B. Tech. - Information Technology

Course Structure and Syllabus

Indian Institute of Information Technology
Allahabad - 211012

	SEMESTER							
	FIRST	**SECOND**	**THIRD**	**FOURTH**	**FIFTH**	**SIXTH**	**SEVENTH**	**EIGHT**
	PHY132[5]	DMA230[3]	MAT330[3]	DAA432[5]	CNE532[5]	COD632[5]	SIM732[5]	PRO800[20]
C	MAT130[3]	MAT230[5]	MIP332[5]	PPL430[3]	SOE532[5]	WBT623[5]	PHS720[2]	
O	EDC132[5]	DST232[5]	OPS332[5]	DBM432[5]	AIN532[5]	DMW632[5]	ORB720[2]	
U	ITC102[2]	COA230[3]	TOC330[3]	PBS432[5]	GVC532[5]	ELT-1[3]	ELT-3[3]	
R	ITP132[5]	PME220[2]	OOM332[5]	DCOM432[5]	POE530[3]	ELT-2[3]	ELT-4[3]	
S	CAS130[3]	DEL232[5]	POM320[2]		PRO500[5]	PRO600[5]	PRO700[5]	
E	LCS102[2]							

IT Courses

ITC 102	Introduction to Computers
ITP 102	Introduction to Programming
EDC 132	Electronic Devices & Circuits
CAS 130	Circuit Analysis and Synthesis
DMA 230	Discrete Mathematics
DST 232	Data Structures
DEL 232	Digital Electronics
COA 230	Computer Organization and Architecture
OPS 332	Operating System
TOC 330	Theory of Computation
OOM 332	Object Oriented Methodologies
MIP 332	Microprocessors
DAA 432	Design and Analysis of Algorithms
PPL 430	Principles of Programming Languages
DBM 432	Data Base Management System
DCOM 432	Digital Communication
CNE 532	Computer Networks
SOE 532	Software Engineering
AIN 532	Artificial Intelligence
GVC 532	Graphics and Visual Computing
COD 632	Compiler Design
WBT 623	Web Technologies
DMW 632	Data Mining and Warehousing
SIM 732	Simulation & Modelling
PRO	Mini Project
	Electives (ELT) VI Semester
OOT 630E	Optimization Techniques
CSE 630E	Control System Engineering
NLP 630E	Natural Language Processing
SCO 630E	Soft Computing
RIA 630E	Robotics & Industrial Automation
IVP 630E	Image & Vision Processing
	Electives (ELT) VII Semester
CIS 730E	Cryptography & Information Security
IWP 730E	Internet & Web Security Protocols
RMP 730E	Robot Motion Planning
MOC 730E	Mobile Computing
IRS 730E	Information Retrieval System
CCS 730E	Cognition & Cognitive Systems
SLT 730E	Speech and Language Technologies
MOC 730E	Mobile Computing
PAC 730E	Parallel Computing
HUR 730E	Humanoid Robotics
MDM 730E	Mobile Data Management
MSE 730E	Mobile Software Engineering
RSC 730E	Radar & Satellite Communication
WSN 730E	Wireless Sensor Network

Basic Courses

PHY 132	Physics-1
MAT 130	Mathematics-1
MAT 230	Mathematics-2
MAT 330	Mathematics-3
PBS 432	Probability & Statistics

HSS Courses

LCS 102	Language and Communication Skills
PME 220	Principal of Management & Economics
POM 320	Principles of Management
POE 530	Principles of Economics
ORB 720	Organizational Behaviour
PHS 720	Philosophy of Science

COURSE DESCRIPTION

PHY 132 **Physics – 1**

L-T-P-[C]

3-0-2-[5]

Mechanics: Hook's law, Modulii of Elasticity and relations between them, Elastic Potential Energy, Twisting of cylinder and bending of beams. Progressive Waves, Excess pressure, Velocity of waves in fluids and on strings, Standing waves, Nodes and Antinodes, Energy considerations. Ultrasonics: Generation & Applications. Particle in Circular motion, Moment of Inertia of a rigid body, Theorems of Parallel and Perpendicular axes, Evaluation in some simple cases. Introductory ideas about Lagrangian and Hamiltonian and their simple applications. Electromagnetic theory: Introduction to vector calculus - Divergence, curl and gradient. Electric field: Electric field and potential, Gauss's law, Farady's, Law Electric field between plates of a capacitor, expression for capacity and stored energy, effect of dielectric, Boundary condition for electric field at the boundary of two homogeneous media, Simple treatment of reflection and refraction at the boundary between two homogeneous media. Magnetic field: Biot-Savart law, Ampere's law vector potential and magnetic field in simple cases. Time varying field and Maxwell's equations and boundary conditions; solution in vacuum. Introductory radiation physics. Thermodynamic: Introduction to thermodynamics, Macroscopic and microscopic, thermodynamic variables, thermal, mechanical, chemical equilibrium, Zeroth law and concept of temperature, first law, second law, and Third law entropy, Entropy and disorder, Thermodynamic relations, Condition of change, condition of equilibrium, thermodynamic potentials.

Text Books:

1. Perspectives on Modern Physics, A. Beiser
2. Introduction to Electrodynamics: D J Griffiths
3. Thermal Physics, B.K. Agrawal
4. Thermodynamics and radiation: A Treatise on Heat, M.N. Saha and B.N. Srivastava
5. Engineering Physics, Arumugam M., 2nd edition, Anuradha Publishers, Kumbakonam, 2003.
6. Physics for Technologists, Thiruvadigal, JD, Ponnusamy, S, Vasuhi, PS and Kumar, C, 5th edition, Vibrant Publication, Chennai, 2007.

Lab Assignments:

1. Torsion Table - Modulus of Rigidity of the Given Wire & Moment of Inertia of an irregular body
2. Compound Pendulum - To determine the value of "g" and radius of gyration using a Bar Pendulum
3. Spiral Spring - To determine the force per unit extension & effective mass of a spiral spring using static and dynamic method
4. AC Bridge (With Capacitance) - To measure the unknown capacitance & to verify AC Bridge
5. Post Office Box (Unknown Resistance) - Measurement of unknown resistance (rheostat) using post office box
6. Specific Heat Capacity - To measure the specific heat capacity of the material of a given metal
7. Thermocouple - To measure the seebeck co-efficient of a given thermocouple
8. To determine the width of the slit using Laser Light Source

CAS 130 **Circuit Analysis and Synthesis**

L-T-P-[C]

3-0-0-[3]

Network Theorems and Elements: Network graphs, matrices associated with graphs, incidence, fundamental cut set and fundamental circuit matrices, Kirchoff's Laws, Node Voltage and Mesh Current Analysis, Delta-Star and Star-Delta Transformation, Source Conversion. Thevenin's, Norton's, Reciprocity, Superposition, Compensation, Miller's, Tellegen's and Maximum power transfer Theorems, Networks with dependent sources, Inductively coupled circuits - mutual inductance, coefficient of coupling and mutual inductance between portions of same circuits and between parallel branches.

Transient and Steady State Analysis: Impulse, step, ramp and sinusoidal response. Analysis of first order and second order circuits. Time domain analysis of RLC circuits. Laplace transform in brief, transform domain (Laplace) analysis of RLC circuits, Initial and final value theorems, Different kind of symmetry, Power in a circuit.

Network Functions & Two Port Networks: Terminals and terminal pairs, driving point impedance transfer functions, state equations for networks, poles and zeros, Procedure of finding network functions for general two terminal pair networks, Stability & causality. Hurwitz polynomial, positive real function, Two port parameters and their interrelations - z-parameters, y-parameters, h-parameters, ABCD parameters.

Network Synthesis: RL & RC networks synthesis, Foster First & Second form, Cauer forms.

Text Books:

1. Network Analysis by M.E. Van Valkenburg, Third Edition, Prentice Hall.
2. Desoer C. A. and Kuh E. S., Basic Circuit Theory, McGraw Hill International Book Company, 1984.
3. DeCarlo R. A. and Lin Pen-Min, Linear Circuit Analysis, 2nd Ed., Oxford University Press.2001.
4. Hayt W. H., Kemmerly J. E. and Durbin S. M., Engineering Circuit Analysis, 6th Ed., Tata McGraw-Hill Publishing Company Ltd. 2008.
5. Director S. W., Circuit Theory: A Computational Approach, 2nd Ed., John Wiley and Sons Inc. 1993.
6. Kuo F. F., Network Analysis and Synthesis, 2nd Ed., Wiley India.

MAT 130 **Mathematics – 1**

L-T-P-[C]

3-0-0-[3]

Ordinary Differential Equations: Motivations and Formulation of physical and real life problems in the Language of Differential equations. Basic concepts, Order and Degree, First order Differential equations: Separation of variables, Homogeneous functions and homogeneous differential equations, Exact differential equations, Integrating factors, Linear differential equations of first order, Bernoullis equation, Equations of first order and higher degree, Orthogonal trajectories, Picards method of successive approximations, Statement of existence and uniqueness theorem. Applications: Simple electric circuits.

Higher Order Differential equations: Existence and uniqueness theorem of Picard (Statement only) Homogeneous linear differential equations of higher order, Space of solutions of homogeneous linear Wronskian of a finite set of smooth functions. Linear dependence and independence of sets of solutions of Homogeneous linear differential equations of higher order. Basis of space of solutions. Use of a known solution to find others. Homogeneous differential equations with constant coefficients Euler-Cauchy equations, Method of variation of parameters, Method of undetermined coefficients. Operator method. System of first order linear differential equations with constant coefficients. Applications: Variation in mechanical systems, Motion under central force, Planetary motions, Electric circuit theory, Partial differential equations, Wave equations, Heat equations, Separation of variable method, DeAlemberts solution.

Calculus: Review of single variable Calculus, Power series, Radius and circle of convergence of power series. Functions represented by power series. Power series solution of differential equations. Algebra of R_n, Standard inner product on R_n, Cauchy scharwz and Bessels inequality, Metric structure on R_n, Subsets and Geometric objects in R_n, Limit points of subsets, Open balls and closed balls.Matrices as linear transformations, Functions from R_n to R_m, Limit of a function, Algebra of limits, Limit of compositions, Continuous functions on closed balls and their properties, Differentiability and derivative of functions from R_n to R_m, Geometric meaning of derivatives, Algebra of differentiable functions, Partial derivatives, directional derivatives, gradient divergence and curl. Chain rule, mean value theorem, repeated partial derivatives, Higher order derivatives, Taylors Theorem, Jacobian matrix and Jacobian, Inverse and implicit functions, Different coordinate systems, orthogonal curvilinear coordinates, Shapes of curves and surfaces, Maxima, Minima and saddle points, Lagrange Multipliers.

Text Books:

1. Differential Equations, G. F. Simmons, Tata Mcgraw-Hill.
2. E.Kreyszig : Advanced Engineering Mathematics. (Wiley Eastern)
3. Calculus (1 & 2), Apostol, T.M
4. Calculus on Manifolds, Spivak
5. Mathematical Analysis, Malik and Arora
6. Principles of mathematical Analysis, Walter Rudin

EDC 132 **Electronic Devices and Circuits**

L-T-P-[C]

3-0-2-[5]

Semiconductor Diodes: Introduction, Energy Bands in conductors, semiconductors, insulators, intrinsic and extrinsic semiconductor.

Carrier transport in semiconductor: diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers in semiconductors. Thermal Noise, Shot Noise. Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Tunnel diode, Diode clipper and clamper circuits, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers), Power Supplies, Light emitting diodes, avalanche photo diode.

Bipolar Junction Transistors (BJTs): Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Current-voltage characteristics of BJT, BJT as an amplifier and as a switch. BJT Circuits at DC, Biasing in BJT amplifier circuits, Small Signal Operation of BJT: Simplified model (h-parameters and y-parameters) and its application to single stage BJT amplifiers (Common-Emitter, Common-Base and Common-Collector configurations).

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CE, CC, CB Amplifier with and without RE, Effect of RS and RL on CE Amplifier, Emitter Follower, Analysis of Cascade, Darlington Connection and Current Mirror Circuits using BJTs.

High Frequency Response of BJTs: Low and High Frequency Response of BJTs, The Unit gain - frequency (ft), Frequency Response of CS Amplifier, Frequency Response of CE Amplifier, Multistage Frequency Effects, Miller Effect Capacitance, Square Wave Testing.

Text Books:

1. Electronic Devices and Circuit Theory by R. Boylestead and Louis Nashelsky. Prentice Education.
2. Streetman, B.G. and Banerjee, S.K, Solid State Electronic Devices, 6th Ed., Pearson Education.
3. Tyagi, M.S., Introduction to Semiconductor Materials and Devices, John Wiley & Sons.

Lab Assignments:

1. Draw the VI characteristics of 1N4007 diode.
2. To observe the waveform of Half wave Rectifier and Full wave Rectifier from 1N4007
3. Design a dual LED circuit to operate at 5VDC. Observe the gradual change in colour from RED to green by changing current through the lines.
4. To implement biased Series Positive Clipper using a 1N4007 diode and verify its waveforms using a Sinusoidal input of 10Vp-p, 1kHz.
5. To implement biased Series Negative Clipper using a1N4007 diode and verify its waveforms using a Sinusoidal input of 10Vp-p, 1kHz.

