Cases on Simulation in Production, Finance, Marketing and Corporate Planning, Project work.

Main Reading:

1. Banks J. Carson S. Nelson B.L, " Discrete-Event System Simulation", (2nd Edition), Prentice Hall of India, New Delhi, 1996.
2. Deo N., " System Simulation with Digital Computers", Prentice hall of India,1979.
3. Law A.M. and Kelton W.D, "simulation Modeling and Analysis", (2nd edition), McGraw Hill N.Y., 1991.

689 – Foundation of Decision Processes

Course Contents:

Role of decision making in management, Framework, Criteria under conditions of certainty, risk and uncertain, Bays theorem, Sequential decision making, decision tree analysis.
Theory of utility. Utility function curve, Competitive game theory, Queuing models, Single channel, single phase waiting line with Poisson. Distributed arrival rates and exponentially distributed service times. Markov models.
Simulation : Monte Carlo Application to queuing and inventory Models. Application in functional areas of marketing, production, Finance, Behavioural aspects in decision making, open and closed models of decisions.
Systematic problem analysis and decision making. Decision making in functional areas-case studies.

Main Reading

1. Gregory G., " Decision analysis", Pitman London, 1988.
2. Johnson R.D. et al, "Quantitative Techniques for Business Decisions", Prentice Hall, N.J., 1977.

690 – Taxation Practices

Course Contents:

Assessments of undivided families, Meaning Basic condition, taxable Income, Partitions, Tax planning, Assessment of firms and Associations, Scheme of taxation types, treatment of losses, Tax Planning.
Assessment of companies Types profits, depreciation, tax Planning, Section 80, Bonus issues, divided policy, Return of income and assessment procedure Types of assessment, Time limits, Reassessment Cooperatives.
Collection and recovery of tax Deduction at source, rates advance payment, Modes of recovery, Refund Appeals and revision Penalties.
Wealth Tax Chargeability, valuation, return, appeals, revisions, payment and recovery, gift tax chargeability, rebate, assessment, appeals, revision, payment and recovery.
Central sales tax, Concept of sale and purchase, Inter-state trade, Inter-state export and import trade, State sale tax: Assessing authority, Single, Multiple point tax, Procedure for registration and cancellation, Returns payment appeals and revisions.

Main Reading :

1. Central and State tax acts.
2. Sinhania V.K. , Taxman direct taxes, Taxman, New Delhi, 1996

691 – Accounting and Financial Management

Course Contents:

Financial Accounting: An Introduction
Meaning and Nature of Accounting, Accounting as language of Business and Accounting as information system. Accounting processes and final output of Accounting system. Principles of Accounting and double entry system. Recording of Transaction in Journal, Posting of transaction to Ledger and preparation of Trial Balance.

Preparation of Final Financial Statement
Preparation of Final Accounts – Profit and Loss account and Balance Sheet. Preparation of statement of changes in Financial Statements – Funds Flow Statement and Cash flow statement.

Analysis of Financial Statements
Horizontal (Trend) analysis and Vertical (Common-Size) analysis. Ratio Analysis – Liquidity ratio, Turnover ratio, Profitability ratio.

Cost Accounting: An Introduction
Meaning, nature and importance of cost Accounting system in an Organization. Elements of Cost and various cost Concept – Direct and indirect cost, Fixed and Variable costs, Sunk Cost Opportunity Cost, Out of Pocket and Imputed cost, Preparation of cost sheet. Understanding the nature of variable cost and fixed cost (total as well as per unit). Contribution, P/V ratio, Break Even Point. Assumptions of Cost-Volume-Profit Analysis and studying the relationship between Cost, Volume and Profit.

Budgeting
Meaning, Importance and Objective of budgeting in an Organization, Different types of Budgets including preparation of cash Budget, fixed and flexible budget, Zero based budgeting.

Financial Management: An Introduction
Nature, Objective and Scope, Financial decision making and type of financial decision. Role of Finance Manager in Organization. Basic axioms of Financial Management. Risk-Return framework for financial decision making.

