3rd SEM							
THEORY							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	BS(CS/IT)307	Mathematics-III	3	0	0	3	3
02	ES(CS/IT)307	Digital Electronics	3	0	0	3	3
03	PC(CS/IT)301	Computer Organization	3	1	0	4	4
04	PC(CS/IT)302	Data structure & Algorithms	3	0	0	3	3
05	HS(CS/IT)303	Economics for Engineers	3	0	0	3	3
PRACTICAL							
01	ESL(CS/IT)308	Digital Electronics Lab	0	0	3	3	1.5
02	PCL(CS/IT)303	Computer Organization Lab	0	0	3	3	1.5
03	PCL(CS/IT)304	Data structure & Algorithms Lab	0	0	3	3	1.5
04	PCL(CS/IT)305	IT Workshop (python/matlab)	0	0	3	3	1.5
		SESSIONAL					
01	CLA(CS)-3	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	15	1	12	28	23

Mathematics-III
Paper Code: BS(CS/IT)307
Contacts: 40L
Credit: 3

Module 1:Sequences and series [8L]

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.

Module 2:Multivariable Calculus (Differentiation) [7L]

Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.

Module 3: Multivariable Calculus (Integration) [8L]

Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar).Theorems of Green, Gauss and Stokes (Statement only) and related problems.

Module 4: Ordinary Differential Equation [9L]

First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution.

Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation.

Module 5: Graph Theory [8L]

Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph.

Matrix Representation: Incidence & Adjacency matrix.

Tree: Basic Concept of tree, Binary tree, Spanning Tree, KrusKal and Prim's algorithm for finding the minimal spanning tree.

Learning Resources:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. Michael Greenberg, Advanced Engineering Mathematics, Pearson.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science.
5. Derek Holton & John Clark, A First Look at Graph Theory
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications.

Course Outcomes

After completing the course the student will be able to

CO 1: use the tools of power series to analyze engineering problems and apply the concept of convergence of infinite series in many approximation techniques in engineering disciplines.

CO 2: apply the knowledge for addressing the real life problems which comprises of several variables or attributes and identify extremum points in different surfaces of higher dimensions.

CO 3: evaluate multiple integrals and apply the techniques to different physical problems.

CO 4: solve first and second order ordinary differential equations by applying different techniques and also will be able to formulate differential equations for model systems and problems of engineering sciences.

CO 5: apply the basic concepts of graph theory to network analysis, data analytics and many other branches of computer science.

Digital Electronics
Code: ES(CS/IT)307
Contacts: 36L
Credit: 3

Module 1: Basic Electronic devices [8L]

PN junction diode, Application of diodes in rectification, Half wave Full wave rectifier and Factors determining rectifier performance , Transistor, Transistor characteristics for CE, CB and CC mode, current amplification factors and their relationship, Introduction to JFET, MOSFET and CMOS.

Module 2: Number system, Boolean algebra & logic gates [10L]

Binary numbers & Boolean algebra , Logic gates, Truth Tables and function minimization using algebraic method, Karnaugh map, , Signed binary number representation with 1's and 2's complement methods, Maxterm, Minterm, Representation in SOP and POS forms ; Realization of Boolean functions using NAND/NOR gates

Module 3: Combinational circuits [10L]

Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, Parity Generator and checker.

Module 4: Sequential Circuits [8L]

Flip-flops - SR, JK, Master slave JK, D and T. Register, counter

References:

1. Morries Mano, Digital Logic Design, PHI
2. Kharate, Digital Electronics, Oxford
3. Leach & Malvino, Digital Principles & Application,Mc Graw Hill
4. D chattopadhyay & P.C.Rakshit. Electronics (Fundamentals and Applications), New Age International Publishers
5. Malvino, Electronic Principle, McGraw Hill.
6. Millman & Halkias, Integrated Electronics, McGraw Hill
7. Boyelstad & Nashelsky, Electronic Devices & Circuit Theory,PHI
8. R.P.Jain, Modern Digital Electronics, McGraw Hill

Course Outcomes

After completing the course the student will be able to

CO 1: identify and understand the difference between analog and digital electronic systems.

CO 2: explain the operation of semiconductor devices from their characteristic curves.

CO 3: represent numbers in various number systems and successfully execute conversions between different representations.

CO 4: implement various logical operations using combinational logic circuits.

CO 5: design various sequential circuits.

Computer Organization
Code: PC(CS/IT)301
Contacts: 40L (3L+1T)
Credits: 4

Module 1: Introduction [3 L]

History of computing, von Neumann machine, Instruction and data, fixed-point and floating point numbers, errors, IEEE standards

Module 2: Processor design [7 L]

Instruction Set Architecture-Instruction format, opcode optimization; operand addressing; Instruction implementation-data movement, branch control, logical, Input/output and debugging instructions; arithmetic instruction implementation–addition and subtraction, multiplication-division, 2's complement multiplication; Booth's algorithm–theory and examples; bit-pair algorithm; high performance arithmetic

Module 3: Control unit design [8 L]

Hardwired control, micro-programmed control design – micro-instruction formats, control optimization;

Module 4: Memory subsystem [9 L]

Registers, Memory technology, memory interfacing, Memory hierarchy–introduction to virtual memory system; cache memory – performance, address mapping, content addressable memory (CAM)

Module 5: Peripherals [7 L]

Basic properties, bus architectures, interfacing of I/O devices, data transfer schemes –programmed I/O, DMA, mass storage, RAID

Module 6: Pipelining [6 L]

Pipelining, data path and instructions, speed up, CPI, latency; linear / non-linear pipeline–reservation table, MAL; super-pipelined and super-scalar processors.

Text Book:

1. Mano, M.M., "Computer System Architecture", PHI.
2. Behrooz Parhami" Computer Architecture", Oxford University Press

Reference Book:

1. Hayes J. P., Computer Architecture & Organisation, McGraw Hill,
2. Hamacher, Computer Organisation, McGraw Hill,
3. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, Microprocessors and Microcontrollers OUP
4. Chaudhuri P. Pal, Computer Organisation & Design, PHI,
5. P N Basu- Computer Organization & Architecture ,Vikas Pub

Course Outcomes

After completing the course the student will be able to

CO 1: represent numbers in fixed-point and floating-point systems.

CO 2: clearly visualize machine's instruction set architecture (ISA) including basic instruction fetch and execute cycles, instruction formats, control flow, and operand addressing modes.

CO 3: explain the design and functioning of a machines central processing unit (CPU), the data path components (ALU, register file) and the control unit.

CO 4: explain organization of memory hierarchies including the basics of cache design and performance of caches. Apply these ideas to solve numerical problems.

CO 5: explain basic input/output functioning including program controlled I/O and interrupt I/O.

CO 6: analyze processor performance improvement using instruction level parallelism.

Data Structure and Algorithm
Code: PC(CS/IT)302
Contacts: 38L
Credits: 3

Module 1: Introduction [10L]

Elementary Data Organizations, Data Structure Operations: insertion, deletion and traversal in arrays, asymptotic Notations, Time-Space trade off, recursion, tail recursion, Tower of Hanoi, recursion tree and master theorem method of complexity analysis, Linear Search and Binary Search Techniques and their complexity analysis, finding min max in O(3n/2) time.

Module 2: Stacks and Queues [6L]

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue and types of Queue: Simple Queue, Circular Queue, Operations on each type of Queue: Algorithms and their analysis.

Module 3: Linked List [6L]

Singly linked lists, Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list. Linked List representation of Stack and Queue. Doubly linked list: operations, space and time analysis. Circular Linked Lists: all operations and complexity analysis. Floyd-Cycle finding algorithm. [6L]

Module 4: Trees [10L]

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, binary heap, b-tree; operations on each of the trees and their algorithms with complexity analysis. Tree traversal algorithms: recursive and iterative. Catalan Number and its connection to binary trees and stack sortable permutations. Comparison of performance of Heap, array and insertion priority queues.

Module 5: Hashing [6L]

Hashing: Chaining, probing, Universal hashing function and analysis of various hashing methods.

Text Books:

1. Horowitz, Sahni, Anderson-Freed**:** Fundamentals of Data Structures in C (Second Edition), Universities Press, 2008.
2. T.H. Cormen, C.E. Leiserson, R. Rivest and C. Stein: Introduction to Algorithms,(Second/Third Edition), PHI*,* 2009.
3. R. Sedgewick: Algorithms in *C*, Pearson, 2004.
4. Steven S Skiena, Algorithm design manual, 2nd Edition, Springer.

Reference Book:

1. Steven S Skiena, Miguel A. Revilla, Programming Challenges: The Programming Contest Training Manual (Texts in Computer Science) Springer.

Course outcomes

After completing the course the student will be able to

CO 1: analyze the algorithm to determine the time and computation complexity.

CO 2: decide based on nature of the search problem which search technique (Linear Search, Binary Search, hashing) to use when.

CO 3: implement the Stacks, Queues and linked list data structure and apply the same to various problems

CO 4: apply non linear data structures in searching, insertion and retrieval of data. Analyze the time complexity of various balanced and unbalanced trees and to apply the data structure to relevant problems.

Economics for Engineers
Code: HS(CS/IT)303
Contacts: 30L
Credits: 3

Module 1: [6L]

Economic Decision Making – Overview, Role of Engineers in Economic Decision making, Problem in Economic Decision Making, Decision Making Process.

Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Step Cost, Product and Period Cost, Direct and Indirect Cost, , Sunk Costs, Shutdown Cost, Opportunity Costs, Recurring and Nonrecurring Costs, Incremental Costs, Cash Costs vs. Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Learning Curve Model, Benefits and difficulties in estimation.

Module 2: [12L]

Cash Flow, Interest and Equivalence: Cash Flow – Diagrams and Cash Flow Statement, Time Value of Money, Real, Nominal & Effective Interest, Different Interest Formulae.

Cash Flow & Rate Of Return Analysis – Net Present Worth Analysis, Annual Worth Analysis, Internal Rate Of Return, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis.

Module 3: [6L]

Inflation And Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Use of Price Indexes In Engineering Economic Analysis.

Uncertainty In Future Events - Risk, Risk vs. Return, Probability, Expected Value and Variance, Economic Decision Trees, Simulation.

Module 4: [6L]

Depreciation and Replacement Analysis - Basic Aspects, Deterioration & Obsolescence, Depreciation Calculation Fundamentals, Depreciation and Capital Allowance Methods, Replacement Analysis Decision Map, Minimum Cost Life of a New Asset.

Accounting – Function, Balance Sheet, Income Statement, Financial Ratios, Role and Functions of a Financial Manager.

Readings:

1. H.L. Bhatia & S.N. Maheswari: Economics for Engineers, Vikas Publishing House Pvt. Ltd.
2. R. Paneer Seelvan: Engineering Economics, PHI.
3. James L. Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
4. Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
5. Sullivan and Wicks: Engineering Economy, Pearson.
6. Partha Chatterjee: Economics for Engineers, Vrinda Publications.

Course Outcome

After completing the course the student will be able to

CO 1: explain the role and scope of Engineering Economics and apply the process of economic decision making.

CO 2: analyze the different concepts of cost and apply different cost estimation techniques.

CO 3: explain the concepts of cash flow, time value of money and different interest formulas and create cash flow diagrams for different situations and apply different interest formulae to solve associated problems.

CO 4: apply various analytical methods like net present worth analysis, internal rate of return analysis, future worth analysis, benefit –cost ratio analysis, break-even analysis , sensitivity analysis etc. to evaluate different engineering projects.

CO 5: explain the process of inflation and apply different price indices to quantify the effects of inflation.

CO 6: state and explain the concepts of risk, return and uncertainty and incorporate the effect of uncertainty in economic analysis by using various concepts like probability, expected value, variance, decision trees and simulation.

CO 7: explain the concepts of depreciation and replacement analysis and solve associated problems of depreciation.

CO 8: interpret and apply the various concepts of Accounting like balance sheet, income statement and financial ratio analysis and understand the role and functions of a Financial Manager

Digital Electronics Lab.
Code: ES(CS/IT)308
Contacts: 3P
Credit: 1.5

Group 1: Experiments on Analog Electronics

1. I-V characteristics of semiconductor diode.
2. Input and output characteristics of BJT in CE configuration
3. Output and transfer characteristics of JFET in CS configuration.

Group 2: Experiments on Digital Electronics

1. Logic function realization using logic gates.
2. Design and implementation of half adder and full adder
3. Design and implementation of parity generator and checker
4. Construction of simple Decoder & Multiplexer circuits.
5. Realization of RS / JK / D flip flops using logic gates.

Computer Organization Lab.
Code: PCL(CS/IT)303
Contacts: 3P
Credits: 1.5

1. Familiarity with IC-chips, e.g. a) Multiplexer , b) Decoder, c) Encoder b) Comparator Truth Table verification and clarification from Data-book.
2. Incremental circuit.
3. Design an Adder/ Subtractor composite unit .
4. Design a BCD adder.
5. Design of a 'Carry-Look-Ahead' Adder circuit.
6. Use a multiplexer unit to design a composite ALU .
7. Design counter circuit.
8. Implement read write operation using RAM IC.
9. (a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.

Data Structure & Algorithm Lab
Code: PCL(CS/IT)304
Contacts: 3P
Credits: 1.5

1. Application of array insertion, deletion and traversal operations in solving problems.
2. Linear Search, Binary Search Techniques and time complexity comparison.
3. Application of binary search like divide and conquer technique in various array related O (log n) problems.
4. Implementation and applications of Stacks and queues using arrays.
5. Implementation of Singly linked lists, Linked representation of Stack and Queue.
6. Implementation of Binary Search Tree.
7. Application of binary trees in solving various problems.
8. Array implementation of binary heap.
9. Comparison of performance of binary Heap and array as priority queues.
10. Implementation of B-Tree.
11. Implementation of Chaining and probing techniques of collision resolution in hashing. Application of hashing in appropriate problems.