EDC 132
Continued

6. To implement biased Parallel Positive clipper using a 1N4007 diode and verify its waveform using a Sinusoidal input of 12Vp-p, 1kHz. To implement biased Parallel Negative clipper using a 1N4007 diode and verify its waveform using a Sinusoidal input of 12Vp-p, 1kHz.
7. To implement Positive clamper and verify its working using Sinusoidal input of 8Vp-p, 1kHz.
8. To implement Negative clamper and verify its working using Sinusoidal input of 8Vp-p, 1kHz.
9. Plot the VI characteristics of Zener Diode.
10. To plot the input and output characteristics for Common base configuration using a BC547 transistor.
11. To plot the input and output characteristics for Common emitter configuration using a BC547 transistor.
12. Plot frequency vs. gain curve for a BC547 transistor on to a semi log sheet.

ITP 132 **Introduction to Programming**

L-T-P-[C]

3-0-2-[5]

Introduction, Pseudocode, Operators, expressions and statements, if-else condition, for loop, while loop, do while loop, Jump statements, 1-d arrays, Strings, 2-d arrays, Pointers, arrays vs. pointers, Functions, Header files (math.h, time.h, custom headers), External functions, Pointers to pointers and pointers to functions, Bitwise operators, struct and union, Pre-processor directives and macros, I/O handling, Operator precedence vs. order of evaluation, Type casting, Integral promotions, Conversions (standard type and arithmetic), Dynamic memory allocation, Linked lists, Command line arguments, Standard libraries, Introduction to Python, OOP concepts in Python.

Text Books:

1. C Programming Language (Ed 2) by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall
2. Expert C Programming: Deep C Secrets by Peter van der Linden, Prentice Hall
3. C Programming FAQs by Steve Summit, Deborah Lafferty, Addison-Wesley Professional
4. C Traps and Pitfalls by Andrew Koenig, Addison-Wesley Professional
5. The C Puzzle Book by Alan R. Feuer, Addison-Wesley Professional
6. C99 standard (ISO/IEC 9899:TC3)
7. A Beginner's Python Tutorial: http://en.wikibooks.org/wiki/A_Beginner%27s_Python_Tutorial.

Lab Assignments:

1. **Commands:** Find the C compiler version of your system, Use man command to see the pre-defined functions of stdio, Use man command to see the syntax of printf function, Analyze the vi commands.
2. **Programs:** Write the program to print the Hello World. Write the program to find the size of all data types. Write the program to find the minimum and maximum value of the integer and float. Write a program to analyze and find the maximum size integer can support in the system compiler. Write the program to perform the calculator operation. Write the program to read 'n' real numbers and print the maximum. First input is 'n'. Write the program to find if given numbers are prime (do not use functions). Write the program to print ASCII values of each letter for a given a string (of maximum size 100 characters). Write the program to read two matrices A and B of dimension n x n. Print A + B. Write the program to read n words, each of different length. Print them according to their length. Write the program to read n unsigned characters and print the average values of the bits. Write the program to read the n numerical characters from the file and do the sum of it. Write the program to print the multiplication table using static and functions. Write the program for student mark list using structure, pointer and dynamic memory allocation. Write the python program to get the integer input n and print the odd sequence till n. Write a Python program to find first n primer numbers.

ITC 102 **Introduction to Computers**

L-T-P-[C]

0-0-2-[2]

Two credit hours lab oriented course conducted through live demo on projector PC and hands on practice in the lab. Hardware lab is setup at LT using old hardware components for the sake of demonstration and explanation of working and principles of computer hardware.

Computer Hardware Components: Motherboard, Hard Disk, RAM, Processor, Bus, Ports, Signaling, Formatting, BIOS Settings, Assembling and Troubleshooting.

Operating System (Open Source & Windows): Basic Design & Architecture, Memory Management, Server and Client Concept, Process Management, File System & Management, User Accounts & Security Features, Installation of Windows & Linux for Multiboot, Multi-homed environment using various sources viz., CD/DVD, Pen Drive, LAN, Internet, Mobile etc.

OS Features & Commands: Foreground & Background Services, Shell Commands & Scripting, Physical Networking, PC Level Network Troubleshooting, IIITA Network Demonstration as Case Study, Remote Login and File Sharing on Intranet, Transfer of Contents using HTTP, FTP, SSH protocols.

Basics of Internet & Web Concept: Data Transfer on LAN, Switch & Router Operations, Web Server Concept, HTML Coding, Web Page Hosting, DNS Working, Central Authentication using LDAP, Routine Troubleshooting w.r.t. IIITA Campus LAN (specially hostels and labs).

Maintenance of Computers & Servers: Objective of Software Services & Software used at IIITA, Basic Idea of Installation and Configuration, Frequent Run Time Problems and their Possible Solutions.

LCS 102 **Language and communication skills**

L-T-P-[C]

0-0-2-[2]

Communication Process and Principles of Communication - Barriers to Communication.

Written Communication - Letter and Report Writing.

Written Analysis of Business Situation - Case Analysis

Text Books:

1. Business Correspondence and Report Writing - R.C.Sharma
2. Business Communication - M.Balasubramanyam
3. Essentials of Business Communication - R.Pal and Kolahalli
4. Business Communication and Report Writing - Sharma, Mohan
5. Lesikar's Basic Business Communication - Lesikar

PME 220 **Principal of Management & Economics**

L-T-P-[C]

2-0-0-[2]

Principles of Management: Concept of Management, Functions of Management, Planning and its Nature & Organising, Designing organizational Structure, Authority relationships, Delegation of Authority. Staffing: Motivation and its Theory, Leadership Communication. Directing, Controlling & its techniques. Coordinating.

Principles of Economic: Microeconomics: Concept of consumption, production, exchange, distribution. Demand analysis: Concept, kind of demand, change in demand, law of demand. Utility analysis: Marginal, total, consumer surplus, consumer equilibrium. Production analysis: Law of supply, different factors of production, law of returns, economies of scale. Cost analysis: Cost concept, importance of cost behaviour, cost classification. Pricing analysis: Different kinds of markets, pricing & equilibrium in different markets - perfect, imperfect, monopoly. Income distribution: Briefing them about rent, wages, interest and profit. The international economics: Changing scenario, globalization, structural adjustment programme, stabilization policy, the multinational corporation. IBRD, IMF, GATT, WTO, ITO, IDA, IFC, MIGA.

Text Books:

1. Management - James A.F. Stoner, K.Edward Freeman, Daniel R.Gilbert.
2. Business Organisation & Management - C.R Basu.
3. Essentials of Management - Harold Koontz, Heing Werhrich.
4. Management Mess Ups - Mark Eppler
5. Management - W. Haynes
6. Economics; Samuelson & Nordhaus.
7. An introduction to Positive Economics; Lipsey.
8. Modern Microeconomics; A. Koutsoyiannis.
9. Macroeconomics - an open economy approach; Eric Pentecost.
10. International Economics; Soren Kjeldsen-Kragh.
11. Managerial Economics - Analysis, Problems and Cases; P.L. Mehta.
12. Business Economics; Manab Adhikary.
13. Managerial Economics; G.S. Gupta.
14. Business Economics; P.N. Chopra.
15. The Economics of Technological Diffusion; Stoneman.

COA 230 **Computer Organization and Architecture**

L-T-P-[C]

3-0-0-[3]

Digital Computers and Performance Measures: Introduction, functional entities, general purpose computer, brief-review of computer development and analog-digital conversion, Performance Measures Representation of Information: Data types and classification, number system, binary and alphanumeric codes, complements, unsigned, signed, fixed-point and floating-point representation, binary arithmetic using signed and unsigned number systems, concept of overflow and normalization, Gray and other binary codes, Error detection and correction codes.

Basic Building Blocks: Boolean algebra, combinational logic design, flip-flops, registers, counters, decoders, ALU, arithmetic circuits and their implementation. Register transfer and micro-operations: Register transfer, Memory and bus transfer, Arithmetic, logic and shift micro-operations, Arithmetic-logic-shift (ALU) unit and design consideration.

Computer organization, design and programming: Instruction code, registers, timing and control, cycle, Input-output and interrupts, accumulator and basic computer design, addressing modes, machine language, assembly language, subroutines, assembler, programming AL operations. Micro-programmed control and CPU: Control memory, address sequencing, control unit design, register & stack organization, instruction formats, addressing modes, data transfer, program control, RICS and CISC computer.

Performance enhancement with Pipelining and vector processing: pipelining, parallel processing, pipelined data path, control, data and branch hazards and forwarding, exceptions, vector processing. Computer arithmetic and memory organization: addition, subtraction, division, multiplication algorithms, floating point and decimal arithmetic operations, asynchronous data transfer, DMA, priority interrupts, IOP, memory types, organization and management.

Text Books:

1. Mano, M. M: Computer System Architecture, Prentice-Hall of India, 1983
2. Patterson, D. A. and Hennessey, J. L., Computer organization and design, Harcourt Asia, second edition.
3. Hayes: Computer Architecture and Organization, Mc Graw-Hill International Edition.

DMA 230 **Discrete Mathematics and Mathematical Logic**

L-T-P-[C]

3-0-0-[3]

Mathematical Logic: Statements and Connectives, Elementary operations of logic, Well formed statement formulas, Equivalence of formulas, Principle of duality, Tautologies and Implications, Functional completeness of sets of connectives, Exclusive OR: NAND and NOR, Disjunctive and Conjunctive Normal forms, Principal Normal forms and their index representation, Inference theory, Predicates, Variables and Quantifiers, Predicate formulas, Free and Bound Variables, Universe of Discourse, Valid formulas and Equivalences, Theory of Inference for Predicate Calculus, Formulas involving multiple quantifiers, Prenex Normal form, Resolution principle.

Sets: Relations, Properties of Relations, Equivalence relations and Partitions, Relation matrices, Boolean sum and Product of Bit Matrices. Counting: Principle of Inclusion and Exclusion, Division and Euclidean Algorithm in Integers, Elements of Probability, Recurrence Relations.

Directed Graphs: Matrix representation of Digraphs, Path and Reachability, Transitive Closures and Warshalls Algorithm. Functions: Characteristic Functions, Permutation Functions, Cycle decomposition of permutations, Even and Odd permutations, Growth of Functions. Graphs: Eulerian and Hamiltonian paths and cycles, Colouring of Graphs.

Lattices and Boolean Algebra: Partially Ordered sets, Lattices properties of Lattices, Finite Boolean Algebras. Trees: Rooted Trees, Undirected Trees, Spanning Trees of Graphs, Algorithms for Minimal Spanning Trees.

Text Books:

1. Tremblay & Manoher: Discrete Mathematical Structures with Applications to Computer Science (Tata McGraw Hill)
2. Kolman, Busby & Ross: Discrete Mathematical Structures (Prentice Hall of India)
3. Mott, Kandel & Baker: Discrete Mathematics for Computer Scientists and Mathematicians (Prentice Hall of India).

DST 232
L-T-P-[C]
3-0-2-[5]

Data Structure

Programming in C. Elementary data structures: arrays and strings; packing; space arrays; algorithm development; complexity; simple examples of algorithm development; recursion. Sequential search: divide and conquer-binary search; selection and insertion sort; merge-sort; quicksort; complexity of sorting. Linear lists-stacks: stack use-postfix notation; recursion removal. Queues-circular queues. Linked lists-definition on Pascal and C; creation and deletion of nodes; circular and doubly linked lists; applications of lists.

Graphs and representation sets-UNION and FIND operations: graph algorithms; optimization and greedy method; minimum spanning tree, shortest path. Trees; binary tree traversals; search trees, AVL trees; threaded trees; heapsort; tries and B-trees; external search. Tables and information retrieval; hashing; depth first and breadth first search; examples of backtracking. String algorithmspattern search and text editing. Structured approach to programming step wise refinement approach. Reasoning about programs, program specification, pre-and post condition, weakest pre-conditions, program assertions, loop invariants. Programming style-documentation, basic concepts of program testing.

Text Books:

1. Tanonbaum, A.M., and Augenstein, M.J.; Data Structures with Pascal, Prentice Hall International, 1985
2. Stubbas, D.: Data Structures with Abstract Data Types and Modula 2, Brooks & Cole Publications Comp., 1987.

Lab Assignments: Assignments based on implementation of all theoretical concepts learned.

MAT 232 **Mathematics-II**

L-T-P-[C]

3-0-2-[5]

Linear Algebra: Review of Vector Algebra in R^3 and generalizing it to R^n including scalar product. Definition and examples of fields (including Z_p , p a prime). Vector space over a field. Subspaces and subspaces generated by a subset. Subspaces of R^3 and of R^2. Linear dependence and independence. Concept of a basis and dimension of a vector space. Sum of subspaces and Quotient of a vector space modulo a subspace. Dimension of Sum of subspaces and of quotient spaces.

Matrices, different types of matrices, Linear Transformations, Matrices as Linear Transformations and Matrix representation of Linear Transformations. Range space and Null space, Rank and Nullity of a linear transformation and of matrices. Rank-nullity theorem. Echelon form. Reduction to Echelon form and also to normal form. Computations of rank, nullity of matrices and inverse of nonsingular matrices. System of Linear equations as matrix equation. Consistency and inconsistency of system of linear equations. Solution space. Different decompositions of matrices (LU, LLt) Concept of Determinant and properties of determinant. Adjoint of a matrix Cramers rule.