Time Value of Money and Mathematics of Finance
Time Value of Money and Opportunity cost of Money, Present value and future value and Interest rate and discount rate Annuities and their types Numerical related to the calculation of present values and future values.

Capital Budgeting Decisions
Nature and kinds of Capital budgeting decisions. Techniques of evaluating Capital budgeting decisions – Payback Period, Accounting rate of return, NPV, IRR and Profitability Index.

Cost of Capital and Sources of Finance
Basic valuation Model, Concept of Cost Capital – Weighted average Cost and Marginal Cost, Cost of debt and cost of Equity, Various long term sources of funds for a Organization.

Capital Structure and Dividend Decisions
Concept of Capital Structure, Financial Leverage and Capital Structure, Determinants of Capital Structure, Dividend and its forms – cash dividend, right and bonus shares and buy-back of shares, determinants of Dividend Policy of firm.

Working Capital Management
Basics of Working Capital management: Meaning of Gross and Networking Capital, Components of Working Capital. Risk-Return framework for Working Capital Decisions.

Main Reading

1 Pandey I. M., "Financial Management", 7th Edition, 2002, Vikas Publishing Pvt Ltd.
2 M. Y. Khan and P.K. Jain, "Management: Accounting" 2nd Edition1995, Tata McGraw-Hill Publishing New Delhi
3 Maheshwari S.N. "Accounts" 2002, Vikas Publishing Pvt. Ltd.

692 - Management Fundamentals & Information System

Course contents:

Introduction to Management
Understanding the meaning and definition of Management; Nature of Management; Importance of Management; An overview of Management processes; Evolution of management thought.

Functions of Management
Planning: Strategy, types of plans, Decision making, SWOT analysis. Forecasting, tools for forecasting.
Organizing: Principle and Structure of Organization, Theories and types of Organization, Concept of Authority, Responsibility Power, Delegation & centralization of Authority. Span of control.
Staffing: Meaning, nature and principles of staffing, Recruitment, Selection, Training, Performance Appraisal.
Controlling: Controlling - Tools, Budgeting – tools and techniques, Communication in Organization, Motivation, Leadership

Production and Operation Management
Production Planning, Inventory Management - tools and techniques, Vendor Management, EOQ, Production methods, Quality control.

Marketing Management
Overview of Marketing functions, Product, Price Promotion and distribution strategies Marketing research and its Role. Business to Business Marketing, Export, Import Management

Financial Management
Accounting Principles, Balance Sheet and profit loss statement. Working capital Management. Cost concept Break even analysis, Investment decision – Pay back period NPV, IRR

Human Resource Management
Nature and Function of HRM, Human resource planning – HR information System, Performance appraisal system, Rewards and Incentive schemes; Professions in HR – Consultancy, Outsourcing

Information Systems, Organization Management & Strategy
Information need of Management at various level of Organization, flow of information in organization: top down bottom and up and integrated.
Information System: Meaning, Nature and their role. Types of Information systems: DSS, MIS, Expert systems, Knowledge Management systems Transaction processing Systems. Importance of Information Systems in Supporting various levels of business strategy formulation and decision making in different Managerial Functional areas: Production and Operations, Sales and Marketing, Personnel Management.

Current Issues
Role of Internet and intranet in development of various information systems: E-Commerce, ERP, CRM, SCM.
Global Perspectives to Management; International marketing, International HR;
Essentials of Entrepreneurship – Writing a Business Plan, Funding Agencies

Main Reading

1. Harold Koontz and Heinz Weihrich, "Essentials of Management" 5th Edition Tata McGraw-Hill Publishing New Delhi
2. C.B. Gupta "Management Concepts and Practices" 2002 Sultan Chand, New Delhi.
3. W.S. Jawadekar, "Management Information Systems", 1 st Edition 1999, Tata McGraw-Hill Publishing New Delhi
4. K. C. Laudon and J. P. Laudon, " Management Information Systems: Organization and Technology" 4th Edition, Prentice Hall India New Delhi