IT Workshop
Code: PCL(CS/IT)305
Contacts: 3P
Credits: 1.5

1. Python Introduction
2. NumPy Introduction
3. Numpy Arrays & Numerical Operations on Numpy Arrays
4. Python, Numpy and Probability
5. Weighted Choices and Weighted Samples

6. Creation of Synthetic Test Data
7. Matrix Arithmetic
8. Reading and Writing ndarrays
9. Matplotlib Introduction
10. Histograms
11. Contour Plots
12. Pandas Introduction
13. Pandas DataFrames & Data Files
14. Data Visualization with Pandas and Python
15. Python, Pandas and Timeseries

Study Material:

https://www.python-course.eu/numerical_programming_with_python.php

Course Outcome

After completing the course the student will be able to

CO 1: do numerical computations efficiently.

CO 2: exploit the parallelism in vector operations to implement mathematical calculations.

CO 3: generate synthetic test data.

CO 4: employ matrix parallelism to solve algebraic problems.

CO 5: plot graphs of functions with appropriate representation

CO 6: implement various data visualization techniques.

4th SEMESTER							
THEORY							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	BS(CS/IT)408	Discrete Mathematics	3	1	0	4	4
02	ES(CS/IT)409	Communication Engineering	3	0	0	3	3
03	PC(CS/IT)406	Design & Analysis of Algorithm	3	0	0	3	3
04	PC(CS/IT)407	Formal Language and Automata Theory	3	1	0	4	4
05	PC(CS/IT)408	Computer Architecture	3	1	0	4	4
06	MC(CS/IT)401	Environmental Sciences	2	0	0	2	0 (non-credit according to AICTE)
PRACTICAL							
01	ESL(CS/IT)410	Communication Engineering Lab	0	0	3	3	1.5
02	PCL(CS/IT)409	Algorithm Lab	0	0	3	3	1.5
03	PCL(CS/IT)410	Programming Lab using C++	0	0	3	3	1.5
		SESSIONAL					
01	CLA(CS)-4	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	17	3	9	29	23.5

Discrete Mathematics
Code: BS(CS/IT)408
Contacts: 36L (3L+1T)
Credit: 4

Module 1: Theory of Numbers: [8L]
Principles of Mathematical Induction, Well Ordering Principle, Divisibility theory and properties of divisibility; Fundamental theorem of Arithmetic; Euclidean Algorithm for finding G.C.D and some basic properties of G.C.D with simple examples; Congruence, Residue classes of integer modulo n (Zn) and its examples, Chinese Remainder Theorem.

Module 2: Counting Techniques: [4L]
Pigeon- hole Principle, Principles of inclusion and exclusions; Recurrence relations: Formulation & Modelling of different counting problems in terms of recurrence relations, Solution of linear recurrence relations with constant coefficients (upto second order) by (i) The iterative method (ii) Characteristic roots method (iii) Generating functions method.

Module 3: Propositional Logic: [6L]
Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module 4: Algebraic Structures and Morphism: [10L]
Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Permutation Groups, Normal Subgroups, Quotient group, Homomorphism & Isomorphism (Elementary properties only). Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Module 5: Graphs: [8L]
Planar and Dual Graphs. Kuratowski's graphs. Homeomorphic graphs. Eulers formula (n - e + r = 2) for connected planar graph and its generalisation for disconnected graphs. Detection of planarity. Graph colouring. Chromatic numbers of simple graphs. Chromatic Numbers and its bounds, Independence and Clique Numbers, Perfect Graphs-Definition and examples, Chromatic polynomial and its determination, Applications of Graph Colouring. Simple applications of chromatic numbers. Statement of four and five colour theorems.

Text Books

1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI.
3. J.K. Sharma, Discrete Mathematics, Macmillan.

References

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
3. Douglas Brent West, Introduction to Graph Theory, Prentice Hall
4. Clark John, Holton Derek Allan, A First Look at Graph Theory, World Scientific

Course Outcomes

CO 1: determine multiplicative inverses, modulo n and use to solve linear congruences.
CO2: solve different engineering problems using counting techniques.
CO3: express a given logic sentence in terms of predicates, quantifiers, and logical connectives and derive the solution for a given a problem using deductive logic and prove the solution based on logical inference.
CO4: classify the algebraic structure for a given mathematical problem and evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
CO5: develop the given problem as graph networks and solve with techniques of graph theory.

Communication Engineering
Code: ES(CS/IT)409
Contacts: 36
Credit: 3

Module 1: [12L]
Introduction to Communication Engineering, need of Modulation [2L]
Amplitude Modulation(AM): Concept of AM, Calculation of Modulation Index, Total transmitted power of AM, DSB-SC modulation & SSB-SC modulation techniques, calculation of Bandwidth and Savings of power ,Demodulation of AM, Superheterodyne receiver [10L]

Module 2: [5L]
Frequency Modulation(FM): Concept of FM, Direct & Indirect Method, Bandwidth calculation of FM, Demodulation of FM. [3L]
Phase Modulation(PM) : Concept of PM , generation of PM from FM [2L]

Module 3: [12L]
Pulse & Digital Communication: Sampling Theorem, aliasing effect, natural and flat top sampling, PAM, PWM,PPM, basic concept of Pulse Code Modulation (PCM) , concept of quantization and quantization error, Companding, DPCM, Delta Modulation and Adaptive Delta Modulation, signal to quantisation noise ratio in PCM system.[9L]
ASK, FSK, PSK, QPSK [3L]

Module 4: [7L]
Data Formatting: NRZ-Unipolar, NRZ-polar, NRZ-Bipolar, RZ-Bipolar, Manchester Coding [2L]
Synchronous and Asynchronous Data Transmission [3L]
Concept of Satellite Communication [2L]

Text Books:
1. Modern Digital and Analog Communication Systems by B.P. Lathi, Published by Oxford University Press.
2. An Introduction to Analog and Digital Communications by Simon Haykin (Wiley India)
3. Principles of Communication Engineering by Taub H. & Shilling D.L.- TMH
4. Introduction to Digital and Data Communication – Michael A. Miller, Jaico Publishing House

Reference Books:
1. Communication Systems by A. B. Carlson, Published by McGraw-Hil
2. Principles and Analog and Digital Communication by Jerry D Gibson, Published by MacMillan.
3. A Text Book of Analog and Digital Communication by A Kumar, Umesh Publication
Modern Electronic Communication, Principles and Practice- Sharma & Sinha,
Dhanpat Rai Publishing Company (p) Ltd.

Course Outcomes

After completion of the course the students will be able to-
CO1: Understand the necessity of modulation and how to transfer information from one place to another place using Amplitude Modulation, Frequency modulation and phase modulation and Compare their merits & demerits.
CO2: Apply the concept of sampling for analog to digital signal conversion.
CO3: Analyze various techniques of digital communication techniques.
CO4: Understand different data formatting techniques.
CO5: Apply the concept of modulation and demodulation for understanding Satellite Communication system..

Design and Analysis of Algorithm
Code: PC(CS/IT)406
Contacts: 36L
Credits: 3

Module 1: Models of computation & Algorithm design frameworks [5L]
Models of computation [2L]: RAM model, Deterministic and Non-deterministic problems, Tractable and Intractable problems, Solvability,
Algorithm design frameworks [3L]: Divide/Decrease and Conquer, Backtracking, Greedy, Dynamic Programming, Decision and Optimization problems-; Comparison: Divide & Conquer, Greedy and Dynamic Programming.

Module 2: Sorting [8L]
Comparison based sorts: Bubble sort, insertion sort, selection sort, quick sort, merge sort, analysis and comparison. [4L]
Non-comparison based sorts: radix sort, count sort. [1L]
Median order statistics. [2L]
Lower bound of sorting. [1L]

Module 3: Illustrations of various design framework [7L]
Dynamic Programming: Optimal substructure and overlapping subproblems; Matrix-chain multiplication [4L].
Backtracking: 8-queens problem [1L].
Greedy Method: Knapsack problem, Job sequencing with deadlines [2L].

Module 4: Graph Algorithms [6L]
BFS and DFS- algorithm and comparison; Single source shortest path, All pair shortest paths; Prim's and Kruskal's algorithms for finding minimum spanning tree.

Module 5: String matching problem [3L]
Naive algorithm, Knuth-Morris-Pratt (KMP) algorithm.

Module 6: Amortized Analysis [4L]
Basic concept of amortized analysis, disjoint set data structure.

Module 7: P and NP [3L]
Notion of NP Class: P, NP, NP-hard, NP-complete; reduction (concept only); Cook’s theorem (statement only)

Text Books:

1. T.H.Cormen, C.E. Leiserson, R.L.Rivest and C. Stein ,"Introduction to Algorithms", PHI.
2. Ellis Horowitz, Sartaz R. Sahani, "Fundamentals of Computer Algorithms". Computer Science Press.
3. A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of algorithms", Pearson Education.

Reference:

1. D.E. Knuth: The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, Addison-Wesley.
2. G.Brassard, P.Bratley, Fundamentals of Algorithmics -, PHI.
3. S.Baase, Allen Ven Gelder"Computer Algorithms-Introduction to Design & Analysis"- 3rd Edition, Pearson Education

Course Outcomes

After completing the course the student will be able to-
CO 1: classify algorithms as on the basis of various design paradigms.
CO 2: analyze a problem to determine which design paradigm to use to solve the problem.
CO 3: clearly distinguish between problems employing divide and conquer, greedy and dynamic programming.
CO 4: solve various graph problems efficiently.
CO 5: identify whether a problem is in P or NP.

Formal Language and Automata Theory
Code: PC(CS/IT)407
Contacts: 36L (3L+1T)
Credits: 4

Module 1: Introduction:[2L]
Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Module 2: Regular languages and finite automata:[10 L]
Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages (proof not required), pumping lemma for regular languages, minimization of finite automata.

Module 3: Context-free languages and pushdown automata: [9L]

Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (NPDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs(proof not required).

Module 4: Context-sensitive languages: [4L]
Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

Module 5: Turing machines: [9L]
The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Module 6: Undecidability: [2L]
Universal Turing machine, the universal and diagonalization languages, Rice s theorem.

Text books:
John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Reference books:
1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing. 4. John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill

Course Outcomes

After completing the course the student will be able to-
CO 1: identify the class to which a language belongs.
CO 2: design finite automaton, grammar, expressions for regular languages.
CO 3: design pushdown automaton, grammar, for context free languages.
CO 4: proof correctness of automata for various languages.
CO 5: decide whether a language is decidable or undecidable.

Computer Architecture
Code : PC(CS/IT)408
Contacts: 38 (3L+1T)
Credits : 4

Module 1
Pipelining Architecture: [10L]
Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance.
Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques.

Module 2
Memory Module: [9L]
Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization.

Module 3
Instruction-level parallelism: [9L]
Basic concepts, techniques for increasing ILP, RISC Architecture, superscalar, super pipelined and VLIW processor architectures. Array and vector processors.

Module 4
Multiprocessor Architecture: [10L]
Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared-memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture, Cluster computers.
Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures

TEXT BOOKS:
1. Advanced Computer Architecture-Kai Hwang & Naresh Jotwani, McGraw Hill
2. Computer Architecture and Parallel Processing -Kai Hwang and A. Briggs, McGraw Hill
3. Computer Architecture: a quantitative approach - J. L. Hennessy and D. A. Patterson,, Harcourt Asia, Singapore.
4.Computer Organization and Architecture - V. Rajaraman and T. Radhakrishnan PHI Learning Pvt. Ltd.

REFERENCE BOOKS:

1.Computer Architecture and Parallel Processing - Hwang and Briggs, TMH.
2.Computer Architecture and Organization - Hayes, McGraw-Hill.

Course Outcome

After completing the course the students will be able to-
CO 1: explain the concept of pipeline architecture, different hazards and analyze different techniques for handling pipeline hazards
CO 2: clearly visualize the hierarchical memory technology and design cache and virtual memory organization
CO 3: explain multiprocessor architecture and taxonomy of parallel architecture
CO 4: analyze the concepts of distributed shared-memory architecture, cluster computers
CO 5: explain the design of Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.

ENVIRONMENTAL SCIENCES
Code: MC(CS/IT)401
Contacts: 27L
Credit: Non credit

MODULE 1: The Multidisciplinary nature of environmental studies [2 LECTURES]
Definition, scope and importance, Need for public awareness.
MODULE 2: The Natural Resources [5 LECTURES]
Renewable and non renewable resources:
a) Natural resources and associated problems

Forest resources: Use and over-exploitation, deforestation, mining, dams and their effects on forests and tribal people.
Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.
Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity.
Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion, and desertification.

b) Role of individual in conservation of natural resources.
c) Equitable use of resources for sustainable life styles.

MODULE 3: Eco Systems [5 LECTURES]
a) Concept of an eco system: Understanding ecosystems, Ecosystem degradation, Resource utilisation
b) Structure and function of an eco system.
c) Producers, consumers, decomposers.
d) Energy flow in the eco systems: Water cycle, Carbon cycle, Oxygen cycle, Nitrogen cycle, Energy cycle, Integration of cycles in nature
e) Ecological succession.
f) Food chains, food webs and ecological pyramids.
g) Introduction, types, characteristic features, structure and function of (1) Forest ecosystem (ii) Grass land ecosystem (iii) Desert ecosystem (iv) Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

MODULE 4: Biodiversity and its Conservation [5 LECTURES]
(a) Introduction, Definition: genetic diversity, species diversity and ecosystem diversity.
(b) Biogeographically classification of India.
(c) Value of biodiversity: consumptive, productive, social, ethical
(d) Biodiversity at global, national and local level.
(e) India as a mega diversity nation.
(f) Hot-spots of biodiversity.
(g) Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.
(h) Endangered and endemic species of India.
(i) Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

MODULE 5: Environmental Pollution [6 LECTURES]
(a) Definition,
(b) Causes, effects and control measures of: (1) Air pollution, (2) Water pollution, (3) Soil pollution, (4) Marine pollution, (5) Noise pollution, (6) Thermal pollution, (7) Nuclear hazards
(c) Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
(d) Role of an individual in prevention of pollution.
(e) Disaster management: Floods, earth quake, cyclone and landslides, industrial safety.