Real and complex inner product spaces. Cauchy Schwarz and Bessels inequalities. Orthonormal basis and Gram Schmidt Orthonormalization. Hermitian Skew Hermitian, Symmetric and Skew Symmetric matrices. Eigen values and Eigen vectors, Unitary reduction of Hermitian and orthogonal reduction of real symmetric matrices. Singular Value decompositions.

Numerical Methods: Root finders: Solution of polynomial and transcendental equations - bisection method, Regula falsi method, Secant method, Iteration Method and Newton-Raphson method. Interpolation: Interpolation Formulae: For equi-spaced data - Newtons forward, backward, central difference Interpolation formulae, Stirlings and Bessels formulae: For unequal intervals - Lagranges Interpolation formulae, Errors in various interpolation formulae. Inverse Interpolation - Lagranges method and iterative method, Examples and Exercises.

Numerical Differentiation and Integration: Numerical Differentiation - derivatives using Newtons Forward, Backward Difference Interpolation Formula, Maxima and Minima. Numerical Integration - Newton-Cotes formulae, General quadrature formula for equidistant ordinates, Trapezoidal, Simpsons 1/3 and 3/8 rules, Booles and Weddles rule. Introduction to double differentiation and Integration with errors. Error Analysis: Errors estimation of errors, error propagation, errors in approximations

Text Books:

1. E.Kreyszig : Advanced Engineering Mathematics. (Wiley Eastern)
2. B.Rai, D.P. Choudhury and H.I. Freedman: A Course in Ordinary Differential Equations. (Narosa Publishing House).
3. Gilbert Strang, Linear Algebra, Cambridge Press.
4. Grewal B S, Numerical Methods in engineering & Science, Khanna Publishing.
5. Serg, Lang, Introduction To Linear Algebra.
6. Seymour Lipschutz, Marc Lipson, Schaum'S Outline Of Theory And Problems Of Linear Algebra.

MAT 230 Continued

Lab Assignments:

1. For Linear Algebra: 1) Write a program to check if a natural number n is prime and if so to find the multiplicative inverse of an element $r \neq 0$, r in Z_n. Implement it to find the inverse 20 in $Z_{2^{16}+1}$ and 21 in Z_{641}. 2) Write a program to reduce a matrix in echelon and also to normal form. 3) Write a program to check if a system of 3 linear equations in 3 variables is consistent and if so to find the solution set. 4) Write o program to find the inverse of a square 3×3 matrix if possible. 5) Write a program to find square root of a real symmetric matrix.

2. For Numerical Methods: Write down an algorithm and specific computer programs in C or C++ for each method discussed in the theory lecture.

DEL 232 **Digital Electronics**

L-T-P-[C]

3-0-2-[5]

Number System: Introduction to Binary Numbers, Data Representation, Binary, Octal, Hexadecimal and Decimal Number System and their Conversion. Boolean Algebra and Logic Gates: Basic Logic Operation and Identities, Algebraic Laws, AND, OR, NOR, NAND, EX-OR, EX-NOR Gates, Useful Boolean Identities, Algebraic Reduction, Complete Logic Sets, Arithmetic Operation using 1's and 2's Compliments, Signed Binary and Floating Point Number Representation, Introduction to logic families: DTL, TTL, MOS, CMOS, ECL.

Combinational Logic Design: Specifying the Problem, Canonical Logic Forms, Extracting Canonical Forms, EX-OR Equivalence Operations, Logic Array, K-Maps: Two, Three and Four variable K-maps, NAND and NOR Logic Implementations, Concept of Digital Components, An Equality Detector, Line Decoder, Multiplexers and De-multiplexers, Code converters, Binary Adders, Subtraction and Multiplication.

Sequential Network: Concepts of Sequential Networks, Latches, Flip Flops, Analysis of Sequential Networks: Single State and Multi-variable Networks, Sequential Network Design, Binary Counters and Shift Registers, Importance of state machine.

Memory Elements and Arrays: General Properties, Latches, Flip Flops: RS Flip Flop, D Flip Flop, T Flip Flop, JK Flip Flop, Clock and Synchronization, Master-Slave and Edge-triggered Flip-flops, Registers, RAM and ROMs: different types, Programmable logic array, C-MOS Memories. Sample and Hold circuits, Analog to Digital Converters and Digital to Analog Converters.

Text Books:

1. Digital Design by M. Morris Mano.
2. Digital Logic and Computer Design by M. Morris Mano.
3. Balabanian, N. and Carlson, B., Digital Logic Design Principles, John Wiley & Sons.
4. Malvino, A.P. and Leach, D.P., Digital Principles and Applications, 6th Ed., Tata McGraw-Hill. 2008.
5. Floyd, T.L., Digital Fundamentals, 8th Ed., Pearson Education.

Lab Assignments:

1. Realization of logic gates using IC. Implementation of all gates using universal gates.
2. Construction of Half/Full Adder and Half/Full Subtractor.
3. Realization of circuit for binary to gray conversion and vice-versa
4. To design 4-bit binary adder and subtractor using IC 7483
5. To construct circuit for 9s complement of a BCD number.
6. To construct a full adder using 3x8 decoder.
7. To construct a 4:1 multiplexer circuit.
8. To construct SR and D flip-flop, JK and T flip-flop.
9. To design a binary converter using IC 7473 and 7400.

MAT 330 **Mathematics -III**

L-T-P-[C]

3-0-0-[3]

LAPLACE TRANSFORMS: Definition and properties, Sufficient condition of Existence, Transforms of derivatives and integrals , Derivatives and integrals of transforms , Inverse Laplace Transforms , Exponential shifts, Convolutions, Applications: Differential and Integral Equations, Abel Mechanical Problem, Circuit Theory.

FOURIER SERIES: Periodic Functions, Fundamental Period, Trigonometric series, Fourier Series, , $L^2[0, 2\pi]$, Bessel's Inequality, orthonormal and orthogonal set, Euler Formulas, Functions with arbitrary periods, Even and odd Functions , Half Range Expansions, Fourier Coefficients without integration , Approximation by Trigonometric polynomials. Application to Differential equation.

FOURIER TRANSFORMS: Fourier Integral Theorem , Sine and Cosine Integrals, Inverse Transforms , Transforms of Elementary Functions, Properties, Convolution ,Parsevals relation , Transform of Dirac Delta Function, Multiple Fourier Transform. Finite Fourier transform.

Z TRANSFORMS: Z transforms, properties, Inverse Z- transforms, relationship with Fourier transforms. COMPLEX ANALYSIS: Complex Numbers, Modulus, Argument, Curves and Regions in Complex Plane, Functions, Limits, Derivatives, Analytic Functions, Cauchy Riemann Equations, Complex Exponential Logarithms and Trigonometric function, General powers, Line Integrals, Cauchy's theorem, Cauchys Integral Theorem, Cauchys integral Formula. Taylor and Laurent Series, Zeros and Singularities, Residues, Residues Theorem, Evaluation of Real Improper Integrals.

Text Books:

1. E. Kreyszig : Advanced Engineering Maths (Wiley).
2. Jain & Iyenger: Advanced Engineering Mathematics (Narosa).
3. Churchill: Complex Variables & Application.
4. G. F. Simmons: Differential equations.

MIC 332 **Microprocessors**

L-T-P-[C]

3-0-2-[5]

General architecture of microcomputer system, evolution of Intel microprocessors, stored program concept, microcomputer applications. 8086/88 software architecture: memory space, data types and organization, segmented memory concept, dedicated, reserved and general use memory, addressing modes. Instruction set: data transfer, arithmetic, logical, string, control transfer instructions and processor control instructions.

Microprocessor program specification, design and coding: conceptualization and modularization of problem, coding, assembling, testing, debugging and documentation. Arithmetic & logical programming, timing delays, data tables, procedure and macros, modular programming. Assembly language programming examples, case studies and product development. 8086/88 hardware organization and design: three bus architecture, system clock and reset signal generation, bus types and buffering techniques, minimum and maximum modes of operations.

Input/output and main memory design, parallel, serial, programmed, interrupt driven I/O (8279) and DMA based data transfer (8237), Peripheral controllers for 8086/88: 8237, 8251, 8255, 8259, and 8279. Coprocessors: Numeric data processor (8087), I/O Processor (8089), Introduction to other Intel microprocessors.

Text Books:

1. The 8086/8088 Family: Design, Programming and Interfacing by John Uffenbeck (PHI).
2. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications (PHI).
3. Microprocessor and interfacing by Douglas hall (McGraw Hill).

Lab Assignments:

1. Assembly language programming of 8086.
2. Interfacing of 8086: memory interfacing, design of I/O modules and interfacing of different peripherals, parallel interfacing using A/D and D/A converters.
3. Mini Project based on microcontroller and microprocessor.

OPS 332 **Operating System**

L-T-P-[C]

3-0-2-[5]

OS basics: Definition, OS as resource manager, Types of OS, Operating-System Services, Operating-System Structure, System Calls, Types of System Calls. Processor Management: Processes, Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication.

Threads: Overview, Multithreading Models. CPU Scheduling: Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling. Process Synchronization: Monitors, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization. Deadlocks: System Model, Deadlock Characterization, Methods for Handling, Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery From Deadlock.

MEMORY MANAGEMENT: Main Memory Basics, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Basics of Virtual Memory, Demand Paging, Page Replacement, Allocation of Frames, Thrashing. STORAGE MANAGEMENT: File Concept, Protection, Access Methods, Directory Structure, File-System Mounting, File Sharing, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Mass-Storage Structure, Overview of Mass-Storage, Disk Scheduling , Disk Management.

MINIX: Basic Commands, Directory Structure, Internal Architecture, Source Code organization, All minix task assigned in Lab.

Text Books:

1. Avi Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts. Wiley.
2. Andrew S. Tanenbaum, Modern Operating Systems. Pearson.

Lab Assignments:

1. Write c programs for the following: 1) Simulate First come First Serve CPU scheduling algorithm (a) Assume that all arrived at the same time (b) Simulate with different arrival times. 2) Simulate Shortest Job First CPU Scheduling algorithms. 3) Simulate Round Robin CPU Scheduling algorithm. 4) Simulate Priority based CPU Scheduling algorithm. 5) Combine all CPU Scheduling approaches in a single C Program. 6) Write a c program to simulate Bankers Safety Algorithm. 7) Simulate Bankers Resource Request Algorithm. 8) Simulate Producer Consumer problem with all possible solutions. 9) Simulate Readers Writers problem with all possible solutions. 10) Simulate Sleeping Barber problem with all possible solutions. 11) Simulate Dining Philosopher problem with all possible solutions. 12 Implement First Come First Serve Disk scheduling algorithm. 13) Implement Shortest Seek Time First Disk scheduling algorithm. 14) Implement Scan Disk Scheduling algorithm. 15) Implement Look Disk Scheduling algorithm. 16. Write a c program to simulate FIFO page replacement algorithm. 17) Simulate LRU page replacement algorithm. 18) Simulate Optimum page replacement algorithm.

OPS 332
Continued

2. MINIX OS: 1) Study of the directory structure of Minix Operating System. 2) Change the root banner in Minix. 3) Create an user account in Minix. 4) Modifying prompt message displayed by Minix when it boots. 5) Modifying output format of cal command. 6) How to Add a New System Call in Minix explain with example. 7) Modify the tty driver so that control-W erases the previous word typed by the user. 8) Modify the F6 key to output your name and current version of Minix. 9) How to implement a System Call (SC) on Minix 3 that returns the PID (Process ID) and the PPID (Parent Process ID). 10) Write a command to show the size and date of last modification of the contents of each directory along a given path. 11) Write a system call to change the priority of the process. 12) How to Exchange Data with Other Operating Systems to Minix. 13) Modify the mined editor in Minix. 14. Explain how we can restore the previous settings in Minix.

3. Study and development of various android apps.

TOC 330 **Theory of Computation**

L-T-P-[C]
3-0-0-[3]

Regular languages: Introduction: Notion of a formal language, DFAs and notion for their acceptance, informal and formal definitions. Class of regular languages, Closure of the class under complementation, union and intersection. Strategy for designing DFAs, Pumping lemma for regular languages, NFAs. Notion of computation trees. Definition of languages accepted. Construction of equivalent DFAs of NFAs. NFAs with epsilon transitions, Regular expressions, Closure properties for regular languages, Myhill-Nerode theorem as characterization of regular languages, States minimization of DFAs.

Context free languages: Notion of grammars and languages generated by grammars. Equivalence of regular grammars and finite automata. Context free grammars and their parse trees. Context free languages. Ambiguity. Pushdown automata (PDAs): deterministic and nondeterministic. Instantaneous descriptions of PDAs.Language acceptance by final states and by empty stack. Equivalence of PDAs and CFGs, Elimination of useless symbols, epsilon productions, unit productions from CFGs. Chomsky normal form, Pumping lemma for CFLs and its use. Closure properties of CFLs, Decision problems for CFLs.

Turing machines, Recursively enumerable languages, undecidability Informal proofs that some computational problems cannot be solved, Turing machines (TMs), their instantaneous descriptions. Language acceptance by TMs. Church-Turing hypothesis and its foundational implications, Codes for TMs. Recursively enumerable (r.e.) and recursive languages. Existence of non-r.e. languages. Notion of undecidable problems. Universal language and universal TM. Separation of recursive and r.e. classes. Notion of reduction. Some undecidable problems of TMs. Rice's theorem, Undecidability of Post's correspondence problem (PCP), some simple applications of undecidability of PCP.