MODULE 6: Social issues and the Environment [4 LECTURES]
(a) Urban problems related to energy
(b) Water conservation, rain water harvesting, water shed management

(c) Resettlement and rehabilitation of people; its problems and concerns,
(d) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust
(e) Wasteland reclamation
(f) Consumerism and waste products
(g) Environment protection Act
(h) Air (prevention and control of pollution) Act
(i) Water (prevention and control of pollution) Act
(j) Wildlife protection act
(k) Forest conservation act
(l) Issues involved in enforcement of environmental legislations
(m) Public awareness

Recommended Books:

1. Textbook of Environmental studies, Erach Bharucha, UGC
2. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd
3. Environmental chemistry, A. K. Dey
4. Environmental studies, Anil Kumar Dey & Arnab Kumar Dey, New Age International (P) Ltd.
5. Perspectives in Environmental Studies, Anubha Kaushik & C.P. Kaushik, New Age International (P) Ltd.

Course outcome

After completing the course the students will be able to-

CO 1: apply the knowledge regarding how human beings should make a sustainable living using the Earth's finite resources.
CO 2: use scientific methods judiciously in preventing causes which damage natural ecosystems.
CO 3: use the knowledge in protecting endangered and endemic species and conserving biodiversity.
CO 4: use the knowledge in preventing/minimising various types of pollution, their causes and effects.
CO 5: apply their knowledge of disaster management in case of natural and anthropogenic calamities.
CO 6: apply their knowledge of various environment protection acts, "Environment Impact Assessment" (EIA) as and when required in setting up of new industries as well as expansion of industries in which they will be employed.

Communication Engineering Lab.
Code: ESL(CS/IT)410
Contact Hrs./Week : 3P
Credit: 1.5

1. Amplitude Modulation and Demodulation
2. Frequency modulation and Demodulation.
3. Generation and Detection of PAM
4. Generation and detection of PWM & PPM
5. Generation and detection of ASK
6. Generation and detection of FSK
7. Time Division Multiplexing & Demultiplexing

Course Outcomes

After completion of the course the students will be able to-
CO1: Compare the performance of different analog communication system.
CO2: Evaluate analog modulated waveforms and measure the modulation index.
CO3: Compare the performance of different pulse modulation systems.
CO4: Evaluate the waveforms of different shift keying techniques and compare with the corresponding analog systems.
CO5: Understand the concept of multiplexing and demultiplexing of different signals.

Algorithm Lab
Code: PCL(CS/IT)409
Contact Hrs./Week : 3P
Credit: 1.5

1. Comparison of performance of various sorting algorithms.
2. Implementation of median order statistics in O(n) time
3. Performance comparison of problem solving using dynamic programming and recursion
4. Solving 8 queens problem using backtracking and brute force method with comparison of performance
5. Solving of Knapsack and job sequencing using greedy approach
6. Implementation of BFS and DFS both recursive and non-recursive version and their performance comparison

7. Implementation of Prim's algorithm and performance comparison based on different data structures used
8. Implementation of Dijsktra's algorithm and performance comparison based on different data structures used
9. Implementation of Bellman Ford algorithm and all pair shortest path algorithm.
10. Implementation of KMP algorithm

Course Outcomes

After completion of the course the students will be able to-
CO1: Compare performance of various sorting algorithm.
CO2: Decide which design paradigm to use for a particular problem
CO3: Implement various graph algorithms
CO4: Apply graph algorithms to real life problems
CO5: Implement string matching algorithms.

Programming Lab Using C++
Code: PCL(CS/IT)410
Contact Hrs./Week : 3P
Credit: 1.5

1. Introduction to the source code writing, compilation and execution process of C++ programme. Writing C++ Programme using I/O stream, command line arguments. basic loop control, functions with CBV and CBR, identification of variables with scope resolution operator. [3P]
2. Programme writing on classes, creation of objects, constructors and destructors, accessing members, array of objects, accessing of static members [3P]
3. Programme writing on function overloading, constructor overloading and default constructor, Object passing as function arguments and returning of objects from functions. [3P]
4. Programme writing on friend functions, local classes., dynamic initialization of objects [3P]
5. Programme writing on copy constructor, operator overloading – binary and unary operators. operator overloading using friend functions [3P]
6. Programme writing on derived classes, implementation of single inheritance, multilevel inheritance, hierarchical inheritance with constructor calling sequence. [3P]
7. Programme writing on multiple inheritances, constructor calling in derived classes, virtual base classes. [3P]
8. Programme writing on abstract classes, pointer to objects, this pointer, pointers to derived class. [3P]

9. Programme writing on virtual functions and run time polymorphism [3P]
10. Programme writing on basic Class and Function templates [3P]

Course Outcomes

After completion of the course the students will be able to-
CO1: Implementing ADT in the form of classes incorporating their data protection along with ways of accessing the different class members and distinguishing between function call by value and call by reference.
CO2: Recognizing the usage of same function declaration under different implementation scenarios and also sharing of private data between different classes including nested classes.
CO3: Utilizing indirect accessing of class members through pointers and also exploring the data abstraction concept through operator overloading.
CO4: Applying code reusability through generalization/specialization concept and utilizing same functions for different types of specialized entities with their different implementation scenarios.
CO5: Implementation of generalized structure patterns with class and function templates.

THEORY							
5th SEM							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./ WEEK	CREDIT
01	PC(CS/IT)511	Operating Systems	3	1	0	4	4
02	PC(CS/IT)512	Database Management System	3	1	0	4	4
03	PC(CS/IT)513	Object OrientedProgramming	3	1	0	4	4
04	PEC(CS)501	Elective-I A: Advanced Algorithms B: Soft Computing C: Embedded Systems	3	0	0	3	3
05	MC(CS/IT)502	Constitution of India/ Essence of Indian Traditional Knowledge	2	0	0	2	0 (non-credit according to AICTE)
PRACTICAL							
01	PCL(CS/IT)514	Operating System Lab	0	0	3	3	1.5
02	PCL(CS/IT)515	Database Management System Lab	0	0	3	3	1.5
03	PCL(CS/IT)516	Programming Lab using Java	0	0	3	3	1.5
		SESSIONAL					
01	CLA(CS)-5	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	14	3	9	26	20.5

Operating System
Code: PC(CS/IT)511
Contact: 3L + 1T
Credit: 4
Allotted Hrs: 36L

Module I:

Introduction of O.S [2L]: Concept of OS. Operating system services, dual-mode operation, Evaluation of O.S, Different types of O.S: batch, multi-programmed, timesharing, real-time, distributed, network.

Introduction of Process [2L]: Concept of process, Process life cycle, Operations on processes, IPC.

Module II:

System Structure [2L]: Computer system operation, Operating system structure, kernel: microkernel, monolithic kernel, system calls**.**

Threads [2L]: Overview, Benefits of threads, User and kernel threads.

Module III:

CPU Scheduling [4L]: Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms(FCFS,SJF/SRTF,RR,Priority), MLQ scheduling, Multi-processor scheduling.

Process Synchronization [3L]: Race condition, Critical Section problem, Semaphore, Mutex, Monitor.

Deadlocks [3L]: Deadlock criteria, Methods for handling deadlocks, Resource allocation graph, Banker's algorithm, Recovery from deadlock.

Module IV:

Memory Management [3L]: Background, Logical vs. physical address, Address binding, Swapping, Contiguous memory allocation, Fragmentation, Segmentation, Paging.

Virtual Memory [3L]: Concept**,** Demand paging, Page replacement, Page replacement algorithms (FCFS, LRU, Optimal).

File Systems [2L]: File attributes, File system structure, File access methods, File allocation methods (contiguous, linked, indexed).

Module V:

Disk Management [3L]: Disk structure, Disk formatting, Boot block, Bad blocks, Disk scheduling algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK,C-LOOK).

Module VI:

I/O Management [3L]: I/O hardware, Polling, Interrupts, DMA, Application I/O interface, Kernel I/O subsystem, Spooling and device reservation.

Protection & Security [2L]: Goals of protection, Security problem, Authentication, Program threats, System threats

Case Study [2L]: Windows family, Linux family, Mac and iOS, VMWare, XEN family, Android.

Text Books / References :

1. SilbersehatzA.,Galvin P. And Gagne G."Operating System Concepts", Willey.
2. Tanenbaum A.S. and Woodhull "Operating System Design & Implementation", Pearson Education US.
3. Milenkovie M, "Operating System : Concept & Design", McGraw Hill.
4. Dhamdhere: Operating System. TMH
5. Stalling, William, "Operating Systems", Maxwell McMillan International Editions.
6. Dietel H. N, "An Introduction to Operating Systems", Addison Wesley.

Course Outcomes:

After successful completion of this course students can able to

CO1: Understand the concept of operating system with different types of operating system and concept of process.

CO2: Understand the structures of operating system and mechanism to handle resources and concept of kernel and thread.

CO3: Analyze different mechanism to handle CPU scheduling of processes, process synchronization, deadlock.

CO4: Analyze different memory management mechanism to provide better performance to users, file management mechanism

CO5: Implement different disk management policies.

CO6: Implement input/output devices management technique, evaluate protection and security aspects related to operating system and some case studies related to modern day operating systems.

Database Management System
Code: PC(CS/IT)512
Contacts: 3L + 1T
Credits: 4

Allotted Hrs: 36L

Module 1: Introduction [2L]:
Concept of File system & Database system & their differences, Data abstraction & Data independence in DBMS, Instances & Schemas, Data models, Database languages (Data definition & Data manipulation languages).

Module 2: Entity Relationship Model [3L]:
Basic concepts, Types of attributes, Relationship sets, Mapping cardinalities & Participation constraints, Types of Keys., Entity – Relationship diagram(E-R diagram)., Strong & Weak entity sets, Specialization & Generalization & Aggregation in ER model.

Module 3: Relational Model [4L]:
Fundamental operations in Relational Algebra, Extended Relational Algebra operations, Concept of View, Relational Calculus.

Module 4: Relational Databases [11L]:

Introduction to SQL [4L]:
Characteristic of SQL, Types of SQL commands(DDL, DML, DCL, TCL), SQL operators & their procedures, Queries, Sub-queries & nested queries., Aggregate Functions, Operations on Modification of databases (Insertion, Updation, Deletion).

Integrity Constraints [2L]:
Concept of Foreign Key, Definition of integrity constraints, Types of integrity constraints(Domain Constraints, Entity Integrity Constraint, Referential Integrity Constraints, Key Constraints).

Functional Dependencies & Normalization [5L]:
Functional Dependency, Closure of functional dependency, Armstrong's Axioms, Canonical Cover., Lossless join decomposition & Dependency preservation, Full & Partial & Transitive dependency, Prime & Non-prime attribute, Need of Normalization, 1NF, 2NF, 3NF, BCNF.

Module 5: Transaction Management [13L]:

Transaction [6L]:
Overview of Database transaction concepts, ACID properties, Transaction state, Concurrent executions, Conflicts in Transaction, Serializability, Conflict & View Serializability, Test for serializability (Precedence Graph), Recoverability, Recoverable&Cascadeless& Strict schedules.

Concurrency Control [4L]:
Shared lock & Exclusive lock, Two phase locking protocol, Deadlock handling, Deadlock prevention, Deadlock detection, Deadlock Recovery

Recovery System [3L]:
Causes of transaction failure, Storage structure, Log-based recovery, Write Ahead Logging (WAL) protocol, Checkpoints, Shadow paging

Module 6: Storage [3L]:
Single level & Multi level indexing, Structure of B & B^+ tree, File organization in B^+ tree, Hashing techniques.

Text Books

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. ElmasriRamez and NovatheShamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. RamakrishnanGehrke: Database Management System , McGraw-Hill

Reference

1.SQL, PL/SQL the Programming Language of Oracle,4th edition, Ivan Bayross
2.An Introduction to Database Systems, 8th edition, C.J. Date,

Course Outcomes:

After completing the course the student will be able to-

CO 1: Design ER-models to represent simple database application scenarios.

CO 2: Implement SQL queries on data.

CO 3: Apply normalization to Improve database design.

CO 4: Solve concurrency problems in database transactions.

CO 5: Explain basic database storage structures and access techniques.

Object Oriented Programming
Code: PC(CS/IT)513
Contact: 3L + 1T
Credit: 4
Allotted Hrs: 36L

Module I [2L]

Introduction to Object Oriented Programming Concepts

Object Oriented Programming language concepts & features, Comparison between Object Oriented Programming language and conventional programming languages, Object Oriented Modelling concepts.

Module II [10L]

Introductory Concept of Java Programming

Advantages of Java, Data types & variables, Loops, Arrays, Operators, Control statements, constants, methods, Compile time Polymorphism: Method Overloading, Keyboard input operations.

Classes & Objects

Defining Classes and Creation of objects, Access specifiers, Instance variables and Static variables, Constructors, Constructor overloading, Static blocks, Array of objects, Use of **this** keyword, Passing objects as parameter to a method & returning objects from a method, Nested classes & Inner classes concept of string object with length(), equals() and charAt() method of string object, Command Line Arguments, garbage collection.

Module III [10L]

Inheritance and Polymorphism in Java

Concept of Inheritance, Super classes & Subclasses, Object Modelling in Java: Generalization and Specialization, Constructor calling mechanism in inheritance, Use of **super** keyword, Runtime Polymorphism: Method Overriding. Use of **static** keyword in java.

Abstract classes & Interfaces
Concept of Abstract classes & Interfaces and their properties, use of **final** keyword, Dynamic binding in abstract classes and interfaces, Inheritance of interfaces, Nested Abstract classes & Nested Interfaces.

Packages in Java
Creation of packages, Importing packages, Member access rules in the aspect of packages.

Module IV [5L]
Exception handling in Java
Basic concept of exception handling in Java, Different types of exception classes, Concept of **try** and **catch** block, Concept of nested try block and multiple catch blocks, **throw** and **throws** clause, Concept of **finally** block, Creation of user defined exception classes.

Module V [6L]
Multithreading in Java
Basic concept of multithreading, Concept of main thread and child thread, Thread life cycle, Creation of multiple threads, Thread priorities, Thread synchronization, Inter thread communication, Deadlocks, Suspending & Resuming threads.

Module VI [3L]
Applet Programming in Java
Basics of applet programming, Applet life cycle, Differences between application & applet programming, Parameter passing through applets, I/O operations in applets.

Textbooks:
1. **Core Java Volume I — Fundamentals (9th Edition)** by **Cay S Horstmann and Gary Cornell**
2. Object Oriented Modelling and Design by Rambaugh, James Michael, Blaha; Prentice Hall, India
3. **Java: A Beginner's Guide** byHerbertSchildt, Oracle Press.