Text Books:

1. Michael Sipser, Introduction to the theory of Computation, Cengage Learning; 3 edition.

OOM 332 **Object Oriented Methodologies**

L-T-P-[C]

3-0-2-[5]

The Course introduces the characteristic differences between Procedural and Object Oriented approach for programming, Concepts of Class, Objects and Object Oriented Characteristics. Building upon basic programming skills in OO, specifically using basic Java programming constructs for object oriented problem solving (e.g., Classes: Abstraction, inheritance, interfaces, polymorphism), Methods in OO Programming: Method overloading and overriding.

To appreciate the role of Object orientation in problem solving and to be able to design and implement a Java program to model a real world system, and subsequently analyse its behaviour. Java implementation for GUI, Event handling and Applets for Web enabled applications. Developing Applications with GUI and Database connectivity.

This module focuses on the design and analysis of larger, more complex programs using Object Oriented Modeling with UML. Why build models of software, Why should we build comprehensive designs before coding Static and Dynamic modeling diagrams and role of Use Case Diagrams.

Overview of UML for Java Programmers: Class Diagrams Object Diagrams. Sequence Diagrams, Collaboration Diagrams, Static Diagrams: Working with Diagrams and role of Modeling, Making Effective use of UML, Communicating with Others, Back end documentation What to keep, and What to throw away, Iterative Refinement Behaviour, Iterative Refinement Minimalism, When to draw diagrams, and when to stop.

Design Metrics: Cohesion and Coupling- CRC. Class Diagrams & OO Relationships: Inheritance, Aggregation and Composition. OO Design Principles: Open Close Principle, Interface segregation principle, Liskov Substitution Principle. Dynamic modeling diagrams.

Text Books:

1. Objects First with Java, 5th edition, David Barnes and Michael Kolling.
2. UML distilled by Martin Fowler.

POM 330 **Principles of management**

L-T-P-[C]

3-0-0-[3]

Nature and Functions of Management - Importance and Process of Management - Historical Roots of Contemporary Management Practices: Pre-modern era-Classical Contributions - Development of Management Thoughts - Managerial Roles: Role of a Manager - Levels of Management - Managerial Skills - Social Responsibilities of Business.

International Business and its Environment - globalization & WTO-. Dynamics of development Global business environment-. Internal and External analysis.

Nature and Importance of Planning -Types of Plans - Steps in Planning-Making Planning Effective - Strategic Considerations in Planning - Management by Objectives - Decision Making: Rationality in Decision Making - Decision Making and MIS - Forecasting: Techniques of Forecasting.

Need for Organization - Principles and Process of Organizing - Span of Management - Organization Structure - Variables affecting Structure - Departmentalization - Authority, Delegation and Decentralization - Committees.

Staffing and Directing: Staffing as a Function of Management - Requirement of Effective Direction - Functions of Direction - Principles of Direction - Supervisor and his Qualities - Supervisors Role and Functions - Effective Supervision.

Co-Ordination - Need for Co-Ordination - Principles and Techniques of Co-ordination - Control: Need for Control - Steps in Control Process - Control Techniques.

Text Books:

1. Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.
2. P.C.Tripathi, P.N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
4. Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
5. James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
6. Williams, Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

PS 432 **Probability & Statistics**

L-T-P-[C]

3-0-2-[5]

Probability: Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events. Random Variable: Random Variables, Distribution function, Discrete and Continuous random variables, Probability mass and density functions, Expectation, Function of random variable, Moments, Moment generating function, Chebyshev's inequality.

Special discrete distributions: Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson, Uniform. Special continuous distributions: Uniform, Exponential, Gamma, Normal, Weibull, Reyleigh. Random vector: Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Covariance, Correlation, Functions of random variables. Law of Large Numbers: Weak law of large numbers, Levy's Central limit theorem (i.i.d. finite variance case), Normal and Poisson approximations to Binomial.

Statistics: Introduction: Population, Sample, Parameters. Point Estimation: Method of moments, Maximum likelihood estimation, Unbiasedness, Consistency. Interval Estimation: Confidence interval. Tests of Hypotheses: Null and Alternative hypothesis, Type-I and Type-II errors, Level of significance, p-value, Likelihood ratio test, Chi-square goodness of fit tests. Regression Problem: Scatter diagram, Simple linear regression, Least square estimation, Tests for slope, prediction problem, Graphical residual analysis, Q-Q plot to test for normality of residuals.

Text Books:

1. Sheldon Ross (2009), A First Course in Probability, 8th edition, Pearson Prentice Hall.
2. Rohatgi, V. K. and Saleh, A. K. (2000), An Introduction to Probability and Statistics, 2nd Edition, Wiley-interscience.
3. Hogg, R., McKen, J., and Craig A. (2012), Introduction to Mathematical Statistics, Pearson.
4. Ross, S. M. (2014), Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Academic Press.
5. Trived, K. S. (2008), Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley India Private Limited.
6. A. M. Mood, F. A. Grabill, and D. C. Boes (1974), Introduction to the Theory of Statistics, 3rd edition, McGraw Hill.
7. D.P. Bertsekas and J. N. Tsitsiklis (2008), Introduction to Probability, 2nd edition, Athena Scientific.

DCOM 432 Digital Communication

L-T-P-[C]

3-0-2-[5]

Introduction to Digital Communication, Sampling, Quantization, Pulse Code Modulation, Delta Modulation, adaptive delta modulation.

Line coding techniques (RZ, NRZ, AMI, and Manchester), Spectra of digital signals, Spectral shaping by precoding, Binary and M-ary error probability, Matched filters, Nyquist pulse shaping, Equalization, Optimum terminal filters and correlative coding, synchronization techniques.

Optimum detection and MAP receivers, digital multiplexing, Digital continuous wave modulation techniques: ASK, FSK, PSK, staggered and non staggered QPSK, /4-QPSK, MSK, GMSK, coherent and non coherent systems, Spread Spectrum, Jamming considerations, CDMA fundamentals.

Information measure and source coding techniques, mutual information, Binary symmetric channel, Channel capacity, Shannon Hartley law.

Principle of error control coding, BEC and FEC systems. Introduction to block codes, Cyclic Codes, Convolution codes and trellis coded modulation.

Text and Reference Books:

1. Communication systems, IV edition, A B Carlson, McGraw Hill.
2. Digital Communication, B. P. Lathi.
3. Digital Communication, IV edition, J. Proakis, McGraw Hill.
4. Digital Communication, II edition, B Sklar, Prentice Hall.

Lab Assignments:

1. **To be performed on bread-board:** Perform Amplitude modulation, Perform Frequency modulation, Implement ASK Modulator using RC shift Oscillator IC LF398, Implement BPSK Modulator using IC LF398 & IC 741 FSK Modulator using IC LF398, Implement a circuit to generate Convolution Coder output bit sequence using 7486, Implement Mixer circuit using 565 PLL IC and study its working characteristics, Implement Digital Phase Detector using IC-741 & IC-7486.
2. **MATLAB/C++ Programming:** Write a MATLAB and C++ program to generate output of ASK, FSK & PSK, Write C++ program for Huffman encoding, Write a C++ program for implementing Linear Block Code and illustrate encoding & decoding

DAA 432 **Design and Analysis of Algorithms**

L-T-P-[C]

3-0-2-[5]

Asymptotic notations and their significance, introduction to RAM model of computation, complexity analysis of algorithms, worst case and average case. Basic introduction to algorithmic paradigms like divide and conquer, recursion, greedy, etc. Searching: binary search trees, balanced binary search trees, AVL trees and red-black trees, B-trees, skip lists, hashing. Priority queues, heaps, Interval trees, tries. Order statistics. Sorting: comparison based sorting - quick sort, heap sort, merge sort: worst and average case analysis. Decision tree model and (worst case) lower bound on sorting. Sorting in linear time - radix sort, bucket sort, counting sort, etc. String matching. Graph Algorithms: BFS, DFS, connected components, topological sort, minimum spanning trees, shortest paths - single source and all pairs.

Models of computation: RAM model and its logarithmic cost. Formal introduction to algorithmic paradigms: divide and conquer, recursion, dynamic programming, greedy, branch and bound, etc. Advanced data structures: Fibonacci heap, union-find, splay trees. Amortized complexity analysis Randomized algorithms: Randomized algorithms to be introduced a bit early, i.e., before NP-completeness to highlight randomization as an algorithmic technique.

Application areas: Geometric algorithms: convex hulls, nearest neighbor, Voronoi diagram, etc. Algebraic and number-theoretic algorithms: FFT, primality testing, etc. Graph algorithms: network flows, matching, etc. Optimization techniques: linear programming

Reducibility between problems and NP-completeness: discussion of different NP-complete problems like satisfiability, clique, vertex cover, independent set, Hamiltonian cycle, TSP, knapsack, set cover, bin packing, etc. Backtracking, branch and bound,Approximation algorithms: Constant ratio approximation algorithms. Miscellaneous: Introduction to external memory algorithms, parallel algorithms.

Text Books:

1. E. Horowitz & S. Shahni, Fundamentals of Computer Algorithms, Galgotia.
2. Sedgewich, Algorithms in C.

Lab Assignments:

1. Sorting the list of given numbers using Heap sort & merge sort.
2. Sorting the list of characters using Heap sort & merge sort.
3. Job sequencing using Greedy method.
4. Knapsack problem using Greedy method.
5. Travelling sales person using dynamic programming.
6. Shortest path problem.
7. Generating optimal binary search trees.
8. 8 queens problem using backtracking.
9. 5 puzzle problem using Branch & Bound.
10. 0-1 Knapsack using backtracking.

PPL 430 **Principles of Programming Languages**

L-T-P-[C]

3-0-0-[3]

Classification of Programming Languages : Imperative and Declarative languages; Procedural and Object Oriented languages; Concurrency; Functional and Logic Programming and other languages; Data Types : Static and Dynamic Types; Early and Late binding; Type Conversion; Records, Union, Array and Pointers; Dangling References and Garbage Collection; Concept of Objects and Classes; Abstract Data Types and Classes; Hierarchy and Inheritance; Constructors; Kinds of access; C++ and Java Comparison. RAM and PRAM. Concept of Concurrency, Concurrent Programming Languages. Functional Programming Languages : LISP. Logic Programming : PROLOG. Event Handling and Languages. Exception Handling. Specialized Languages: Intro to XML, PHP, etc.

Text Books:

1. Robert W. Sebesta, Concepts of Programming Languages, Tenth Edition. Pearson.

DBM 432 **Database Management Systems**

L-T-P-[C]

3-0-2-[5]

Evolution of Data Centric Systems, Need & Purpose of Database Systems. Transaction Management, Database user categories and Database architecture, Data Modeling-ER Diagrams, Case Study discussions for ER Diagrams. Relational Database-concepts of Keys-Super Key, Primary, Candidate and Foreign Keys. Weak Entity Surrogate Keys. Integrity constraints, Referential constraints and SQL Constructs. Database languages-Procedural & Non-procedural. Relational Algebra, Database Query languages- SQL, PL-SQL :

SQL and PL/SQL: Introduction to SQL constructs (SELECTFROM, WHERE GROUP BY HAVING ORDERBY.), INSERT, DELETE, UPDATE, DROP, VIEW definition and use, Temporary tables, Nested queries, and correlated nested queries, Integrity constraints: Not null, unique, check, primary key, foreign key, references, Triggers, Embedded SQL and Application Programming Interfaces.

PL/SQL: Variables literals data types advantages of PL/SQL; Control statements : if ; iterative control loop, while, for , goto ; exit when; Cursors : Types implicit, explicit parameterized cursors cursor attributes; Exceptions: Types internal , user-defined , handling exceptions raise statement; PL/SQL tables and records: Declaring PL/SQL tables - referring PL/SQL tables, inserting and fetching rows using PL/SQL table, deleting rows; records - declaration of records - deleting records; Sub programs: Functions - procedures - in, out, inout parameters; purity functions - packages - package specification - advantages of packages - private and public items - cursors in packages.

Protecting the Data Base - Integrity, Security and Recovery. Domain Constraints, Referential Integrity, Assertion, Triggers, Security & Authorization in SQL. Relational Database design - Logical, Conceptual and Physical database design, Normalization, Various Normal Forms & Design discussions. Database performance issues. Transaction Management & Distributed database, Storage management in Database, User Interface for Database, connectivity issues & Database access from Smartphone and Database on Cloud. Data Warehouse and Data Mining, Information storage and retrieval. (Evaluation for DBMS Theory will be done through Assignments, Quizzes, Mid Semester and End Semester examinations)

Text Books:

1. Ramakrishnan, Gehrke, Database Management Systems.

Lab Assignments:

1. ER diagrams exercise and SQL , PL-SQL: Modeling exercises for ER Diagrams, Identification of Attributes & Keys. Design Discussions.SQL Commands and Queries (20-25 Queries to be written and data retrieved) Writing SQL Triggers & Assertions.
2. Mini Project implementation (Details of following are given to the students with functional components with Project Tasks : Draw ER Diagram, Schema of each table required in Project, Normalize all table up to 3NF, Implementation Task: User Interface creation and Report generation.

CNE 532 **Computer Networks**

L-T-P-[C]

3-0-2-[5]

Introduction to Computer Networks, OSI & TCP/IP Reference Models, Physical Layer.