References:
1. Head First Java by Kathy Sierra and Bert Bates
2. Deitel and Deitel- "Java How to Program", Pearson Education.

Course Outcomes:

After completion of this course the students will be able to -
CO1: Recognize some of the enhanced features of Object Oriented Programming (OOP) and also be able to design an entity structure in the perspective of object oriented modelling.
CO2: Implement ADT with data protection, method overloading, string operations and object independent access features of the java programming.
CO3: Learn selective inheritance, implement run time polymorphism for abstractions, and build modular programming scenarios with development of packages.
CO4: Effectively handle java run time exceptions, recognize the control flow of exception paths and also design user defined exception classes.
CO5: Implement parallel processing scenarios with multithreading concepts and their synchronizations.
CO6: Design window based I/O operations for web applications through applet programming.

Advanced Algorithms
Code: PEC(CS) 501 A
Contact:3L
Credits: 3
Allotted Hrs: 36L

Module 1: Probabilistic Analysis and Randomized algorithms [6L]
The hiring Problem, Indicator random variables, Randomized algorithms.

Module 2: Polynomials and FFT[6L]
Representing Polynomials, DFT and FFT, Efficient FFT implementation.

Module 3: Number Theoretic Algorithms [10L]
Modular arithmetic, Solving Modular Linear Equations, The Chinese Remainder Theorem, primality Testing, Integer Factorization.

Module 4: Computational Geometry [6L]
Line Segment properties, determining whether any pair of segments intersect, Convex hull, Finding the closest pair of points.

Module 5: Approximate Algorithms [8L]
Performance ratios for approximation algorithms, The vertex cover problem, The Travelling Salesman Problem, The set covering Problem, Randomization and linear programming.

Text Books:
1.T.H.Cormen, C.E. Leiserson, R.L.Rivest and C. Stein ,"Introduction to Algorithms", PHI

Reference:
1.Randomized •algorithms, Rajeev Motwani, PrabhakarRaghavan, Cambridge University Press
2. Computational Geometry Algorithms and Applications, Third Edition, Mark de Berg ,Otfried Cheong Marc van Kreveld , Mark Overmars, Springer
3.Approximation Algorithms, Vazirani, Vijay V, 2003, Springer.

Course Outcomes
After completing the course the student will be able to-
CO 1: Analyze Randomized algorithms for a given problem.
CO 2: Efficiently implement FFT, primality testing and integer Factorization.
CO 3: Solve Modular Arithmetic Problems.
CO 4: Apply computational geometry algorithms to real life problems
CO 5: Design approximate algorithms for problems.

Soft Computing
Code: PEC (CS) 501B
Contacts: 36L
Credit: 3
Allotted Hrs: 36L

Module-I [2L]

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, some applications of Soft computing techniques.

Module-II [12L]

Artificial Neural Network:

Introduction to Artificial Neural Networks, Perceptron, Neural Networks Learning Rules, Activation Functions, Derivation of generalized delta learning rule (back propagation) for Multilayer perceptron. Kohonen Self- Organizing Feature Maps.

Module-III [5L]

Fuzzy Logic:
Fuzzy Sets, Basic Definitions and Terminology, membership function Set-theoretic operation. Fuzzy union, intersection and complement, various T-norm and T-conorm operators, Fuzzy Relations. Fuzzy Logic, Approximate Reasoning, Compositional Rule of Inference.

Module-IV [10L]

Evolutionary Algorithms:
Genetic Algorithms: Simple GA, Encoding Techniques, Crossover, mutation, inversion and deletion, genetic algorithms in search and optimization.
Ant Colony Optimization(ACO).
Particle Swarm Optimization(PSO).

Module-V [7L]

Hybrid Systems:
Hybrid Systems, GA based Fuzzy Systems and Neural Networks Training, Any other applications of soft computing.

Text Books:

1. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
2. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
3. Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH,
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
5. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.

Reference Books:

1. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall
2. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall.
3. A beginners approach to Soft Computing, Samir Roy &Udit Chakraborty, Pearson

Course Outcomes

After completing the course the student will be able to

CO 1: Identify and select a suitable Soft Computing methodology to solve the problem

CO 2: Understand & define fuzzy sets and represent these sets by membership functions

CO 3: Describe the relation between real brains and simple artificial neural network models

CO 4: Design genetic algorithms for single and multiple objective optimization problem

CO 5: Analyze and design neuro fuzzy and other hybrid approaches of soft computing techniques for problem solving

Embedded Systems
Code: PEC(CS) 501 C
Contact:3L
Credits: 3
Allotted Hrs: 36L

Module 1:Introduction[3 L]
Introduction to Embedded System, features of Embedded System, application of Embedded System.

Module 2:8051 Microcontroller[10L]
Overview of 8051 family and various versions of 8051 Microcontroller. Block Diagram of 8051 Microcontroller, Memory Organization: bit addressable register, byte addressable register, general purpose register and special function register (SFR). Assembly Language Programming for Arithmetic and Logic operations, Assembly Language Programming using the instructions JUMP, LOOP, CALL etc. Description of Timers and Ports of 8051 Microcontroller.

Module 3: AVRAtmega8[11L]
Introduction to AVR Microcontroller.Description of AVR ATmega8 Microcontroller.Assembly Language Programming for Arithmetic and Logic operations using AVR ATmega8 Microcontroller.Assembly Language Programming for Input-Output Port for AVR ATmega8 Microcontroller.Interfacing of sensors with AVR ATmega8 Microcontroller.Data uploading toAVR ATMega8 Microcontroller.

Module4:Arduino UNO R3[12L]
Overview and features of Arduino UNO R3.Mapping of AVR ATMega8 pins and Arduino UNO R3 pins.Analog pins, Digital Pins and Power Supply of Arduino UNO R3.Programming of Arduino UNO R3.Interfacing of sensors with Arduino UNO R3.Usage of the common instructions pinMode(), analogRead(), analogWrite(), digitalRead(), digitalWrite(), Serial.begin(), Serial.print() , delay(), etc.

Text Books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C by M.A. Mazidi, J. G. Mazidi an R. D. McKinlay, published by Pearson.
2. The 8051 Microcontroller by Kenneth J. Ayala, published by Cenage Learning.
3. AVR Microcontroller and Embedded Systems: Using Assembly and C by M. A. Mazidi , published by Pearson.
4. Make: Getting Started with Arduino by Massimo Banzi and Michael Shiloh (Available at Amazon).

Reference Books and Websites

1. Make: AVR Programming by Elliot Williams, SHROFF PUBLISHERS &DISTRIBUTERS PVT.LTD.
2. Internet of Things with Arduino-Cookbook by Marco Schwartz published by Packt[www.packtpub.cpm].
3. Getting Started with Arduino [www.it-ebooks.info]
4. Arduino Software [www.arduino.cc]
5. AVR Microcontroller Book[www.finebook.ir]
6. AVR Studio Software [www.microchip.com]

Course Outcomes
After completion of the course the students will be able to-
CO1: Identify the features of Embedded System and their necessity.
CO2: Gather knowledge on Assembly Language Programming of Microcontroller.
CO3: Program AVR Microcontroller using low level as well as high level language.
CO4: Design of various experiments, analysis and interpretation of results on Arduino Platform.

Constitution of India
Code: MC(CS/IT)502
Contact: 2L
Credit: 0
Allotted Hrs: 35L

Indian Constitution: [5]
Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Union government and its administration: [10]
Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. State government and its administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.

Supreme court: [10]
Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court. High court: Organization of high court, procedure of the court, independence of the court, jurisdiction and power of supreme court. Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, Lokadalats, family courts, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL.

Local Administration: [10]
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Text books:
1. Indian polity, M, Laxmikanth, MC Graw Hill education, 5th Edition.

Reference books:
1. DD Basu, " Introduction to the constitution of India", 21st Edition, Lexis Nexis Books Publication ltd, India.

Course Outcomes:

After completion of this course, the learners will be able to
1. describe
   - different features of Indian constitution.
   - power and functioning of Union, state and local self-government.

- structure, jurisdiction and function of Indian Judiciary.
- basics of PIL and guideline for admission of PIL.
- Functioning of local administration starting from block to Municipal Corporation.

2. identify authority to redress a problem in the profession and in the society.

OPERATING SYSTEM LAB
Code: PCL(CS/IT)514
Contact:3P
Credits: 1.5
Allotted Hrs: 33P

1. Managing Unix/Linux Operating System [9P]:
Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions,commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock,I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules andmethods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Passwordsecurity, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes andpermissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users &user groups.

2. Process [3P]: starting new process, replacing a process image, duplicating a process image, waiting for a process,zombie process.

3. Signal [3P]: signal handling, sending signals, signal interface, signal sets.

4. Semaphore [6P]: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).

5. POSIX Threads [6P]: programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit,pthread_attr_init, pthread_cancel)

6. Inter-process communication [6P]:pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO),message passing & shared memory(IPC version V).

Database Management System Lab
Code: PCL(CS/IT) 515
Contacts: 3P
Credits: 1.5
Allotted Hrs: 33P

1. Structured Query Language [6P]
   Creating a Database, Creating a Table, Specifying Relational Data Types, Specifying Constraints, Creating Indexes

2. Table and Record Handling[6P]

INSERT statement, Using SELECT and INSERT together, DELETE, UPDATE, TRUNCATE statements, DROP, ALTER statements.

3. Retrieving Data from a Database[9P]
The SELECT statement, Using the WHERE clause, Using Logical Operators in the WHERE clause, Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause, Using Aggregate Functions, Combining Tables Using JOINS, Sub queries.

4. Database Management[6P]
Creating Views, Creating Column Aliases, Creating Database Users, Using GRANT and REVOKE

5. PL/SQL Concepts and Constructs[6P]
Introduction of PL/SQL , Structure of basic PL/SQL Structure, Conditional statements, Basic loops, Cursors in Oracle PL / SQL

Programming Lab Using Java
Code: PCL(CS/IT)516
Contact: 3P
Credit: 1.5
Alloted Hrs:33P

1. Programming with java classes involving data members having various access protection, class methods, constructors, overloading features, this and final keyword, static block, static variables and methods. [3P]

2. Use of array of objects, passing of object in method and returning of object form method, use of string handling functions– length (), equals (), charAt(), keyboard input operations, command line arguments. [3P]

3. Program implementation for nested/inner classes, name conflict resolving for inner and outer classes. [3P]

4. Programme implementation for abstract class, interface, inheriting multiple interfaces in a single class, extending multiple interfaces within a single interface, combined inheritance of both abstract class and interface. Use of dynamic method dispatch for abstract class and interface implementation. [6P]

5. Implementation of nested abstract class and interface combinations. Resolving name conflict scenarios for the combined inheritance of abstract class and interface. [3P]

6. Designing programme modules with creation and accessing of packages. [3P]

7. Handling exception with try, catch and finally. Adoption of throw, throws and user defined exception. [3P]

8. Programme writing for creation of multiple threads, thread synchronization, inter thread communication. [6P]

9. Applet programme execution with I/O operation, use of repaint () method. [3P]

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Course Outcome:

After completion of this course the students will be able to -

CO1: Implement java classes with incorporation of data protection, method overloading, string operations, call by reference aspects and object independent access of the class members.

CO2: Design nested structuring of classes and resolve name conflict issues for the nested classes.

CO3: Implement abstract class, interface and their nested structuring along with dynamic method dispatch.

CO4: Tackle java run time exceptions, and also design user defied exception classes.

CO5: Perform parallel processing with multithreading concept and implement their synchronization.

CO6: Execute applet programming for web applications with window based I/O operations.

THEORY							
6th SEM							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	PC(CS/IT)617	Computer Networks	3	1	0	3	4
02	PC(CS/IT)618	Compiler Design	3	0	0	3	3
03	PEC(CS)602	Elective-II A. Real Time System B. Information and Coding Theory C. Software Engineering D. Bio-Informatics	3	0	0	3	3
03	PEC(CS)603	Elective-III A. Machine Learning B. Operation Research C. Digital Signal Processing D. Advance Architecture	3	0	0	3	3
05	HS(CS/IT)604	Industrial Management	3	0	0	3	3
PRACTICAL							
01	PCL(CS/IT)619	Computer Network lab	0	0	3	3	1.5
02	PROJ(CS)601	Project 1	0	0	6	6	3
		SESSIONAL					

01	CLA(CS)-6	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	15	1	9	25	21.5

Computer Network
PC(CS/IT) 617
3L+1T
Credit: 4
Allocated Hrs: 44L

Module 1:Introduction[4L]: Overview of Data Communication and Networking; Layered Network Architecture; Mode of communication, topology, Data and Signal; Transmission Media: Guided, Unguided, categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Module 2: Physical Layer[4L]: Transmission Media: Guided, Unguided; switching: time division & space division switch, TDM bus, Banyan switch; MODEM, Repeater and hub, Multiplexing: TDM, FDM, SDM, WDM.

Data link Layer[8L]: Medium Access sub layer: MAC address and LLC; Error Control: Types of errors, framing (character and bit stuffing), error detection & correction; Flow control: Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC; Point to Point Protocol, LCP, NCP, Token Ring; Access mechanism: Reservation, Polling, Random access: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, TDMA, FDMA, CDMA, Traditional Ethernet, fast Ethernet.

Module 3: Network layer[10L]: Internetworking & devices: Bridges, Switches, Router, Gateway; Addressing: IP addressing (IPV4, IPv6), masking, Classful and Classless Addressing, Subnetting, NAT; Routing : Intra and Inter Domain Routing, Unicast, Multicast Broadcast routing. static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP and RARP, IP, ICMP, IPV6; Mapping between IP and MAC address: ARP & RARP Switching Communication Networks: Circuit switching; Packet switching; Routing in packet switched networks; X.25; Frame Relay; ATM, SONET.

Module 4: Transport layer [8L]: Process to Process delivery; UDP; TCP, Features, Segment, Three-Way Handshaking, socket and port addressing, Flow Control, Error Control, Congestion Control: Open Loop, Closed Loop, choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.

Module 5: Application Layer [5L]: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW;
Security [3L]: Attacks, Cryptography, Firewalls, IDS & IPS, Malware, IP and transport layer security, DMZ.
Modern topics [2L]: ISDN services & ATM, DSL technology, Wireless LAN, Bluetooth, VPN.