Data Link Layer: Framing, Error Control, Error Detection and Correction, Flow Control. Data Link Protocols: Simplex Stop-and-Wait Protocol, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sublayer, The Channel Allocation. Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x - Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802 xx , Bluetooth, Rfid, Bridges, Virtual LANs.

Network Layer: Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing, Routing for Mobile Hosts, Routing in Ad Hoc Networks, Congestion Control: Approaches, Traffic-Aware Routing, admission Control, Traffic Throttling, load Shedding. Quality Of Service: Application Requirements, Traffic Shaping, Packet Scheduling, Admission Control, Integrated Services, Differentiated Services, The IPv4 and v6, IP Addressing, Internet Control Protocols, Label Switching and MPLS, OSPF, BGP, Internet Multicasting, Mobile IP.

Transport Layer: Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Congestion Control Algorithms UDP, Remote Procedure Call, RTP, TCP, Delay Tolerant Networks.

Text Books:

1. Computer Networking: A Top-Down Approach Featuring the Internet by James F. Kuross, Keith W. Ross.
2. Computer Networks by Andrew S. Tanenbaum.

SOE 532 **Software Engineering**

L-T-P-[C]

3-0-2-[5]

Introduction to Software Engineering: Role of Software Engineering, Software Evolution, Legacy system structures, Legacy system design, Legacy System Assessment, Software Development Life Cycle. Software Process Models: Software process models, Software Specification, Software design and implementation, Software validation, Automated process support, Prescriptive Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized process models, Extreme Programming, Agile Methodology, Scrum, The Unified Process.

Project Management and Requirement Engineering: Project Planning and Scheduling, Risk Management, Functional and Non Functional Requirements, Users Requirement, System Requirements, SRS Document Generation, Feasibility Studies, Types of Feasibilities, Requirement Analysis, Requirement Validation, Requirement Management, Software Measurement and Matrices. System Modeling and Prototyping: Context models, Behavioral models, Data models, Object models, CASE Workbenches, Prototyping in the Software Process, Rapid Prototyping Techniques, Interface Specification, Behavioral Specification.

Design Engineering: Architectural Design, System Structuring, Control Models, Modular Decomposition, Domain-Specific Architectures, Object Oriented Design Process, Design with Reuse, Component-Based Development, Application Families, Design Patterns, User interface Design Principles, User interaction, Information presentation. Verification and validation: Verification and Validation Planning, Software Inspections, Clean room Software Development, Software Testing, Black Box Testing, White Box Testing, Integration Testing, Object-Oriented Testing, Writing test cases, Testing tools, Configuration Management and Version control.

Text and Reference Books:

1. Software Engineering, Ian Sommerville.
2. Software Engineering, A Practitioners Approach, Roger S. Pressman.
3. An Integrated Approach to Software Engineering Pankaj Jalota.
4. Journals and Papers.

POE 530 **Principles of Economics**

L-T-P-[C]

3-0-0-[3]

Microeconomics: Concept of Consumption, Production, Exchange, Distribution. Demand Analysis: Concept, Kind of Demand, Change in Demand, Law of Demand. Utility Analysis: Marginal, Total, Consumer Surplus, Consumer Equilibrium.

Production Analysis: Law of Supply, Different Factors of Production, Law of Returns, Economies of Scale. Cost Analysis: Cost Concept, Importance of Cost Behaviour, Cost Classification.

Pricing Analysis: Different Kinds Of Markets, Pricing & Equilibrium In Different Markets Perfect, Imperfect, Monopoly. Income Distribution: Rent, Wages, Interest And Profit.

National Income and Accounting: Concepts and Indicators (gross domestic product (GDP), gross national product (GNP) and gross national income (GNI)).

Macroeconomic Analysis: Macroeconomic Equilibrium; Inflation and Unemployment; Economic Growth and Productivity.

Central Bank & Money: Money, Banking and Financial Markets Central Bank and the Money Supply Fiscal and Monetary Policies.

Text Books:

1. Economics; Samuelson & Nordhaus.
2. Modern Microeconomics; A. Koutsoyiannis.
3. Managerial Economics Analysis, Problems and Cases; P.L. Mehta.

AIN 532 **Artificial Intelligence**

L-T-P-[C]

3-0-2-[5]

Part A: Searching, Planning and Uncertainty

Introduction: Definition, Foundations, History, Current AI systems. Intelligent Agents: Agents and environment, Rationality, PEAS, Nature of Environment, Different types of agents. Searching: Agent design, Toy Problems, Searching, Tree Search and Graph Search, Uninformed Search, Breadth First Search, Depth First Search, Depth-Limited Search, Iterative Deepening, Iterative Lengthening, Bidirectional Search, Sensorless problems, Contingency problems.

Informed Search: Informed/Heuristic Search, Heuristic Search, A* Search, Memory bounded heuristic search, heuristic functions, local search and optimization, hill-climbing, simulated annealing, local beam search, online search, online depth first search.

Constraint Satisfaction Problems: Constraint Satisfaction Problems, Backtracking, Minimum Remaining Values heuristic, Most Constraint Variable heuristic, Least Constraining Value heuristic, Forward Checking, Constraint Propagation, local search, problem decomposition. Adversarial Search: Games, optimal decisions in games, minimax algorithm, multiplayer games, alpha-beta pruning, evaluation functions, cutting off search, expectiminimax algorithm, dice/card games.

Planning: The planning problem, language specification and PDDL, examples of planning problems, forward search, backward search, heuristics, partial order planning, planning graphs, heuristics from planning graphs, Graphplan algorithm. Uncertainty: Uncertainty, probability basics, axioms of probability, inference using full joint distributions, independence, Bayes' rule, Naive Bayes.

Probabilistic Reasoning: Representation, Bayesian Networks, Construction of Bayesian Networks, Conditional Independence, Bayesian Networks with continuous variables. Making Simple Decisions: Beliefs, Desires and Uncertainty, Utility Theory, Utility Functions, Multi-attribute Utility Functions, Decision Networks, Value of Information. Making Complex Decisions: Stochastic Problems, Value Iteration, Policy Iteration, Game Theory.

Reinforcement Learning: Reinforcement Learning, Passive Reinforcement Learning, Direct utility estimation, Active Dynamic Programming, Temporal Difference Learning, Active Reinforcement Learning, Exploration and Exploitation, Q-Learning.

Part B: Knowledge Representation, Expert Systems, Logic and Inferences, Basics of ANN and Prolog Programming

Introduction to knowledge-based intelligent systems: Intelligent machines, Journey from 'dark ages' to knowledge-based systems, Introduction to Expert Systems. Logic and Inferences: Propositional Logic, First Order Logic (FOL), Resolution method for FOL, Forward and Backward chaining. Knowledge Representation (KR): Approaches to KR: Relational knowledge, Procedural knowledge and knowledge represented as logic; Semantic Nets, Extended Semantic Networks, Frames. Rule-based Expert systems: Structure of rule based expert system, Conflict resolution, Uncertainty Management, Advantages & disadvantages of rule-based expert systems, Example, Introduction to JESS.

AIN 532
Continued

Frame-based Expert systems: Inheritance in frame-based expert systems, Methods and demons, Interactions of frames and rules, Example. Artificial Neural Network and Neural Expert Systems: How brain works, the Neuron as a single computing element, Perceptron, Multilayer FFNN, Backpropagation algorithm, Recurrent networks, Neural expert system. Introduction to Prolog Programming language: Syntax and meaning of Prolog Programs, Using Data Structures, Controlling Backtracking, Input and Output, Built-in Predicates, Using Prolog Grammar Rules.

Text Books:

1. S. Russell and P. Norvig, Artificial Intelligence, Pearson.
2. M. Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, Addison Wesley.
3. D. Khemani, A first course in Artificial Intelligence, McGraw Hill Education (India) Pvt. Ltd.
4. S. Kaushik, Artificial Intelligence, CENGAGE Learning.
5. I. Bratko, Prolog Programming for Artificial Intelligence, Pearson.

Lab Assignments:

1. Part A: Design of a simple reflex agent. Searching using Breadth First Search. Searching using Uniform Cost Search. Searching using A* Algorithm and Heuristic Search. Constraint Satisfaction Problems using Minimum Remaining Values, Most Constrained Variable, Least Constraining Value Heuristics. Adversarial Search. Value Iteration. Policy Iteration.
2. Part B: Programming in Prolog (based on following topics covered in the class): Syntax and meaning of Prolog Programs. Using Data Structures. Controlling Backtracking. Input and Output. Built-in Predicates. Using Prolog Grammar Rules. Higher level assignments/exercises for implementation using Prolog. Expert system design: Using the Expert System Shell (JESS/CLIPS) for development of an Expert System (in domains like Financial, Industrial, Social or other Engineering problems).

GVC 532 **Graphics and Visual Computing**

L-T-P-[C]

3-0-2-[5]

A Survey of Computer Graphics: Survey of art from cave painting, Egyptian and Roman Tapestry, to Perspective painting of Renaissance, to the modern Computer-Aided Design, Presentation Graphics, Computer Art, Entertainment, Education and Training, Visualization, Image Processing, Graphical User Interfaces. Input and output devices such as cameras and displays, graphics hardware and software, input technologies and interactive techniques, typography and page layout, light and color representations, exposure and tone reproduction, image composition and imaging models. Output Display Devices: Printers, Refresh Cathode-Ray Tubes, Raster-Scan Displays, Random-Scan Displays, Colour CRT Monitors, Direct-View Storage Tubes, Flat-Panel Displays, Three-Dimensional Viewing Devices, passive and active spectacles for 3D viewing, Stereoscopic and Virtual-Reality Systems. Input Devices: Keyboards, Mouse, Trackball and Spaceball, Joysticks, Data Glove, Digitizers, Image Scanners, Touch Panels, Light Pens.

Output Primitives: Graphics pipeline, Points and Lines, Line-Drawing Algorithms, DDA Algorithm, Bresenham's Line Algorithm, Parallel Line Algorithms, Loading the Frame Buffer, Line Function, Circle-Generating Algorithms, Properties of Circles, Midpoint Circle Algorithm, Ellipse-Generating Algorithms, Properties of Ellipses, Midpoint Ellipse Algorithm, Other Curves Conic Sections, Pixel Addressing and Object Geometry Screen Grid Coordinates, Maintaining Geometric Properties of Displayed Objects, Filled-Area Primitives, Scan-Line Polygon Fill Algorithm, Inside-Outside Tests, Scan-Line Fill of Curved Boundary Areas, Boundary-Fill Algorithm, Flood-Fill Algorithm, Fill-Area Functions, Cell Array, Character Generation. Color and Grayscale Levels, Color Tables, Area-Fill Attributes, Fill Styles, Pattern Fill, Soft Fill, Character Attributes, Text Attributes, Line Attributes, Line Type, Line Width, Digital signal processing, Sampling, aliasing and Antialiasing, Super-sampling Straight Line Segments, Pixel-Weighting Masks, Area Sampling Straight Line, Segments, Filtering Techniques, Pixel Phasing, Compensating for Line intensity Differences, Antialiasing Area Boundaries.

2 & 3 Dimensional Geometric Transformation and Modeling: Basic Transformations: Identity, Translation, Rotation, Scaling (Isotropic, Anisotropic), Reflection and Shear. Classes of Transformations: Rigid Body / Euclidean Transforms, Similitudes/ Similarity Transforms, Linear Transforms, Affine Transforms, Projective Transforms Representing Transformations: Matrix Representations and Homogeneous Coordinates. Combining Transformations: Composite Transformations and Computational Efficiency. General Pivot-Point Rotation, General Fixed-Point Scaling, General Scaling Directions, Concatenation Properties. Rotation around any vector. Common Coordinate Systems: Object spacelocal to each object. World spacecommon to all objects. Eye space / Camera spacederived from view frustum. Screen spaceindexed according to hardware attributes. Change of Orthonormal Basis: Position objects in a scene (modeling), Change the shape of objects, Create multiple copies of objects, Projection for virtual cameras, Animations. Two, Three Dimensional Viewing, The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformations. Three-Dimensional Concepts: Three-Dimensional Display Methods, Parallel Projection, Perspective Projection Depth Cueing, Visible Line and Surface Identification, Surface Rendering, Exploded and Cutaway Views, Three-Dimensional and Stereoscopic Views, Viewing Pipeline, Viewing Coordinates, Specifying the Viewing Plane. Transformation from Object to World to Viewing Coordinates. Projections: Parallel Projections, Perspective Projections.

GVC 532
Continued

Structures and Hierarchical Modeling: Structure Concepts, Basic Structure Functions, Setting Structure Attributes, Editing Structures, Structure Lists and the Element Pointer, Setting the Edit Mode, Inserting Structure Elements, Replacing Structure Elements, Deleting Structure Elements, Labeling Structure Elements, Basic Modeling Concepts, Mode1 Representations, Symbol Hierarchies, Hierarchical Modeling with Structures, Local Coordinates and Modeling Transformations, Modeling Transformations, Structure Hierarchies.