Text Books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education

Reference Books:

4. Black, Data & Computer Communication, PHI
5. Kurose and Rose – "Computer Networking -A top down approach featuring the internet" – Pearson Education

Course outcomes

After completing the course, the students will be able to
CO1. apply the basic concepts of communication Engineering for analysis of data communication and networking.
CO2. explain the functions of different layers of OSI reference model and compare with TCP/IP model.
CO3. compare different flow control and media access control protocols
CO4. recognize the different devices and transmission media used in computer networks and their functionalities.
CO5. explain different routing protocols and address mapping of nodes in a computer network,
CO6. compare different transport layer protocols (TCP/UDP) needed for process to process delivery.
CO7. describe the concepts of DNS, SMTP, SNMP, FTP, HTTP & WWW.
CO8. explain different security aspects in data communication.

Subject Name: COMPILER DESIGN
Code: PC(CS/IT)618
Contracts: 3L
Credits- 3
Total Lecture: 36L

Module -1 [6L]

Introduction to Compiling [2L]

Compilers, Analysis-synthesis model, phases of the compiler, Cousins of the compiler, Basic concepts of NFA, DFA.

Lexical Analysis [4L]

The role of the lexical analyzer, Tokens, Patterns, Lexemes, Specifications of a token, Recognition of tokens, lexical analyzer generator (Lex).

Module-2 [11L]

Syntax Analysis [7L]

The role of a parser, Top down Parsing, Predictive parsing (LL), Bottom up parsing, Operator precedence parsing, LR parsers (SLR, LALR,CLR), Parser generators (YACC).

Syntax directed translation [4L]

Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions.

Module-3[9L]

Type checking [3L]

Type systems, Specification of a simple type checker.

Run time environments [6L]

Activation trees, Control stack, scope of declaration, Binding of names, Activation records, Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables.

Module-4 [10L]

Intermediate code generation [4L]

Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Code optimization [4L]

Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basic blocks, the principle sources of optimization, Loops in flow graph, Peephole optimization.

Code generations [2L]

Issues in the design of code generator, Register allocation & assignment.

Text Book:

1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman.- Compilers Principles, Techniques, and Tools, 2nd Edition, Pearson Education, New Delhi, 2006

Reference Books:

1. A.I.Holub -Compiler Design in C, Prentice Hall of India, New Delhi, 1995

2. J.P. Tremblay - The Theory and Practical of Compiler Writing, McGraw Hill, Singapore, 1993.
3. K.C. Louden- Compiler Construction: Principles and Practice, Thomson Learning, New Delhi, 2005.
4. Chattopadhyay , S- Compiler Design (PHI)

Course Outcome:

Students will be able to do the following:
CO1. Define the phases of a typical compiler, including the front- and backend.
CO2. Identify tokens of a typical high-level programming language; define regular expressions for tokens
and design; implement a lexical analyser using a typical scanner generator.
CO3. Explain the role of a parser in a compiler and relate the yield of a parse tree to a grammar derivation; design and implement a parser using a typical parser generator.
CO4. Apply an algorithm for a top-down or a bottom-up parser construction; construct a parser for a small
context-free grammar.
CO5. Explain the role of a semantic analyser and type checking; create a syntax-directed definition and an
annotated parse tree; describe the purpose of a syntax tree.
CO6. Explain the role of different types of runtime environments and memory organization for implementation
of typical programming languages.
CO7. Describe the purpose of translating to intermediate code in the compilation process.
CO8. Design and implement an intermediate code generator based on given code patterns.

Subject Name: REAL TIME SYSTEM
Code: PEC(CS) 602A
Contracts: 3L
Credits- 3
Total Lecture: 36L
Module-1 [6L]

Module 1: [6L]

Introduction

Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Dead-lines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints.

Module 2: [10L]

Real Time Scheduling

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

Module 3: [8L]

Resources Sharing

Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module Resources, Controlling Concurrent Accesses to Data Objects.

Module 4:[6L]

Multiprocessors and distributed systems: Multiprocessor priority ceiling protocol, End-to-end scheduling.

Module 6:[6L]

Real Time Operating Systems

Basic operating-system functions, Commercial Real Time Operating System

TEXT BOOKS

Real Time Systems – Jane W. S. Liu, Pearson Education Publication

REFERENCE BOOKS

Real Time Systems – Mall Rajib, Pearson Education

Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1:Understand concepts of Real-Time systems and modeling

CO2:Recognize the characteristics of a real-time system

CO3:Understand and develop document on an architectural design of a real-time system

CO4:Develop and document Task scheduling, resource management, real-time operating systems and fault tolerant applications of Real-Time Systems.

Subject Name: INFORMATION & CODING THEORY

Code: PEC(CS) 602B

Contracts: 3L
Credits- 3
Total Lecture: 36L

Module-1 INFORMATION THEORY [6L]

Uncertainty and Information, Self and Mutual Information, conditional self-information, Average Mutual Information and Entropy, Information measures for continuous random variables, source coding theorem.

Module-2 CODING SCHEMES [6L]

Fixed and variable length coding, prefix code, study of static and dynamic dictionary based encoding schemes- Shannon-Fano Coding, Huffman encoding, Run length encoding, Lempel-Ziv encoding and its different types.

Module-3 ERROR CONTROL CODING [10L]

Idea of channel transmission, objective of good error control coding scheme, hamming weight and hamming distance, concept of block code, Linear Block-code, Galois Field, Matrix description of linear block codes with generator matrix, equivalent codes, systematic form of generator matrix, concept of parity check matrix, error syndrome, error detection and corrections with parity check matrix, error correction using nearest neighbour decoding concept of linear block code.

Module-4 CYCLIC CODING [10L]

Idea of cyclic codes, polynomial representation of cyclic codes, cyclic shift in terms of polynomials, monic polynomials, addition and multiplication of polynomials, division algorithm for polynomials, ring of polynomials, generator polynomial, systematic and non-systematic encoding of cyclic codes, error detection and correction for cyclic codes, concept of prime polynomial, factorisation or reducibility aspect of polynomials related to cyclic codes, method for generating cyclic codes.

Module-5 BCH CODES [2L]

Introduction to BCH codes, primitive elements, primitive polynomials, minimal polynomials, concept of conjugates, generator polynomial for error correcting BCH code.

Module-6 CONVOLUTION CODES [2L]

Basic idea, parameters, designing of convolution codes, convolution encoder states and trees, polynomial description of convolution codes.

Books:

1. Information theory, coding and cryptography - Ranjan Bose; TMH

2. Introduction to Error Control Codes – S Gravano; Oxford.

Course Outcome:

After completion of the course, the students will be able to

CO1: Learn the basic idea of information theory.

CO2: Design different forms of coding schemes for the given data.

CO3: Detect and correct errors in the transmitted linear block codes

CO4: Identity cyclic code and also correlate the polynomial aspect of cyclic code.

CO5: Learn the basic idea of BCH code related to error correction.

CO6: Design convolution codes for encoding of the message bits

Subject Name: SOFTWARE ENGINEERING

Code: PEC(CS) 602C

Contacts: 36L

Credit- 3

Module 1 (8L)

Software Engineering –Definitions, Objectives, Software Process models - Waterfall, Spiral, Prototype model, RAD, Evolutionary, Incremental models, Feasibility Analysis, Cost- Benefit Analysis, COCOMO model, Delphi and Putmanmodel.

Module 2 (3L)

System Requirement Specification – DFD, Data Dictionary, ER diagram, Process Organization & Interactions,

Module 3 (5L)

System Design – Problem Partitioning, Top-Down and Bottom-Up design, Decision tree, decision table and structured English, Functional vs. Object- Oriented approach.

Module 4 (6L)

Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics,

Module 5(6L)

Coding & Documentation – Structured Programming, Modular Programming, Module Relationship- Coupling, Cohesion, Information Hiding, Reuse, System Documentation.

Module 6 (6L)

Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.

Module-7 (2L)

CASE tools, Case study on software development process.

Reference Books:

1. Pressman, Software Engineering : A practitioner's approach– (TMH)

2. Pankaj Jalote, Software Engineering- (Wiley-India)

3. Rajib Mall, Software Engineering- (PHI)

4. Agarwal and Agarwal, Software Engineering – (PHI)

5. Sommerville, Software Engineering – Pearson

6. Martin L. Shooman, Software Engineering – TMH

Course Outcomes:

After successful completion of this course students can able to

CO1: Understand the concept of Software Engineering with different types of models.

CO2: Understand the mechanism to handle Software Project Planning, Monitoring, Control, Scheduling and analyze different structured analysis.

CO3: Analyze different designapproach with decision tree, decision table and state chart diagram.

CO4: Analyze Coding &Documentation with different types of Testing methods

CO5: Implement Verification, Validation with different Software Quality AssuranceMetrics.

CO6: Implement CASE tools, Case study on software development process.

Subject Name: Bio-informatics

Code: PEC(CS) 602C

Contacts: 36L

Credit- 3

Module 1:Introduction: [2L]

What is bioinformatics; Different biological processes; Different biological data; Different biological problems we focus to solve; Importance of the computational techniques.

Algorithms and Complexity: [3L]

Algorithm; Biological Algorithms versus Computer Algorithms; Correct versus Incorrect Algorithms; Recursive Algorithms; Iterative versus Recursive Algorithms; Fast versus Slow Algorithms; Big-O Notation; Algorithm Design Techniques – Exhaustive Search, Branch-and-Bound Algorithms, Greedy Algorithms, Dynamic Programming, Divide-and-Conquer Algorithms, Machine Learning, Randomized Algorithms; Tractable versus Intractable Problems;

Module 2:Molecular Biology: [3L]

What is Life made of? Genetic Material; Performance of Gene; Molecule Codes for Genes; Structure of DNA; Transcription and translation; Proteins synthesis; Copying DNA; Cutting and Pasting DNA; Measuring DNA Length; Probing DNA; How do individuals of a species differ? How Do Different Species Differ?

Biological data: [3L]

Sequence data: genome, gene, intron, exon, protein sequence; Structure data: protein secondary and tertiary structure; Biological databases; Features of biological databases; Primary databases – GenBank, EMBL, DDBJ, SWISS-PROT, PIR; Secondary databases – PROSITE, pfam; Structural databases – PDB, SCOPE, CATH; Specialized databases – HGMD, OMIM, TRANSFAE, RFAM;

Exhaustive Search: [5L]

Restriction Mapping; Impractical Restriction Mapping Algorithms; Regulatory Motifs in DNA Sequences; The Motif Finding Problem; Search Trees; Finding Motifs; Finding a Median String

Module 3: Dynamic Programming Algorithms: [5L]

Power of DNA sequence comparison; The change problem revisited; Manhattan Tourist Problem; Edit distance and alignments; Longest common Subsequences; Global Sequence Alignment; Scoring Alignments; Local Sequence Alignment; Alignment with Gap Penalties; Multiple Alignment; Gene Prediction; Statistical Approaches to Gene Prediction; Similarity-Based Approaches to Gene Prediction; Spliced Alignment

Divide-and-Conquer Algorithms: [4L]

Divide-and-Conquer Approach to Sorting; Space-Efficient Sequence Alignment; Block Alignment and the Four-Russians Speedup; Constructing Alignments in Subquadratic Time

Module 4: Graph Algorithms: [5L]

Graph Algorithms; Graphs and Genetics; DNA Sequencing; Shortest Superstring Problem; DNA Arrays as an Alternative Sequencing Technique; Sequencing by Hybridization; SBH as a Hamiltonian Path Problem; SBH as an Eulerian Path Problem; Fragment Assembly in DNA Sequencing; Protein Sequencing and Identification; The Peptide Sequencing Problem; Spectrum Graphs; Protein Identification via Database Search; Spectral Convolution; Spectral Alignment

Module 5:Combinatorial Pattern Matching: [3L]

Repeat Finding; Hash Tables; Exact Pattern Matching; Keyword Trees; Suffix Trees; Heuristic Similarity Search Algorithms; Approximate Pattern Matching; BLAST: Comparing a Sequence against a Database

Clustering and Trees: [3L]

Hierarchical Clustering; k-Means Clustering; Evolutionary Trees; Distance-Based Tree Reconstruction; Reconstructing Trees from Additive Matrices; Evolutionary Trees and Hierarchical Clustering; Character-Based Tree Reconstruction; Small Parsimony Problem; Large Parsimony Problem

Reference Books:

1) An Introduction to Bioinformatics Algorithms by Neil Jones and Pavel Pevzner

2) Algorithms in Bioinformatics: A Practical Introduction by Wing-Kin Sung

3) Bioinformatics Algorithms: Techniques and Applications by Ion Mandoiu, Alexander Zelikovsky

4) Understanding Bioinformatics by Jeremy O. Baum and Marketa J. Zvelebil

Course Outcome:

CO1. To learn to create bridge between biological science and computer science.

CO2. To learn different algorithms to extract biological information from various biological data.

CO3. To develop the student's ability to deal with different biological data.

Subject Name: MACHINE LEARNING
Code PEC(CS) 603A
Contracts: 3L
Credits- 3
Total Lecture: 36L

Module-1: Introduction [5]

Introduction to Analytics and Machine Learning, Framework for Developing Machine, Learning Models, Prepare the Data for Machine Learning Algorithms,Data Cleaning, Handling Textand Categorical Attributes, Handling Missing Values, Exploration of Data using Visualization,Types of Machine Learning Systems

Module-2: Linear Regression [7]

Linear regression, Gradient Descent Algorithm for Linear Regression Model,Polynomial model, Regularization, Multi-Collinearity, Logistic Regression

Module-3: Classification [8]

Training a Binary Classifier, Measuring Performance, Using Linear Regression for Classification, Using Logistic Regression, Multiclass Classifier, Multi-label Classification, Multi-output Classification

Module-4: Some Supervised Machine Learning Algorithms [7]

k-Nearest Neighbors (KNN), Naive Bayes Classifiers, Decision Trees, Ensembles of Decision Trees: Random Forests, Kernelized Support Vector Machines, Model Evaluation and Improvement

Module-5: Dimensionality Reduction [7]

Dimensionality Reduction, Feature Extraction, and Manifold Learning, Principal Component Analysis (PCA),Randomized PCA, Incremental PCA, Kernel PCA, Selecting a Kernel and Tuning Hyper-parameters, Other Dimensionality Reduction Techniques

Module-6: Unsupervised Learning: Clustering [6]

K-Means, Image Segmentation using clustering,Creating Product Segments Using Clustering,Finding Optimal Number of Clusters Using Elbow Curve Method, Normalizing the Features,Hierarchical Clustering, Compare the Clusters Created by K-Means and Hierarchical Clustering,Anomaly Detection using Gaussian Mixtures, Assessment Metrics for Clustering Algorithms.

Text Books:

1. Christopher Bishop. Pattern Recognition and Machine Learning. 2e
2. Machine Learning by Tom Mitchell, McGraw Hill Education

Reference Book:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

After successful completion of the course, the students will be able to
Course Outcomes:

CO1: Develop an understanding what is involved in learning models from data.
CO2: Understand a wide variety of learning algorithms.
CO3: Apply principles and algorithms to evaluate models generated from data.
CO4: Apply the algorithms to a real-world problem.

Subject Name: OPERATION REASEARCH
Code: PEC(CS) 603B
Contracts: 3L
Credits- 3
Total Lecture: 36L

Module- 1[17L]

Linear Programming Problems (LPP):Basic LPP and Applications; Various Components of LP Problem Formulation.

Solution of Linear Programming Problems:Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution,Degenerate and Non-degenerate Solution, Convex set and explanation with examples.Solution of LPP by Simplex Method; Big-M Method; Duality Theory.Transportation Problems and Assignment Problems.

Module- 2[5L]

Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).

Module- 3[5L]

Game Theory: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point;Graphical Method; Principle of Dominance.

Module- 4[5L]

Queuing Theory: Introduction;Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞/ FIFO) and (M/M/1: N / FIFO) and problems.

Module- 5[4L]

Dynamic Programming:Basic Concepts, Bellman's optimality principles, Dynamic programming approach in decision making problems, optimal subdivision problem.

Text Books:

1. H. A. Taha, "Operations Research", Pearson

2. P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House

3. Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency

4. Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA

Reference Books:

1. KantiSwaroop — "Operations Research", Sultan Chand & Sons

2. Rathindra P. Sen—"Operations Research: Algorithms and Applications", PHI

3. R. Panneerselvam - “Operations Research”, PHI

4. A.M. Natarajan, P. Balasubramani and A. Tamilarasi - “Operations Research”, Pearson

5. M. V. Durga Prasad – “Operations Research”, CENGAGE Learning 6. J. K. Sharma - “Operations Research”, Macmillan Publishing Company

Course Outcomes

After completing the course the student will be able to

CO 1: Understand the role and origin of operation research techniques.

CO 2: Differentiate between different types of deterministic and probabilistic models.

CO3: Convert the problem into a mathematical model.

CO 4: apply the various types of deterministic and probabilistic models in complex system for taking better decisions.

CO 5: Understand variety of problems such as assignment, transportation, travelling salesman etc.

CO 6:Understand different queuing situations and find the optimal solutions using models for different situations.

Subject Name: DIGITAL SIGNAL PROCESSING
Code:PEC(CS) 603C
Contracts: 3L
Credits- 3
Total Lecture: 36L

Module 1:Introduction[6L]
Deterministic and Non- deterministic Signal, Periodic and Aperiodic Signal, Unit-step Functionand Unit Impulse Function.Causal and Non-causal System, Recursive and Non-recursive System.Convolution Theorem. Sampling Theorem, A/D Conversion and Resolution of A/D Conversion.High Pass and Low Pass Filter and 3dB Frequency.

Module 2:Fourier Series and FourierTransform[12L]

Fourier Series and its explanation, conditions for existence of Fourier Series, exponential form of Fourier Series. Fourier Transform and Inverse Fourier Transform.Fourier Transform of Impulse Response.
Discrete Fourier Transform (DFT), computation of Discrete Fourier Transform, Twiddle Factor, Periodicity and Symmetry Property of Twiddle Factor. Computation of addition and multiplication operations of DFT. Fast Fourier Transform (FFT), Decimation in Time FFT & Decimation in Frequency FFT, Butterfly operation. Computation of addition and multiplication operations of FFT.

Module 3: Finite Impulse Response (FIR) and Infinite Impulse Response(IIR)Filter[12L]
Basic concepts of FIR Filter,Calculation of Filter Coefficients, Impulse Response Sequence and Window Sequence.Rectangular Window, Hamming Window and Hanning Window Function.Calculation and determination of the Order of FIR Filter.Implementation of FIR Filter.Basic concepts of IIR Filter.Transfer Function of IIR Filter.Advantages and disadvantages of IIR Filter and FIR Filter.
Z- Transform and Bilinear Transform. Realization of Filter using Z-transform.

Module 4: DSP Processor and Programming [6]
Block Diagram of TMS320C54x Processor and brief explanation including Accumulator, Memory and MAC Unit. Basic Instruction Sets and simple Assembly Language Programming using TMS320C54x. FIR Filter design and implementation using TMS320C54x.

Text Books:
[1]Digital Signal Processing - S. Salivahanan, A. Vallavaraj and C. Gnanapriya, Tata McGraw-Hill Publishing Company
Limited, New Delhi.
[2] Digital Signal Processing: A Computer Based Approach - S.K. Mitra, Tata McGraw-Hill PublishingCompany Limited,
New Delhi.
[3] Digital Signal Processing: Principles, Algorithms, and Applications - J.G. Proakis and D.G. Manolakis, Pearson
Education, India.
[4] Theory and Application of Digital Signal Processing - L.R. Rabiner and B. Gold, Prentice Hall of India Private Limited,
New Delhi.

Reference Books and Data:
[1]Digital Signal Processing- A.V. Oppenhiem and R.W. Schafer, Prentice Hall India Private Limited, New Delhi.

[2] Digital Signal Processing: System Analysis and Design - P.S.R Diniz, E.A.B da Silva and S.L. Netto,Cambridge
University Press, Delhi.
[3] Digital SignalProcessors: Architecture, Programming and Applications - B. Venkataramani and M. Bhaskar, Tata
McGraw-Hill Publishing Company Limited, New Delhi.
[4]www.ti.com
[5] www.analog.com

Course Outcomes:

After completion of the course the students will be able to-
CO1: Gather knowledge about various properties and principles of Digital Signal Processing.
CO2: Familiar with the different applications of Digital Signal Processing.
CO3: Design various techniques using the theorem of Digital Signal Processing.
CO4: Implement various experiments and analysis the techniques of Digital Signal Processing.

Subject Name: ADVANCED COMPUTER ARCHITECTURE
Code: PEC(CS) 603D
Contracts: 3L
Credits- 3
Total Lecture: 36L

Module – 1 [10L]

The evolution of modern Computer systems – from DEC PDP-11, IBM 360/370 family, CDC Cyber 6600, Intel X86 architecture, Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. Introduction to high performance Computing – Overview, Flynn's classifications – SISD, SIMD, MISD, MIMD, Examples from Vector & Array Processors, Performance comparison of algorithms for Scalar, Vector and Array Processors, Fundamentals of UMA, NUMA, NORMA architectures, Performance measurement for parallel architectures – Flynn,s measure, Feng,s measure

Module – 2 [10L]

Pipelined processor design, Pipeline performance measurement parameters – speedup factor, efficiency, throughput of a linear pipeline, comparing performance of a N stage pipeline with a N processor architecture, Pipeline design principles, Examples of Arithmetic pipelines, Floating point Adders, Multipliers, Dividers etc.,Classifications of Unifunction, Multifunction & Dynamic pipelines, Scheduling in a pipelines with feedback , Pipeline hazards and their solutions(10L)

Module –3 [10L]

RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with CISC, necessity of using optimizing compilers with RISC architecture, Examples from POWER PC and SPARC architectures ,Superpipelining (MIPS architecture), Superscalar architecture , Diversified pipelines and out of order execution, VLIW architecture (10L)

Module – 4 [6L]

Memory hierarchy – Techniques for improving Cache memory performance parameters,(reduce cache miss rate, reduce hit time, reduce miss penalty), Main memory performance enhancement – interleaved memory, improvement of memory bandwidth, use of TLB for performance enhancement. (6L)

Text books:

1. Advanced computer architecture: Parallelism, Scalability, Programmability - Kai Hwang and NareshJotwani (McGraw Hill)

References books:

1. Computer Architecture: A Quantitative Approach – Patterson & Hennessy (Elsevier)
2. Computer Architecture & Parallel Processing – Hwang &Briggs(TMH)
3. Computer organization and architecture, designing for performance – Stallings (PHI)
4. Advanced Computer Architecture – Hwang (TMH)
5. Structured Computer Organization – Tanenbaum (PHI)
6. Computer Architecture & Organization – J P Hayes (McGraw Hill)

Course Outcome

After completing the course the students will be able to

CO 1: design pipeline processor and use different techniques for handling pipeline hazards.

CO 2: clearly visualize the hierarchical memory technology and design cache and virtual memory organization

CO 3: explain multiprocessor architecture and taxonomy of parallel architecture

CO 4: analyze the concepts of RISC and CISCarchitecture

CO5: explain the concepts of parallel computing and hardware technology

Industrial Management
Code: HS (CS/IT)604
Contact: 3L
Credits: 3
Allotted Hrs: 36L

Module-1: Human Resource Management: [2L]
Introduction of Human Resource Management, Recruitment and selection, Performance appraisal, Industrial Relations, Trade Union, Collective Bargaining

Module-2: Organizational Behaviour: [8L]
Different Schools of Management Thought: Scientific Management, Administrative Theory, Theory of Bureaucracy, Human Relations Theory(Elton Mayo).
Motivation: Concept, Different Theories (Maslow, ERG, Herzberg,) Communication: Purpose, process, Barriers to effective communication, Guidelines to make communication effective.
Perception: Process, Importance, Factors influencing perception, Shortcuts for judging people- Halo effect, Stereotyping, Projection.

Module-3: Quality Management: [6L]
Concept, Dimensions for goods and services, Cost of Quality, Statistical Quality Control, Control Charts, Acceptance Sampling (single). Total Quality Management: Concept, benefits, Criticism. New Quality Tools: Kaizen, Six Sigma, Quality Circles.

Module-4: Productions Management: [2L]
Concept. Difference from Operations Management, Types of Production (Mass, Batch, Project), Functions of Production Management. Productivity: Concept, Different Inputs and Productivity Measures, Efficiency and Effectiveness, Measures to increase Productivity.

Module-5: Marketing Management: [2L]
Basic Concepts of Marketing, Difference between Selling and Marketing, Elements of Marketing Mix- the 4 P's. Brief idea about Marketing Environment, Simple Marketing Strategies: SWOT Analysis.

Module-6: Introduction to Accounting [7L] Basic accounting concepts, important definitions, uses, limitations, advantages; types of Accounting, Financial statements, introduction to Journal Accounting; different types of Vouchers, double entry bookkeeping, different types of transactions related to Financial Accounting.

Module-7: Financial Control [5L] Posting of Ledgers and preparation of Trial Balance; preparation of Balance Sheet and Profit and Loss Accounts; Controlling other departments by Financial Accounting (A practical Approach).

Module-8: Budget Analysis: [4L]
Union and State Budget Analysis of concerned year: Budget at a Glance, Annual financial Statement, Economic Survey of Concerned year

Books:
1. Industrial Management, Vol.1 L.C. Jhamb, EPH
2. Industrial Relations, Trade Unions &Labour Legislation - Sinha, Pearson Education Asia
3. Organizational Behaviour, S.P. Robbins, Prentice Hall
5. Marketing Management, Phillip Kotler, Prentice Hall/Pearson Education.
6. Productions and Operations Management, Joseph Monks,TMH

7. Financial Management and Accounting - P. K. Jain, S. Chand & Co.
8. For Union Budget: indiabudget.gov.in

Course outcome

After completing the course the student will be able to

CO 1: understand a brief idea of human resource management, Trade union and industrial relations, different schools of management thought different theories and concepts.

CO 2: develop a brief knowledge about standard practices and tools for quality management, production control, effective measures to increase productivity.

CO 3: know the basic concepts of marketing, ethical practices for marketing and different marketing strategies.

CO 4: know the basic concepts of accounting, different types of accounting, financial statements and how to create journal, bookkeeping and transaction related issues. Farther they will understand how to manage finance and control finance. What are the tools that can be used for controlling financial issues?

CO 5: understand and analyse Union and State budget of concerned year, know where the capital is invested, how much is invested and develop an idea about this macro economy.