Viewing and Clipping and Surface Removal: Clipping Operations, Point Clipping, Line Clipping, Cohen-Sutherland Line Clipping, Liang-Barsky Line Clipping, Nicholl-Lee-Nicholl Line Clipping, Line Clipping Using Nonrectangular Clip Windows, Splitting Concave Polygons, Polygon Clipping, Sutherland-Hodgernan Polygon Clipping, Weiler-Atherton Polygon Clipping, Other Polygon-Clipping Algorithms, Curve Clipping, Text Clipping, Exterior Clipping. Polygon Surfaces, Polygon Tables, Plane Equations, Polygon Meshes, Curved Lines and Surfaces, (Quadric Surfaces, Sphere, Ellipsoid, Torus) Wire-frame Methods. Classification of Visible-Surface, Detection Algorithms, Back-Face Detection, Depth-Buffer Method, A-Buffer Method, Scan-Line Method, Depth-Sorting Method BSP Trees Method for back surface detection. Area-Subdivision Method, Ray-Casting Method, Curved Surfaces, Curved-Surface Representations.

Interpolation and Spline: Spline Representations, Interpolation and Approximation Splines. Parametric Continuity Conditions Geometric Continuity Conditions, Spline Specifications Cubic Spline Interpolation Methods, Natural Cubic Splines. Hermite Interpolation Cardinal Splines, Kochanek-Bartels Splines, Bezier Curves and Surfaces, Bezier Curves, Properties of Bezier Curves, Design Techniques Using Bezier Curves, Cubic Ezier Curves, Bezier Surfaces, B-Spline Curves and Surfaces. Matrix Representation, Conversion Between Spline Representations, Displaying Spline Curves and Surfaces.

Fractals: Fractal-Geometry Methods, Fractal-Generation Procedures, Classification of Fractals Fractal Dimension, Geometric Construction of Deterministic Self-Similar Fractals, Geometric Construction of Statistically Self-Similar Fractals. Affine Fractal-Construction Methods, Random Midpoint-Displacement Methods, Controlling Terrain Topography.

Illumination: Light Sources, Basic Illumination Reflection Models, Ambient Light, Diffuse Reflection (Lamberts cosine law), Specular Reflection and the Phong Model. Combined Diffuse and Specular Reflections with Multiple Light Sources, Intensity Attenuation, Color Considerations, Transparency, Shadows, Texture mapping, Polygon-Rendering Methods. Ray Casting / Ray-Tracing Methods, Basic Ray-Tracing Algorithm, Ray-Surface Intersection Calculations.

Graphics Card: Processing on the Graphics Card, Graphics Pipeline, NVDIA-CUDA Libraries, Open-CL.

Text Books:

1. Donald Hearn & M. Pauline Baker, Computer Graphics.
2. Foley, van Dam, Feiner & Hughes, Computer Graphics Principles & Practice.
3. MIT Open Courseware: http://ocw.mit.edu/courses/electrical-engineering- and-computer-science/6-837-computer-graphics-fall-2012/

COD 632 **Compiler Design**

L-T-P-[C]

3-0-2-[5]

Compiler Structure: analysis-synthesis model of compilation, various phases of compiler, other related basic concepts related to compilers such as interpreters, preprocessors, macros etc. Lexical Analysis & concepts related to Regular expressions and Finite Automata relevant to Compiler construction Syntactic specification of Languages: Context Free Grammar/ language, ambiguity, associatively, precedence, basic parsing techniques, LEX.

Top-down parsing: Backtracking parser, drawbacks, Top-down parser without backtracking: LL (1) parsing, Problem of Left recursion, Left factoring of Common prefixes, problem solving. Bottom-up parsing: Handle of a rightmost sentential form, Shift-reduce parsing, LR (0) parsing, Conflicts, SLR (1) parsing, limitations, LR(1) and LALR(1) parsing, problem solving, YACC.

Semantic Analysis and Syntax Directed Translation: Static & Dynamic Checks, Typical Semantic errors, Scoping, Type Checking; Syntax directed definitions (SDD) & Translation (SDT), Attribute Types: Synthesized & Inherited, Annotated Parse Tree, S-attributed and Lattributed grammar, Ordering the evaluation of Attributes, Applications of syntax directed translation. Symbol Table Design: Function of Symbol Table (ST), Information provided by ST, Attributes of ST, Data Structures for ST: Unsorted list, Sorted list, Linked list, Search trees, Hash table; Scoping, Methods to deal with Scope.

Intermediate Code Generator: High-level and Low-level Intermediate representation, Syntax tree & DAG representations, Three-address code, Quadruples, Triples, Indirect-triples, SDT for intermediate code, Intermediate code generation for control flow, boolean expressions and procedure calls; Short-circuit code, Back patching. Introduction to run-time environments.

Code Optimization: Criteria for code improving transformation, Basic blocks, Flow graphs, Function-Preserving Transformations: common sub-expression elimination, copy propagation, dead-code elimination and constant folding; Loop optimizations: Code motion, Induction variable elimination and Reduction in strength; Peephole optimization e.g., Flow-of-Control optimization, Algebraic simplification; Data flow analysis.

Text Books:

1. A.V. Aho, M.S. Lam, R. Sethi and J.D. Ullman, Compilers: Principles, Techniques and Tools, 2nd Ed., Pearson.
2. K.C. Louden, Compiler Construction: Principles and Practice, CENGAGE Learning.
3. J.R. Levine, T. Mason and D. Brown, Lex and Yacc, OReilly.

WBT 623 **Web Technologies**

L-T-P-[C]

2-0-3-[5]

Web fundamentals and applications: The internet and the world wide web as its dominant application, Basics of Clients, Servers, and Communications, Static, Dynamic and active websites and their latest applications like Current Dynamic web services: a) for transactions like e-shopping b) Digital content delivery like advertising, tracking of goods, services, patents/research papers. c) Telemetry like sms for stock quotations. E-Banking etc.

Representing Web data: HTML/CSS An Introduction to HTML: History, Versions,Basic XHTML Syntax and Semantics, Some Fundamental HTML Elements, Relative URLs,Lists,tables,Frames,Forms, CSS . Creating HTML Documents Case Study. Host objects: Browsers and the DOM-Introduction, History and Levels, Intrinsic Event Handling, Modifying Element Style, The Document Tree, DOM Event Handling, Accommodating Noncompliant Browsers. XML: XML, X path-Schema,X path, DTD, DOM, Xquery. Java Scripts: Java Scripts, Variables, conditional constructs , Operators, Pop Up Boxes, Functions, loops, events including time event, Catching errors, handling objects-properties and methods, Boolean object, math object , other object, Form validation, AJAX.

Server-Side Programming/Web programming: PHP: Starting to script on server side, Arrays, functions and forms, advanced PHP. Database Connectivity. DOM Programming. JSP Technology & Applications: JSP and Servlets, JavaBeans Classes, JSP- Tag Libraries and Files-Support for the Model-View-Controller Paradigm: Case Study and Related Technologies. Java Servlets- Architecture Overview, A Servelet, Generating Dynamic Content, Life Cycle, Parameter Data Sessions, Cookies, URL Rewriting, Other Capabilities, Data Storage Servelets and Concurrency, Case Study and Related Technology.

Web Services: Need for web services, WSDL,SOAP, SOAP XML and HTTP,UDDI,RDF, Web feeds, Blogs, The server side :the server choices, setting up UNIX and Linux web servers, Logging users, dynamic IP. Architecture of Apache Web Server including TOMCAT. Case Study of Search engines and Blogs.

Text Books:

1. Fifth Edition of Data communication and networking By Behrouz A Forouzan The McGraw-Hill USA.
2. http://www.w3schools.com/
3. Web enabled commercial application dev. using: HTML, DHTML, JAVASCRIPT, PERL CGI by Ivan Bayross.
4. Dom Scripting: Web Design With Javascript And The Document Object Model. By Jeremy Keith Foreword By Dave Shea.
5. Foundation Website Creation: With CSS, XHTML, And Javasript:By Jonathan Lane, MeitarMoscovitz.
6. Beginning Java Script With DOM Scripting And Ajax From Novice To Professional: By Christian Heilmann.
7. Web Technologies: A Computer Science Perspective by Jeffrey C. Jackson.
8. International Journal of Web Engineering and Technology Vol. 1-9, InderScience Publication.

DMW 632 **Data Mining & Warehousing**

L-T-P-[C]

3-0-2-[5]

Overview: Motivation (for Data Mining),Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data, (Binning, Clustering, Regression, Computer and Human inspection),Inconsistent Data, Data Integration and Transformation. Data Reduction: Data Cube Aggregation,Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering,Discretization and Concept hierarchy generation.

Concept Description: Definition, Data Generalization, Analytical Characterization,Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases. Association rule mining: mining Single-Dimensional Boolean Association rules from Transactional DatabasesApriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multi-Dimensional Association rules from Relational Databases.

Classification and Predictions: What is Classification & Prediction, Issues regarding Classification and prediction,Decision tree, Bayesian Classification, Classification by Back propagation, Multi-layer feed-forward Neural Network, Back propagation Algorithm, classification methods K-nearest neighbour classifiers, Genetic Algorithm. Cluster Analysis: Data types in cluster analysis, Categories of clustering methods, partitioning methods.Hierarchical Clustering- CURE and Chameleon. Density Based methods-DBSCAN, OPTICS.Grid Based Methods- STING, CLIQUE. Model Based Method Statistical Approach, Neural Network approach, Outlier Analysis.

Data Warehousing: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes,Stars, Snow flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting. Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAPServers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.

Text Books:

1. M.H.Dunham, Data Mining:Introductory and Advanced Topics Pearson Education.
2. Jiawei Han, Micheline Kamber, Data Mining Concepts & Techniques, Elsevier
3. Sam Anahory, Dennis Murray, Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems, 1/e Pearson Education.
4. Mallach, Data Warehousing System, McGrawHill.

SIM 732 **Simulation & Modelling**

L-T-P-[C]

3-0-2-[5]

Definition of Systems: Types of system, continuous and discrete modeling process and definition of model. Common type of mathematical models used for engineering and non-engineering system (such as differential and partial differential equation models). Simulation Process: Discrete and continuous simulation procedures, random number generation and its testing discrete and continuous random variables, density and distributive functions, study of few distributions such as Poisson, Normal.

Simulation of Queuing Systems: Specification and measures of queuing system, Structure of basic queuing system, simulation, Example of time sharing computer system, Elementary idea about networks of Queuing with particular emphasis to computer system, environment. Verification and Validation: Design of simulation experiments and validation of simulation experiments comparing model data units and real system data.

Simulation Languages: A brief introduction to important discrete and continuous languages such as GPSS (Study & use of the language), Use of data base & AI techniques in the area of modeling and simulation.

Text Books:

1. Narsing Deo: System Simulation with Digital Computers.
2. Gorden G.: System Simulation, Prentice Hall.
3. Kishore Shridhar Bhai Trevide: Probability & Statistics with reliability Queuing, Computer Science Application.
4. Payer, T.A.: Introduction to System Simulation McGraw Hill.
5. Reitman, J: Computer Simulation Application, Wiley.
6. Barnes B.: Modeling and Performance Measurement of Computer System.
7. Spriet, WI A.: Computer Aided Modeling and Simulation (Academic Press).
8. Law A M, Simulation and Modeling Analysis, McGraw Hill.

Lab Assignments:

1. MATLAB SIMULINK tool box.
2. Hardware Simulation using FPGA.
3. Simple Simulation program calculating using different probabilistic approaches in C or C++.

PHS 720 **Philosophy of Science**

L-T-P-[C]

2-0-0-[2]

Science: Creation or Discovery? Facts (Data) and Theories; Induction : Naive ideas about Induction ; the ambiguity of Induction; Probability and the Reflections on the use of probability; Inventing Explanations, and the Search for Laws : Critique of 'data-fitting' and Induction as views of science; Descartes' method of hypotheses, Newtons criticism; Contemporary views; The advantages and disadvantages of Bayesianism;

Ancient and Modern Relativity: Aristotelian relativity; Anomalies of Aristotle's world-picture; Galilean relativity; What is relative, and what absolute?; Newton's view of Absolute Space and Time; Darwinism: Change and chance: new forms of theory; Darwin's basic principles; Genetics: modelling nature on many levels; Philosophical lessons and disputes; The Shift In Historical Perspective: Kuhn's description of how sciences develop; Rivalry among paradigms;

Is Science A Search For Truth Or For Consensus ; A Short Intro to Epistemology; First Proposal for what a search for truth is; Second Proposal; Epistemic dilemmas; the pragmatist turn; Is Science A Search For Causes Or For Satisfying Explanations? Scientific explanation: the traditional view; Kuhnian solution;

Text Books:

1. World Changes: Thomas Kuhn and the nature of science, Horwich
2. Scientific knowledge: basic issues in the philosophy of science , Kourany
3. On the Origin of Species , Darwin
4. To save the phenomena , Duhem
5. The Copernican Revolution , Kuhn
6. Science and hypothesis: historical essays on scientific methodology , Laudan
7. Inference to the best explanation , Lipton
8. Historical introduction to the philosophy of science , Losee
9. The Essential Darwin , Ridley
10. Introduction to the philosophy of time and space , van Fraassen

ORB 720 **Organizational Behavior**

L-T-P-[C]

2-0-0-[2]

Concept, Nature, Characteristics, Conceptual Foundations and Importance, Models of Organizational Behaviour, Management Challenge, A Paradigm Shift, Relationship with Other Fields, Organisational. Behaviour: Cognitive Framework, Behaviouristic Framework and Social Cognitive Framework. Perception and Attribution: Concept, Nature, Process, Importance. Management and Behavioural Applications of Perception. Attitude: Concept, Process and Importance, Attitude Measurement. Attitudes and Workforce Diversity. Personality: Concept, Nature, Types and Theories of Personality Shaping, Personality Attitude and Job Satisfaction. Learning: Concept and Theories of Learning.