Computer Network Lab
PCL(CS/IT) 619
3P
Credit: 4
Allocated Hrs: 36P

1.NIC Installation & Configuration (Windows/Linux)
2. Understanding IP address, subnet, MAC address, IP configuration
3. Networking cables (CAT5, UTP), Connectors (RJ45, T-connector)
4. Physical verification of existing LAN
5.TCP/UDP Socket Programming
i) UDP time client server program
ii) UDP echo client server program
iii) TCP time client server program
iv) TCP echo client server program
v) TCP chat client server program
Vi) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
6. Server Setup/Configuration FTP, TelNet, DNS.
7. Firewall configuration in client level

8. Mini project: Multiple user chat server implementation

Course outcomes

After completing the course the students will be able to

CO1. Install and configure computer networks in both Windows and Linux environment.
CO2. Identify different cables and connectors used in computer networks.
CO3. apply the concept of socket programming for TCP/UDP client server communication.
CO4. Setup and configure servers like FTP, Telnet, DNS
CO5. explain data link layer error detection mechanism

THEORY							
7th SEM							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	OEC(CS/IT)701	Open Elective I A. History of Science & Engineering B. Organizational Behavior	3	0	0	3	3
02	OEC(CS/IT)702	Open Elective II A. Economic Policies in India B. Soft Skills and Interpersonal Communication	3	0	0	3	3
03	OEC(CS/IT)703	Open Elective III A. Programming and Application of Advanced Microprocessors B. Control System	3	0	0	3	3
04	PEC(CS)704	Elective-IV A. Web & Internet B. Artificial Intelligence C. Introduction to Deep Learning D. Digital Image processing	3	0	0	3	3
05	PEC(CS)705	Elective-V A. Internet of Things B. Distributed Database C. Computer Graphics D. Introduction to Quantum Computing	3	0	0	3	3
PRACTICAL							
01	PROJ(CS)702	Project 2	0	0	12	12	6
		SESSIONAL					
01	INDTR(CS)1	Industrial Training Evaluation	0	0	0	0	1
		TOTAL	15	0	12	27	22

Name of the course		**History of Science and Engineering**	
Course Code: OEC(CS/IT)701A		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs/week		Mid Semester 1 Exam:15 Marks	
Tutorial:0 hrs/week		Mid Semester 2 Exam:15 Marks	
Practical:0 hrs/week		Other Assessment tools (Assignment, Quiz etc.):20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To learn the development stages of ancient Science and Engineering		
2.	To explore the inventions of Agricultural, Technological and Medical Sciences		
3.	To judge the contributions of eminent Scientists of India		
Pre-Requisite:			
1.	NIL		
Unit	Content	Hrs	Marks
1	**Development of Ancient Science and Engineering :** Stone Age (3.4 million BCE to 2000 BCE): Stone and bone tools, control of fire and cooking, boats, fishing tackle, stone and mud dwellings etc. Copper and Bronze Age (3300 BCE to 1200 BCE): Metal pots and pans, pottery wheel, pulley, metal tools and weapons etc. Iron Age (1500 BCE to 200 BCE): Block and tackle system, Pump, Lathe, Iron tools, Iron axe, development of weapons etc.	8	
2	**Development of Medieval Science and Engineering :** Middle Age (500 CE to 1500 CE): Waterwheel, windmill, cannon, mechanical clock, wheeled plow, compass, ships, optics, anatomy, Human dissection anatomy, books on optics, books on anatomy etc.	8	
3	**Renaissance and Science and Engineering in Industrial Age** Renaissance Period (c.1300 to c.1700): Mining, metallurgy, development of telescope, microscope, thermometer, barometer, printing press, firearms, nautical compass, sawmills etc. Industrial Age (c.1700 to c.1920): Steam engine, electricity, automobile, radio, airplane, mechanical television, telephone, rocket etc.	8	
4	**Modern Science and Engineering:** Information Age (c. 1920 to Present day): Vacuum tube, transistor, integrated circuits, microprocessor, computer, internet, mobile phones, wireless technology, Nuclear power and space technology, GPS etc.	6	
5	**Eminent Ayurvedacharya & Scientist of India and their contributions:** Sushruta (800 BCE- 700 BCE): Invention and Development of Surgical Procedures Charaka(Approx 200 BCE – 200CE): Contribution to Medicine Aryabhata (476 CE- 550 CE): Trigonometry, Algebra and Astronomy	6	

	Brahmagupta (c.598 – 668 CE): Arithmetic Manipulation Rules for zero and Negative Numbers Bhaskara II (1114 - 1185): Some Principles of Differential Calculus and concept of Infinity Jagadish Chandra Bose (1858 – 1937): Investigation of Radio & Microwaves and Plant Science Prafulla Chandra Ray (1861- 1944): Eminent Chemist. Established Bengal Chemical & Pharmaceutical Ltd Srinivasa Ramanujan (1887-1920): Great Mathematician, Number Theory was among his specialities. C V Raman (1888 – 1970): Noble Prize in Physics in the field of Light Scattering Meghnad Saha (1893-1956): Astrophysicist and developed Saha Ionization Equation Satyendra Nath Bose (1894 – 1974): Best known for his work on Quantum Mechanics		

Text Books:

1. A History of Science, Jackson Tom published by Worth Press Limited.
2. An Introduction to the History of Science, Walter Libby published by Newman Press
3. Science and Technology in World History: An Introduction, James E. McClellan, Harold Dorn published by JHU Press.
4. The History of Science and Technology: A Browser Guide …… by B. H. Bunch, A. Hellemans, Published by Houghton Miffin (USA)

Reference Study Materials:

1. History of Science and Technology in India by B. B. Satpathy
   [available at www.amazon.in]
2. https://en.wikipedia.org/wiki/History_of_science
3. https://en.wikipedia.org/wiki/History_of_technology
4. https://en.wikipedia.org/wiki/Science
5. https://en.wikipedia.org/wiki/Science_education
6. https://en.wikipedia.org/wiki/Timeline_of_historic_inventions#Modern_era

Course Outcomes:

After completion of the course the learners will be able to-

1. **Identify** the technological developments of the Stone Age, Bronze Age and Iron Age.
2. **Interpret** the advancement of Science and Medicine of the Medieval Age.
3. **Differentiate** the developments of Science and Engineering in the Renaissance and Industrial Age.
4. **Estimate** the progress of Modern Science and Engineering in the Information Age.
5. **Review** the activity of eminent Ayurvedacharya & Scientists.

Name of the course		**Organizational Behavior**	
Course Code: OEC(CS/IT)701B		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To understand the human interactions of the organisation.		
2.	To find what is driving it and influence it for getting better result in attaining business goal.		
Pre-Requisite			
1.	Need to have an idea on what is communication		
Unit	Content	Hrs	Marks
1	**Behavioural concept:** Nature & concept of O.B., Relationship with other fields, learning nature significance process of learning.	3	
2	**Individual Behaviour:** Personality self awareness, personality measurement.	3	
3	**Perception & Attribution:** Perceptual process model, perceptual errors in organizational settings, improving perception, Attitude, job satisfaction, organizational commitment, Attribution theory, attribution errors, Ethics & Values.	8	
4	**Motivation & personal effectiveness:** Hierarchy of needs – goal setting theory – content and process theory of motivation – money as a motivator – team motivation.	8	
5	**Group Behaviour:** Stages of group formation, 5 stages model, group structure, task decision making in group, team building and development, conflict and negotiation, leadership approach & development.	8	
6	**Organizing and Organization:** Organization Structure & design, organizational culture, change, development.	6	

Text books:

1. English Organizational Behaviour by S. Shajahan., New Age International Publishers.
2. Organisational Behaviour by Dr Agarwal and Dr Mittal, Sanjeev Prakashan

Reference books

1. Organizational Behaviour Publisher – University of Minnesota
2. A Text book of O.B., Dr. C. S. Gupta
3. OB by Dr. Mittal & Agarwal

Course Outcomes:
After completion of the course the learners will be able to-

1. **Identify** different forms of an organization.
2. **Examine**, what makes an organization, how it evolves, what makes them effective.
3. **Evaluate** their own behavior and that of others in an organizational setting.
4. **Assess** human behavioral problems like conflict, politics etc.
5. **Appraise** their ability to manage, lead and work with other members in an organizational setting.

Name of the course	**Economic Policies in India**
Course Code: OEC(CS/IT)702A	**Semester: 7th**
Duration: 6 months	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hrs/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:	
1.	To understand the changing nature of Economic policy in India.
2.	To discuss the different sector-specific policies.
3.	To explain the implications of sectoral policies.

Pre-Requisite			
	NIL		
Unit	Content	Hrs	Marks
1	**Changing nature of Economic Policy in India:** Indian economy at independence. Economic Planning in India – Objectives, development strategy and assessment. Economic reforms and liberalization.	8	
2	**Policies in Agriculture:** Importance of agriculture in Indian economy. An overview of policies for agriculture and rural development. Green Revolution – features, phases and impact. LandReforms. Food security and food policy. Agricultural price policy.	8	
3	**Policies in Industry:** Industrial policy prior to 1991.Industrial Licensing Policy. New Industrial Policy 1991.Public sector in the Indian economy. Evolution of disinvestment programme and privatization policy. Small scale industries.	8	
4	**Policies in Financial Sector:** The banking sector in the pre-reform	6	

	period. Banking sector reforms. Indian capital market – pre and post reform phase.		
5	**India's Fiscal Policy:** Objectives of fiscal policy in India**.** Fiscal imbalance and deficit financing. The fiscal imbalance and the new fiscal approach. The tax reforms since 1991.Federal finance in India.	6	

Text books:

1. Ruddar Dutt & KPM Sundaram: Indian Economy, S. Chand & Company Ltd,
2. Mishra and Puri: Indian Economy, Himalaya Publishing House
3. Uma Kapila (ed.): Indian Economy since independence, Academic Foundation
4. Uma Kapila: Understanding the problems of Indian economy, Academic Foundation
5. Uma Kapila: Indian Economy issues in development & planning and sectoral aspects, Academic Foundation.

Reference books

1. Economic Survey, Government of India- various issues.
2. Finance Commission Report, Ministry of Finance, various issues.

Course Outcomes:

After completion of the course the learners will be able to-

1. **Explain** the Changing nature of Economic Policy in India
2. **Analyze** the different policies in Agriculture
3. **Examine** the different policies in Industry
4. **Outline** the policy reforms in the financial sector
5. **Discuss** the different aspects of fiscal policy.

Name of the course	**Soft Skill and interpersonal communication**
Course Code: OEC(CS/IT)702B	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hr/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Assignment ,Quiz, Attendance: 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:	
1.	To handle interpersonal relations.
2.	To communicate effectively.
3.	To take appropriate decision.
4.	To gain professional development
Pre-Requisite	
1	To know at least basic grammar in English language

Unit	Content	Hrs	Marks
1	**Introduction:** Difference between soft and hard skill, communication the most important soft skill, types, process, barriers.	2	
2	**Verbal Communication oral**: listening, reading, speaking.	2	
3	**Verbal Communication Written**: paragraph, letter, essay, precie, comprehension.	2	
4	**Communication As A Source Of Career Building**: Job application letter with resume./cv, group discussion, presentation, mock interview.	10	
5	**Business Communication:** Memo, agenda, minutes of meeting, notice, Email.	10	
6	**Soft Skill:** Time management, goal setting, problem solving, decision making, leadership style, intra &interpersonal skill, swot analysis	10	

Text books:

1. English communication and soft skill by prof Nira Konar.
2. Soft skill by Seema Gupta,V&S publication.

Reference books

1. Communication skill by Nageswar Rao & P. Rajendra, himalayan publication.
2. Talk like Ted by Carmine Gallo
3. How to speak how to listen by Mortimer J. Adler.
4. You Can Win by Shib Khera.... MacMillan publication.
5. www.indiabix.com website

Course Outcomes:

After completion of the course the learners will be able to-

1. **Define** what communication is .
2. **Build** strong professional vocabulary by reading writing listening and speaking**.**
3. **Express** themselves properly to others.
4. **Organize** Their thought processes, ideas, arguments through group discussion, presentation, interview.
5. **Negotiate** with people.

Name of the course	**Programming And Application Of Advanced Microprocessors**
Course Code: OEC(CS/IT)703A	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hrs/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Assignment, Quiz, Attendance: 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks

	converted to 50)		
Objective:			
1.	To understand the features of 8086 and Pentium family of Microprocessors.		
2.	To learn Assembly Language Programming of advanced Microprocessors.		
3.	To design interface circuits and their connection with Microprocessors.		
4.	To implement Microprocessor based systems		
Pre-Requisite			
1.	Digital Electronics [ES(CS/IT) 307]		
Unit	Content	Hrs	Marks
1	**Introduction to 8086 Microprocessor:** 8086 Microprocessor: Block diagram, Execution Unit, Bus Interface Unit, General Purpose Registers, Flag Registers, Memory Segmentation, Logical Memory and Physical Memory, Addressing Modes.	8	
2	**X86 and Pentium family of Microprocessors:** Simple Block Diagram, Address Bus, Data Bus, other Buses, Control Registers, General Purpose Registers, Cache Memory, Upward compatibility of features and privileges.	8	
3	**Instruction Sets and Assembly Language Programming:** Basic Instruction Sets, Assembler Directives and Assembly Language Programming, Machine Cycle and instruction Cycle, Minimum Mode and Maximum Mode.	8	
4	**Controller and Peripheral Devices** Working principles of DMA Controller, Interrupts and its application. Programmable Peripheral Interface, Working principles of LCD, Interface with LCD, Interface with Stepper Motors. Interface with Ports.	6	
5	**BIOS and DEBUG:** BIOS Function Calls, DEBUG in DOS and Windows Environment. Various DEBUG Commands, Memory access using DEBUG Command, Advanced Assembly Language Program with DEBUG. Disassemble and generation of HEX Codes using DEBUG.	6	

Text Books:

1. Advanced Microprocessors and Peripherals by K.M. Bhurchandi and A. K. Ray, McGraw Hill Education (India) Private Limited.
2. An Introduction to the Intel Family of Microprocessors by James L. Antonakos, Pearson Education Asia.
3. The x86 PC: Assembly Language, Design and Interfacing by M.A. Mazidi, J. G. Mazidi and D. Causy, Pearson Publication.
4. The x86 Microprocessors: Architecture, Programming and Interfacing (8086 to Pentium) by Lyla B. Das, Pearson Publication.

Reference Books:

1. Fundamentals of Microprocessors and Microcomputers by B. Ram, Dhanpat Rai Publications, New Delhi.
2. Microprocessors and Interfacing: Programming and Hardware by Douglas V. Hall, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Microprocessor Data Hand Book, BPB Publications.

Course Outcome:

After completion of the course the learners will be able to-

1. **Explain** the characteristics of 16 bit Microprocessor.
2. **Determine** the features of upward compatible Microprocessors.
3. **Execute** Assembly Language Program.
4. **Simulate** programs using DEBUG.
5. **Design** circuits based on Microprocessors.