Motivation: Concepts and Their Application, Principles, Theories, Employee Recognition, Involvement, Motivating a Diverse Workforce. Leadership: Concept, Function, Style and Theories of Leadership-Trait, Behavioural and Situational Theories. Analysis of Interpersonal Relationship, Group Dynamics: Definition, Stages of Group Development, Group Cohesiveness, Formal and Informal Groups, Group Processes and Decision Making, Dysfunctional Groups.

Organizational Power and Politics: Concept, Sources of Power, Distinction between Power, Authority and Influence, Approaches to Power, Political Implications of Power: Dysfunctional Uses of Power. Knowledge Management & Emotional Intelligence in Contemporary Business Organization. Organizational Change: Concept, Nature, Resistance to change, Managing resistance to change, Implementing Change, Kurt Lewin Theory of Change.

Conflict: Concept, Sources, Types, Functionality and Dysfunctionality of Conflict, Classification of Conflict Intra, Individual, Interpersonal, Intergroup and Organizational, Resolution of conflict, Meaning and Types of Grievance and Process of Grievance Handling. Stress: Understanding Stress and Its Consequences, Causes of Stress, Managing Stress. Organizational Culture: Concept, Characteristics, Elements of Culture, Implications of Organization culture, Process of Organizational Culture.

Text Books:

1. Newstrom John W. - Organizational Behaviour: Human Behavour at Work (Tata McGraw Hill, 12th Edition)
2. Luthans Fred - Organizational Behaviour (Tata McGraw Hill)
3. Mc Shane L. Steven, Glinow Mary Ann Von & Sharma Radha R. - Organizational Behaviour (Tata McGrawHill, 3rd Edition)
4. Robbins Stephen P. - Organizational Behaviour (Pearson Education, 12th Edition)
5. Hersey Paul, Blanchard, Kenneth H and Johnson Dewey E. - Management of Organsational Behavior: Leading Human Resources (Pearson Education, 8th Edition)
6. Greenberg Jerald and Baron Robert A. - Behavior In Organisations: Understanding and Managing the Human Side of Work (Prentice Hall of India)
7. Davis, Keith - Human Behaviour at Works Tata McGraw Hill, New Delhi.
8. Pareek, Udai - Behavioural Process in Organization (Oxford 4 IBH, New Delhi).

OOT 630E **Optimization Techniques**

L-T-P-[C]

3-0-0-[3]

Introduction: Engineering application of optimization, statement of an optimization problem with example for minimum weight and optimum cost consideration, classification of optimization problems and techniques, Single variable optimisation, multi-variable optimization with equality and inequality constraints and without constraints.

Linear Programming: Introduction, standard form of the problem, Geometry, basic terminology Techniques of linear programming: Simplex method, Revised simplex method: Duality in linear programming, decomposition principle, post-optimality analysis, applications to engineering design.

Non Linear Programming: Introduction, elimination methods: various search methods-Fibonacci method and golden section method Interpolation method-Quadratic and cubic interpolation methods, Direct root method.

Unconstrained optimization Techniques: Introduction; Standard form of the problem and basic terminology; Direct search method- Simplex method, Random search method, Univariate and pattern search method Indirect search method-Steepest Descent (Cauchy) method, Conjugate gradient method, Newtons method, Application to engineering problems.

Constrained Optimization Introduction: Standard form of the problem and basic terminology; Direct method: Sequential Linear Programming; Generalised Reduced gradient method, Methods of feasible direction Indirect method: Penalty function method Interior and exterior penalty function method, Convex programming problem, Check for convergence Application to engineering problems.

Introduction to non-traditional methods: Genetic Algorithm: Introduction, Representation of design variables, objective function and constraints, Genetic operators and numerical results. Introduction to Neural network based optimization.

Text Books:

1. S.S.Rao, Engineering Optimisation- Theory and Practice, New Age International.
2. Deb K., Optimisation for Engineering Design-Algorithms and Example, Prentice Hall.
3. Gallagher and O.C Zeinkiewicz, Optimum Structural Design Theory & Applications, John Wiley.
4. Jozsef Farkas, Optimum Design of Metal structures, Ellis Horwood Limited, Chichester.
5. U.Kirsch, Optimum structural design , McGrawHill, New York.

CSE 630E **Control System Engineering**

L-T-P-[C]

3-0-0-[3]

Control System Modeling: Basic Elements of Control System Open loop and Closed loop systems, Transfer Functions: Poles and Zeros, Block diagram reduction Techniques, Signal flow graph, Modelling of various control systems.

Response Analysis:Transient and Steady State Response, Time response analysis: First Order Systems, Second order systems, Steady state errors, Control Actions: P, PI, PD and PID Control.

Analysis: Concept of Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram Nyquist Stability Criterion - Relative Stability.

Frequency Response Analysis: Frequency Response Bode Plot, Polar Plot, Nyquist Plot Frequency Domain specifications from the plots Constant M and N Circles Nichols Chart Use of Nichols Chart in Control System Analysis. Compensators of control system: Phase Lead, Phase Lag, and Phase Lead-Lag Compensators.

State Variable Analysis And Design : Concept of State, State Variables, and State Model, State space representation of Continuous Time systems State equations Transfer function from State Variable Representation Solutions of the state equations - Concepts of Controllability and Observability State space representation for Discrete time systems.

Text Books:

1. Norman S.Nise, Control Systems Engineering, Wiley.
2. Richard c Dorf, Modern Control Systems, Pearson.

NLP 630E **Natural Language Processing**

L-T-P-[C]

3-0-0-[3]

Characteristics of Natural Languages; Components of languages; Syntax and Semantics; SOV and SVO languages; Indian Languages and their comparisons; Language Modeling : Grammar based and Statistical Models;

Morphological Analysis; POS Tagging; Syntactic Analysis; Parsing : Shallow and Deep Parsing; Grammars for Parsing : Lexical Functional Grammar; X- Bar Theory and Paninian Grammar; Statistical Parsing;

Semantic Analysis; Types of Ambiguities and Disambiguation; Word Sense Disambiguation and Phrase and Sentence level disambiguation;

Machine Translation : Transformation Approaches and Statistical approaches; Analysis of some Translation Systems; English to Indian Languages and Indian Languages to English Translation Systems; Translation among Indian Languages.

Language Generation : Various approaches; Text Summarization and Classification.

IVP 630E **Image & Vision Processing**

L-T-P-[C]

3-0-0-[3]

Perspective and Importance of Image Processing and Computer Vision. Introduction to Various types of Images, Human Vision and Computer Vision; Formation of Digital Images, View Geometry and Radiometry, Representation of Color and Color Spaces. Image Representation in Spatial and Transformed Domains. Image Enhancement, Filtering and Edge, Corner and Curve Detection. Segmentation and Feature Extraction: Model based and Probabilistic Methods. Image Classification, Recognition and Understanding. Camera Calibration, Stereopsis. 3D Shape from Shadow, Motion and Optical Flow. Motion Analysis and Activity Recognition. Research Trends in Image Processing and Computer Vision.

RIA 630E **Robotics & Industrial Automation**

L-T-P-[C]

3-0-0-[3]

Robotics: Introduction, definition of robotics, Spatial description and transformation. Manipulator Kinematics- D-H principle, Inverse manipulator kinematics. Manipulator Jacobian : Velocity and static forces. Manipulator dynamics: Lagrangian formulation and N-E formulation. Trajectory generation. Linear control of manipulator, Nonlinear control, Force control. Robot programming languages and systems, Off-line Programming systems.

Automation: Introduction , definition of automation. Different types of automation : Flexible and Rigid automation their advantages and disadvantages. Details about flexible automation: JIT, KANBAN, KIZEN. CIM (Computer Integrated Manufacturing using CAD/CAM).

SCO 630E **Soft Computing**

L-T-P-[C]

3-0-0-[3]

Artificial intelligence systems Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks: Biological neural networks, model of an artificial neuron, Activation functions, architectures, characteristics learning methods, brief history of ANN research-Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE.

Backpropagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, hidden layer, output layer computations, calculation of error, training of ANN, BP algorithm, momentum and learning rate, Selection of various parameters in BP networks. Variations in standard BP algorithms- Adaptive learning rate BP, resilient BP, Levenberg-Marquardt, and conjugate gradient BP algorithms (basic principle only)-Applications of ANN.

Fuzzy LogicCrisp & fuzzy sets fuzzy relations fuzzy conditional statements fuzzy rules fuzzy algorithm. Fuzzy logic controller fuzzification interface knowledge base decision making logic defuzzification interface design of fuzzy logic controller case studies.

Genetic algorithms basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Elitism. Inheritance operators, Crossover-different types, Mutation, Bit-wise operators, Generational cycle, Convergence of GA, Applications of GA case studies. Introduction to genetic programming- basic concepts.

Text and Reference Books:

1. R. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India, New Delhi, 2003
2. L. Fausett, Fundamentals of Neural Networks, Prentice Hall, Upper Saddle River, N.J, 1994. Reference Books
3. D. E. Goldberg, Genetic Algorithms in Search, Optimisation, and Machine Learning, Addison-Wesley, Reading, MA, 1989
4. M. T. Hagan, H. B. Demuth, and M. H. Beale, Neural Network Design, PWS Publishing, Boston, MA, 1996.
5. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill, New Delhi, 1995
6. J. R. Koza, Genetic Programming: On the Programming of Computers by Natural Selection, MIT Press, Cambridge, 1992.
7. B. Yegnanarayana, Artificial Neural Networks. Prentice Hall of India, New Delhi

COG 730E **Cognition and Cognitive Process Modelling**

L-T-P-[C]

3-0-0-[3]

Introduction to Cognition and Cognitive Processes; Perceptual , Attention and Cognitive Processes; Computational Theory of Mind; Connectionist Models.

Learning and Memory Models; Short term and Long term Memory Models; Knowledge Acquisition and Deployment; Learning and Forgetting; Implicit and Explicit Learning; Intelligence Modelling; Social Cognition and Social Intelligence; Evolution and Evolving Machines; Thinking Machines; Modelling Emotion in computation.

Computational Cognitive Architectures: SOAR Architecture for Modelling General Intelligence; ACT-R Architectures; CLARION Architecture; Applications in Intelligent and Interactive Systems : ECA and Talking computers.

CIS 730E **Cryptography & Information Security**

L-T-P-[C]

3-0-0-[3]

Introduction: Classical Encryption Schemes, Principles of Modern Cryptography. Perfect Secrecy and Its Limitations. Private-Key Encryption: Computational Security, Pseudo-random Generators and Stream Ciphers, Pseudorandom Functions and Block Ciphers, Modes of Encryption, Security against Chosen-Ciphertext Attacks and Padding-Oracle Attacks. Message Authentication: Secrecy vs. Integrity, Message Authentication Codes, CBC-MAC, Authenticated Encryption. Hash Functions: Security Requirements, HMAC, Additional Applications of Hash Functions.Number Theory. Public-Key Revolution: Key Distribution and Key Management, Diffie-Hellman Key Exchange. Public-Key Encryption: Definitions of Security, Hybrid Encryption and the KEM/DEM Paradigm, El Gamal Encryption and DHIES, RSA Encryption and the RSA PKCS #1 Standard. Digital Signatures: Signatures vs. MACs, RSA-Based Signatures and the RSA PKCS #1 Standard, DSA/ECDSA, Public-Key Infrastructures.

Text Books:

1. Introduction to Modern Cryptography by J. Katz and Y. Lindell.
2. Handbook of Applied Cryptography by A. Menezes, P. Van Oorschot, S. Vanstone.

IWP 730E **Internet & Web Security Protocols**

L-T-P-[C]

3-0-0-[3]

Introduction to Internet protocols: Introduction to TCP/IP Protocol, IPv4-and v6, Routing Protocols-RIP,OSPF,BGP: IP address management using ICMP, DHCP, RADIUS and DIAMETER. World Wide Web Services: CIDR, ICANN & Domain Name Services: static and dynamic urls a packets tour of the web. Internet Security Protocols: Security threats and Security measures at each layer protocol of OSI model: Application, Presentation, Session, Transport, Network, Data and Physical layer.

Web Security Protocols: Secure Socket Layer & Transport Layer Security Protocols, Digital identification: Biometrics and digital signatures, digital certificates, CAs and PKI. Privacy, Phising and security for users privacy protecting techniques. Domain Name Disputes and their settlements. Botnet , Copyrights violations and the Detection of Botnets. Spams and their Control/ Filtering.

Web Server Security: Physical security, Host security for servers, Securing web applications, Security for content providers. Securing the Interfacing of Data Communication Networks with Cellular Mobile Networks: GSM & CDMA Technologies, Mobile IP, Third generation PP & 3G PP2, Secure Interfacing of cellular mobiles with data communication networks.

RMP 730E **Robot Motion Planning**

L-T-P-[C]

3-0-0-[3]

Introduction to Mobile Robotics: Hardware, Software, Vision, Localization, Mapping, Planning, Control, HRI, real life examples, and related topics. Introduction to Robot Motion Planning: Variants, Optimality, Completeness, Soundness, Mathematical Formulation, Real World Examples, Planning and Re-planning, Online Planning, Workspace and Configuration Space, Smoothness, Path Cost, Clearance, Structured and Unstructured Environments, Deliberative and Reactive methods, Anytime Algorithms. Configuration Spaces: Definitions, Representations, Walkthrough with examples involving different kinds of robots and multi-robot system, Holonomic and Non-holonomic Constraints, Topology, Homeomorphism, Diffeomorphism, Manifolds. Collision Detection: Topological Maps, Structured Maps, Un-structured Maps, Distance Functions, Mesh and Bounded Box Approaches, Collision detection between different regular shaped objects/regular objects in an unstructured environment.

Bug Algorithms: Bug0/Bug Zapper, Bug 1, Bug 2, Tangent Bug, Assessment of optimality and completeness. A* Algorithm - An Introduction: States, Actions, Graph Formulation, Costs, Heuristics, Pseudo-code and Working of A*Algorithm. A* Algorithm in Robot Motion Planning: Problem Formulation, Resolution-optimality, Resolution-completeness, Effect of resolution, Planning for non point robots, Planning with robot's dynamics, Post-processing and smoothing techniques. Potential Field Approaches: Potential Modeling, Artificial Potential Fields, Gradient Descend, Examples with robots with proximity sensors and vision based approaches, Problems on narrow corridors, equi-potential/getting un-stuck, Bushfire Algorithm, Wave-front planner, Navigation Functions, Implementations in Workspace and Configuration Spaces, Elastic Strip.

RMP 730E Continued

Roadmap Approaches: Roadmaps, Visibility graphs, Deformation Retracts, Voronoi, Generalized Voronoi Diagram, Generalized Voronoi Graph. Cell Decomposition Approaches: Trapezoidal Decomposition, Morse Cell Decomposition, Boustrophedon Decomposition, Bushfire Decomposition, Wave-front Decomposition, Triangular Decomposition, Quad-tree approach, Framed Quad-tree, Cells with variable sizes, Homotopy.

Sampling Based Approaches–1: Probabilistic Roadmaps: Introduction to sampling based approaches, single query algorithms, multi-query algorithms, sampling, computing vertices, constructing edges, local planners, connection with k-closest neighbors, connection with radius of k, edges by reversible and non-reversible local planner, collision-checking, post-processing, smoothing, probabilistic completeness, probabilistic optimality. Sampling Based Approaches -2: Advanced Probabilistic Roadmaps: Obstacle based PRM, Gaussian Roadmap, Bridge Test, roadmaps without cycles, Visibility PRM, Manipulability based PRM, Connection sampling, combination of sampling techniques, connecting disjoint graphs, lazy evaluations, Visibility PRM, Adaptive Roadmap, Elastic Roadmap. Sampling Based Approaches -3: Rapidly-exploring Random Trees: EST, RRT, bidirectional RRT, RRT-Connect, RRG/RRT*, Kinodynamic planning, goal based sampling, SBL, sampling based roadmap of trees, parallel RRT.

Planning using Optimization Techniques: Introduction to optimization and Genetic Algorithm, Individual representation, variable sized individual, fitness function, evolutionary operators, planning using grammatical evolution.

A Brief Overview of the Following Topics: Planning using Fuzzy Logic and Neural Networks: Problem Modeling and use of Fuzzy Logic and Neural Networks for Robot Motion Planning. Multi-Robot Motion Planning and Coordination: Centralized techniques, decentralized techniques, with communication and without communication, prioritization, coordination using reactive planning, mission planning. Motion Planning using Hybrid Algorithms: 2-layer planning, multi-layer planning, ensemble of algorithms, global and local planning. Motion Planning for Autonomous Vehicles: Lateral Axis, Longitudinal Axis, Overtaking, Vehicle Following.

MOC 730E **Mobile Computing**

L-T-P-[C]

3-0-0-[3]

Introduction: Introduction to Mobile Computing, Issues in Mobile Computing, Applications, limitations, and architecture, Mobile Computing Models, Data link layer considerations(Wireless). Mobile Network Layer: Mobile IP, Mobile IPv4 and Mobile IPv6, Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, WAP Architecture.

Mobile Transport Layer: TCP in wired/wireless environments, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP. Data Management: Data management Issues, Adaptive clustering, Caching, Querying Location Data, Data Dissemination. Mobile Ad-Hoc Networks: Basic Concepts, Properties of a MANET: Applications, Design Issues, Routing & protocols, Vehicular Ad Hoc networks.

Text Books:

1. Jochen Schiller, Mobile Communications,Addison-Wesley. second edition, 2004.
2. Stojmenovic and Cacute, Handbook of Wireless Networks and Mobile Computing, Wiley, 2002,
3. Abdelsalam A. Helal et al, Any Time, Anywhere Computing : Mobile Computing Concepts and Technology, Kluwer International Series in Engineering and Computer Science, 1999.
4. Evaggelia Pitoura and Geaorge Samaras, Data Management for Mobile Computing, Kluwer International Series on Advances in Database Management,October 1997.

IRS 730E **Information Retrieval System**

L-T-P-[C]

3-0-0-[3]

Information retireval: definition, differences from question answering system and database retrieval, IR models: classical, non-classical and alternative models, basics of Boolean retrieval model; indexing, inverted index structure, creation of dictionary and postings, Posting merge algorithm., use of skip pointer for efficient merge.
Tokenization, stop word elimination, case folding, stemming and lemmatization, Handling Phrase queries, biword and positional indexes. Tolerant retrieval: Permuterm and k-gram indexes, spelling correction -edit distance algorithm and its implementation (calculation of minimum edit distance through dynamic programming). Heuristics to efficiently retrieve low edit -distance dictionary terms, Soundex algorithm for handling phonetic errors.

Term weighting and Vector Space Retrieval: tf-idf weigthing, frequency and length normalization, term-document matrix representation of documents(Steps involved to arrive this representation), inner product and cosine similarity, Heuristics to cut down number of documents for which to calculate cosine similarity - Champion list, cluster pruning, IDF cutoff etc.).

Evaluation: evaluation Criteria, Recall and Precision, Calculating recall-Precision points, F-measure, E-measure, R-precision, 11 point - interpolated average precision.

Query Expansion; Interactive IR; Cross-lingual Information Retrieval; Intoduction to Image Retrieval and Speech Retrieval Systems.

HUR 730E **Humanoid Robotics**

L-T-P-[C]

3-0-0-[3]

Biped Locomotion Control: Inverted Pendulum model, Compass gait model, Equation of motion of Linear Inverted pendulum & simple pendulum. Concept of ZMP, COP, COM, orbital energy. General control architecture of a Humanoid Robot. Humanoid push recovery, Biped locomotion modeling using hybrid automata, Fundamentals of Second order system, concept of PD, PID controller in the context of biped motion control.

Open SIM: Three tutorials, concepts of forward kinematics, inverse kinematics, forward dynamics and inverse dynamics. Assignments. Concept of Synchronization, Design procedure of CPG (Central Pattern Generator).

Multimodal Human-Robot interactions: Gesture recognition problem using HMM: all the three problems: Forward Backward Algorithm, Viterbi Algorithm, BaumWelch algorithm and their applications in gesture recognition, Gesture creation(using If THEN Rules), interactive Gesture executions. (It will be presumed that the students already have undergone the courses either RIA or Mathematical Foundation of Robotics)

Cognitive robotics: Reactive approach - Subsumption Architecture, Potential field based architecture, Deliberative approach, hybrid deliberative/Reactive approach for creating intelligent behaviors.

KALMAN Filter, SLAM (Simultaneous Localization and Mapping).

SLT 730E **Speech and Language Technologies**

L-T-P-[C]

3-0-0-[3]

Speech and Audio Signals; Speech Perception and Production; Phonemes, Allophones, Speech rate and Coarticulation; Speech and Language; Syllables, Words and Phrases; Sentences and Grammar; Digitalization of Speech Signal; Acoustic Model of Speech Production; Linear Predictive Coding; Cepstral Processing, Mel-frequency cepstrum, formant frequencies and Pitch. Various Types of Speech Coders; Automatic Speech Recognition : Variabilities in Speech Signal, Acoustic and Phonetic feature Extraction; Classification Techniques; Adaptive Techniques; Speaker Recognition. Speech Enhancement: Echo Cancellation, Environment Compensation, Blind Source Separation. N-gram Language Models; N-gram Smoothing and Pruning, Various search algorithms for speech recognition. Text to Speech Systems: Document Structure Detection, Text Normalization, Homograph Disambiguation, Prosody, Duration and Pitch Generation, Speech Synthesis and Prosodic Modification; Evaluation of Text to Speech Systems. Dialog Systems: Spoken Language Analysis, Dialog Management and Response Generation, Study and evaluation of existing Dialog Systems. Speech based Interface Development.

MDM 730E **Mobile Data Management**

L-T-P-[C]

3-0-0-[3]

Mobile Software Architectures: Mobile Computing Models: Software architectures ranging from client-servers and proxies to software mobile agents are introduced. Environmental Awareness: Concepts such as application-awareness of location and disconnection, and adaptation to varying connectivity conditions Web Browsing: realization of mobile architectures and concepts through their deployment in the design of an example web-browsing application. Disconnected Operation and Weak Connectivity: Techniques for sustaining frequent network disconnections and weak connectivity within the context of file, database management, workflow management, object-based, and web systems. Mobility: relocating data and computation, Failure Recovery and distributed checkpointing. Case studies on CMU's Coda file system Coda, IBM's WebExpress web browsing system and Xerox's Bayou weak replication storage system Location and handoff management. Concurrency control mechanism schemes. Transaction management. Mobile database recovery.

Text Books:

1. Data Management for Mobile Computing by Evaggelia Pitoura, George Samaras, Kluwer Academic Publishers, ISBN: 0-7923-8053-3
2. Mobile Database Systems by Vijay Kumar, Wiley Publication, ISBN: 978-0-470-04828-3
3. Research papers.

MSE 730E **Mobile Software Engineering**

L-T-P-[C]

3-0-0-[3]

Embedded Software Vs Mobile Software, Characteristics of Mobile Software, Existing Smartphone Platforms and Languages, Description of iOS and Android OS features for development of Apps, Category of Mobile Apps: Native Apps & Web Apps. When to use Native and when to use Web Apps: Hybrid Apps-Solution worth consideration. Principles of software engineering for Mobile devices and best practices, including Software process model for Mobile Apps: Recent Mobile Software Process Model, Usability & User Experience design, Mobile Interaction Design, Interaction Designs: Hub and Spoke, Bento, tabbed View and other mobile Interaction designs. Android Case Study: Application development with Android: Basic Building Blocks, Activity, Service, Intent & IPC (Inter Process Communication in Android), Security Breach & Attack points. Malware and type of security attacks and privacy breach in Android Apps. Code reviews, source control, and unit tests. Evaluation and usability of mobile devices and services. Testing of Mobile Web Apps and Native apps. Projects and Case Studies.

WSN 730E **Wireless Sensor Network**

L-T-P-[C]

3-0-0-[3]

Basics of wireless sensor network: Sensor network architecture, Individual components of sensor network nodes, Wireless sensor network as embedded system, Tired architecture in sensor bnetwork, Routing and addressing in tired architecture, Draw backs of tired architecture, Communication Protocols in sensor networks, Energy efficient design of Wireless sensor nodes.

Taxonomy of routing techniques inn sensor networks: Routing Protocols in WSN, Reilable Transport in Sensor Networks, Routing on a curve Medium access control in wireless sensor network, A survey of MAC protocol for sensor network, Dissemination Protocols for large sensor networks.

Models of programmability in sensor network: Differences between sensor network and traditional network, Need for sensor network programming, Major models of programming, Framework of system level prog. Localization in WSN, Application layer protocols, Localisation protocols, Positioning and location tracking in WSN. Configuring Wireless sensor network, Simulators in WSN, Tools and languages in WSN.

Coverage and Connectivity: Computation and networking problems, Coverage algo, Connectivity Algo, Area coverage, Point Coverage, Barrier Coverage. Applications, Simulations, Information Retrival in SN, Sensor Fusuion.

References

1. Protocols and Architectures for Wireless Sensor Networks. H. Karl and A. Willig. John Wiley & Sons, June 2005.
2. Wireless Sensor Networks: Technology, Protocols, and Applications. K. Sohraby, D. Minoli, and T. Znati. John Wiley & Sons, March 2007.
3. Wireless Sensor Networks. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors. Springer Verlag, Sep. 2006.
4. Wireless Sensor Networks: Architectures and Protocols. E. H. Callaway, Jr. AUERBACH, Aug. 2003.
5. Networking Wireless Sensors. B. Krishnamachari. Cambridge University Press, Dec. 2005.
6. Wireless Sensor Networks: An Information Processing Approach. F. Zhao and L. Guibas. Morgan Kaufmann, Jul. 2004.
7. Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications. N. P. Mahalik. Springer Verlag, Nov. 2006.
8. Wireless Sensor Networks: A Systems Perspective, N. Bulusu and S. Jha, Editors, Artech House, August 2005.
9. I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci. A Survey on Sensor Networks, IEEE Communications Magazine, August 2002.
10. P. Levis, N. Lee, M. Welsh, and D. Culler. TOSSIM: Accurate and Scalable Simulation of Entire TinyOS Applications, The First ACM Conference on Embedded Networked Sensor Systems (Sensys03), November 2003.