Name of the course		**Control System**	
Course Code: OEC(CS/IT)703B		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To classify different systems and the related parameters.		
2.	To apply different mathematical tools & techniques for analyzing different practical systems.		
3.	To develop the concept of stability of a system and compute stability parameters.		
4.	To design different controller parameters for stabilizing specific systems		
Pre-Requisite			
1.	Basic Electrical Engineering (ES (CS/IT) 101)		
2.	Mathematics (BS (CS/IT) 101, BS (CS/IT) 205, BS(CS/IT)307)		
Unit	Content	Hrs	Marks
1	**Introduction to Control System:** Introduction to control system, objectives and areas of applications, Open loop system and closed loop system, Feedback control and Automatic control: concepts and examples, Concept and examples of linear and nonlinear systems, sensitivity, robustness, accuracy	3	
2	**Concept of transfer function: mathematical modeling of physical systems:** Transfer function of real life systems, properties and applications, Basic concepts of poles and zeroes of a transfer function, Mathematical modeling: electrical analogy of spring–mass-dashpot system, Block diagram representation of physical systems and analysis of block diagram, Different techniques for block diagram reduction, Development of signal flow graph, Mason's gain formula	7	
3	**Control system components:** Potentiometer, Synchros, Resolvers, Position encoders, Tacho-generators, Actuators, Basic concept of position control, speed control, temperature control, liquid level	3	

	control, pressure control.		
4	**Time domain analysis:** Impulse, step and ramp function, Step response of first and second order system, Time domain analysis of a standard second order closed loop system, Understanding of Steady state error, undamped natural frequency, damping, overshoot, rise time and settling time and their applications, Stability assessment using locations of poles and zeroes, Stability analysis using Routh-Hurwitz criteria	7	
5	**Stability Analysis and control:** Stability analysis using Root locus techniques from transfer function, Idea of semi-log graph, Bode plots and stability analysis using Bode plots from transfer function, Measurement of phase margin and gain margin, Development of polar plots from transfer function, Measure of relative stability using Nyquist criteria, PI, PD and PID control	11	
6	**Introduction to State variable Analysis:** State variables and state space model, Diagonalization, Solution of state equations, Computation of stability, controllability and observability from state model	5	

Text books:

1. Modern Control Engineering, K. Ogata, 5th Edition, Pearson Education India
2. Control System Engineering, I. J. Nagrath & M. Gopal. 6th Edition, New Age International Publication.
3. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 10th Edition, McGraw Hill India

Reference books

1. Automatic Control Systems (with Matlab Programs), S. Hasan Saeed, Kataria, S. K., & Sons
2. Modern Control Engineering, D. Roy Choudhury, PHI Learning
3. Control Systems, A. Anand Kumar, 2nd Edition, PHI Learning
4. Linear Control Systems with MATLAB Applications, B. S. Manke, Khanna Publishers

Course Outcome:

After completion of the course the learners will be able to-

1. **Develop** transfer function of different systems using mathematical analysis, block diagram reduction, Mason's gain formula etc.
2. **Explain** the operation of different components of control system and physical control systems
3. **Examine** the system performance using different parameters of time domain response
4. **Determine** stability of a system using Root locus techniques, Bode plots and Nyquist criteria using transfer function of a system
5. **Measure** controllability and observability of a system from its state space model

Name of the course		**Web & Internet**	
Course Code: PEC(CS)704A		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0hrs./week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs./week		Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To explain web application development procedures		
2.	To understand the concept of JAVA SCRIPTS, HTML& XML.		
3.	To impart servlet technology for writing business logic		
4.	To familiarize various concepts of application development using JSP		
5	To facilitate students to connect to databases using JDBC		
Pre-Requisite			
1.	JAVA [PC(CS/IT)513]		
2.	Database Management System [PC(CS/IT)512]		
3	Computer Networks [PC(CS/IT)617]		
Unit	Content	Hrs	Marks
1	**Introduction**: Concept of client & server side web applications, Web Architectures, Enterprise architecture styles: Single 2-tier, 3-tier, n-tier, comparison of J2EE and .NET framework, concepts of URL, HTTP, Message format of HTTP-Request and response message, Persistent & Non Persistent connections in HTTP, Web Caching, HTTP Proxies.	5	
2	**HTML Basics**–HTML elements, attributes and tags, comments, title, paragraphs, line breaks, changing font size, style, making text bold, underlined , italicized, Table with Row and Column Header, CSS & its advantages, different style information-inline, internal/embedded and external,css cascading rules. Java Script - statements, comments, placing functions, variables, literals- String, Number, Boolean, looping- for, while, do-while, conditional statements, arrays, objects.	11	
3	**Servlet**- Introduction, servlet architecture, life cycle of servlet, Generic Servlet and HTTP servlet, parameter passing to servlets, retrieving parameters, session management-.cookies, hidden form field,URL rewriting,HttpSession **Java Server Pages(Jsp)-** Introduction, life cycle of JSP,comparision JSP & SERVLET, JSP components- directives, declarations, expressions, scriptlets, variables and methods, scope of JSP objects, concepts of beans-useBean, setProperty, getProperty.	12	

	.		
4	**Java Database Connectivity (Jdbc)-**Introduction to data streams, JDBC architecture, JDBC Driver types- Type1, Type2, Type3 and Type4, making connections with the database for accessing records from JSP & servlet.	4	
5	**Xtensible Mark Up Language** –XML-Need for XML, HTML and XML, XML syntax and tags, elements and attributes, comments, Role of XML DTD and Schema, need for XML parser.	4	

Text books:

1. Web Design Technology (Theory And Technique On The Cutting Edge)-D.P. Nagpal, S.Chand Publication
2. Learn Object Orinted Programming Using Java: An Uml Based- Dr. N.B. Venkateswarlu& Dr. E.V. Prasad- S.Chand Publication
3. Web Technologies-Uttam K. Roy, Oxford University Press, Higher Education
4. Web Technologies: Tcp/Ip To Internet Application Architectures-Achyut S. Godbole, Achyut S Godbole, Atul Kahate-Tata Macgraw-Hill Publication

Reference books:

1. Web Technology & Design - Xavier C., New Age Publication.
2. Java Server Programming, J2EE edition. (VOL I and VOL II); WROX publishers.

Course Outcome:

After completion of the course the learners will be able to-

1. **Explain** web application & their types
2. **Design** web application using JavaScript and HTML
3. **Analyze** appropriate Server-side applications
4. **Apply** JDBC and ODBC technologies to create database connectivity
5. **Identify** the engineering structural design of XML and parse tree

Name of the course	**Artificial Intelligence**
Course Code: PEC(CS)704B	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs./week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs./week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:	
1.	The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand what the AI is.
2.	Apply the basic principles, models, and algorithms of **AI** to recognize, model, and solve problems in the analysis and design of information systems.

3.	Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.		
Pre-Requisite			
1.	Strong knowledge of Mathematics. (BS (CS/IT) 101, BS (CS/IT) 205, BS(CS/IT)307).		
2.	Good command over programming languages. (PCL(CS/IT)305, PCL(CS/IT)514).		
3.	Design & Analysis of Algorithm PC(CS/IT)406		
Unit	Content	Hrs	Marks
1	**Introduction of AI and Agents :** Overview of Artificial intelligence- Problems of AI, AI technique, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.	5	
2	**Problem Solving:** Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	3	
3	**Search techniques:** Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	11	
4	**Knowledge & reasoning and Representing knowledge using rules:** Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation, The First Order Predicate Logic, Semantic Nets, Frames and Scripts Formalisms, Resolution in Predicate Logic, Unification, Strategies for Resolution by Refutation, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.	6	
5	**Planning and Learning:** Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques, preliminary ideas of distributed and real time planning, Subsumption architecture based planning, Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.	5	
6	**Natural Language processing and Expert Systems:** Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing, Representing and using domain knowledge, expert system shells, knowledge acquisition.	6	

Text books:

1. E. Charniak, et.al., Introduction to Artificial Intelligence, PEARSON Education. P. H. Winston, Artificial Intelligence, PEARSON
2. Education. E. Rich and K. Knight, Artificial Intelligence, PEARSON Education. R. Honavar and E. Uhr, Artificial Intelligence and
3. Neural Networks, Academic Press, 1992. F. Hayes Roth et.al., Building Expert Systems, PEARSON Education. P. R. Cohen,et.al.,
4. The Handbook of Artificial Intelligence, Vol.1,2 and 3, Kaufman Inc.,1982. B. K. P. Horn, Robot Vision, MIT Press, 1985. J.
5. Carbonell, Machine Learning paradigms and Methods, MIT Press, 1990. Journals- Artificial Intelligence, AI Magazine, IEEE 6. Expert, Machine Learning, Computer Vision Image Processing and Graphics, IEEE Transactions on Neural Networks.
6. Logic & Prolog Programming, Saroj Kaushik, New Age International

Reference books

1. Introduction to Artificial Intelligence, Shinji Araya, KYORITSU SHUPPAN, ISBN4-320-12116-3 (in Japanese)
2. New Artificial Intelligence (Fundamental), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13179 (in Japanese)
3. New Artificial Intelligence (Advanced), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13198-X (in Japanese)
4. Artificial Intelligence: a modern approach, S. Russell and P. Norvig, Prentice Hall, ISBN0-13-080302-2

Course Outcome:

After completion of this course, the learners will be able to

1. **Understand** the basic issues of knowledge representation, blind and heuristic search as well as other topics such as minimax, resolution, etc. that play an important role in AI programs.
2. **Inspect** of both the achievements of AI and the theory underlying those achievements.
3. **Apply** the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
4. **Assess** AI language including an ability to write simple to intermediate programs.
5. **Develop** the knowledge of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.

Name of the course	**Introduction to Deep Learning**
Course Code:PEC(CS)704C	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hrs./week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs./week	Other Assessment tools

		(Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To introduce some of the fundamental techniques and principles of neural networks.		
2.	To investigate some common models and their applications.		
3.	To emphasis on Deep Learning algorithms and applications.		
4.	To enable the students to know deep learning techniques to support real-time applications.		
Pre-Requisite			
1.	Machine Learning(PEC(CS) 603A)		
Unit	Content	Hrs	Marks
1	**Introduction to Learning:** Introduction to TensorFlow and Keras, Artificial Neural Networks (ANNs), Perceptron, Multi-Layer Perceptron (MLP), Back propagation, Training an MLP with TensorFlow/keras, Fine-Tuning Hyper-parameters, Hidden Layers, Neurons per Hidden Layer, Activation Functions.	10	
2	**Deep Learning Models:** Training Deep Neural Networks, Vanishing Gradients Problems, Batch Normalization, Reutilizing Pretrained Layers, Optimizers: AdaGrad, RMSProp, Adam Optimization, Escaping Over-fitting by means of Regularization.	6	
3	**Convolutional Neural Networks:** Convolutional Layers, Filters, Pooling strategies, CNN Architectures.	6	
4	**Recurrent Neural Networks:** Recurrent Neurons, Basic RNNs in TensorFlow, Training RNNs, Deep RNNs, LSTM, GRU.	5	
5	**Generative Adversarial Networks:** Autoencoders and GAN	4	
6	**Reinforcement Learning**: Introduction to OpenAI Gym, Markov Decision Processes, Q-Learning and Application.	5	

Text Book:

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition
2. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016
3. M. Nielsen, Neural Networks and Deep Learning, Determination Press, 2015
4. Artificial Intelligence: A Modern Approach, Stuart Russel& Peter Norvig, Pearson, 2009
5. Machine Learning: A probabilistic perspective, kevin P. Murphy
6. Pattern Recognition and Machine Learning, Chris Bishop
7. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman

References

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

Course Outcome:

After completion of this course, the learners will be able to

1. **Describe** the learning concepts in neural networks.
2. **Explain** basic concepts and techniques of Deep Learning.
3. **Design** deep learning models with tensorflow.
4. **Execute** neural networks to classification and recognition problems.
5. **Apply** various deep learning techniques to design efficient algorithms for real-world applications.

Name of the course		**Digital Image Processing**	
Course Code:PEC(CS)704D		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs./week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs./week		Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To understand an Image fundamentals and basic analytical methods to be used in image processing.		
2.	To build various Image enhancement and various restoration techniques		
3.	To develop various Image segmentation methods, Wavelet basedandmorphological Image Processing		
4.	To assess the performance of image processing algorithms and systems		
Pre-Requisite			
1.	Communication Engineering(ES-CS/IT-409)		
2.	Mathematics (BS-M-102, BS-M202)		
Unit	Content	Hrs	Marks
1	**Fundamentals of Image processing and Image Transforms: -** Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT)	7	
2	**Image Enhancement: -** Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.	10	
3	**Image Restoration: -** Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering	5	
4	**Image Segmentation: -** Segmentation concepts, point, line and	8	

	Edge detection, Global Processing (Hough Transform), Thresholding Techniques, Region based segmentation, Morphological processing- erosion and dilation.		
5	**Color Image Processing: -** Color Fundamentals, Color Model, Conversion of one color model to another, Pseudo color image processing, Full color image processing	6	

Text books:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. Chanda Bhabatosh, Majumder Dwijesh Dutta "Digital Image Processing and Analysis" Second Edition, PHI Learning Pvt. Ltd.,2011

Reference books

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. S. Jayaraman, S. Esakkirajan And T.Veerakumar , "Digital Image Processing" 3Ed, Tata McGraw - Hill Education Pvt. Ltd, 2010.
4. William K Pratt, "Digital Image Processing", John Willey, 2002.

Course Outcome:

After completion of this course, the learners will be able to

1. **Extrapolate** the basic elements and applications of image processing
2. **Identify** image sampling and quantization requirements and implications
3. **Design** and implement two-dimensional spatial and frequency filters for image enhancement
4. **Illustrate** restoration process (both time and frequency domain), image segmentation and morphological image processing.
5. **Manipulate** their knowledge by analyzing image processing problems including color images while recognizing and employing (or proposing) effective solutions

Name of the course	**Internet of Things**
Course Code: PEC(CS)705A	**Semester: 7th**
Duration: 6 month	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs/week	Mid Semester 2 Exam: 15 Marks
Practical: 0hrs/week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:			
1.	To understand the application areas of IOT .		
2.	To realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.		
3.	To understand building blocks of Internet of Things and characteristics.		
Pre-Requisite			
1.	Computer Networks [PC(CS/IT)617]		
Unit	Content	Hrs	Marks
1	**Introduction:** What is IoT,Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Physical design of IoT, Logical design of IoT, A simplified IoT Architecture.	7	
2	**Major components of IoT:** IoT enabling Technologies, Sources of IoT, M2M Communication, M2M Architecture, Difference between M2M and IoT,Data and Analytics for IoT,An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology.	8	
3	**Smart Objects: The "Things" in IoT:** Sensors,Actuators, and Smart Objects, Sensor Networks, Connecting Smart objects,Working Principles of sensors,Selection of Sensors for Practical Applications,Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.	7	
4	**IoT Physical Devices-Arduino Uno**: Introduction to Arduino, Different versions of Arduino, Features and applications of Arduino, Basic concept of integration of Sensors and Actuators with Arduino.	8	
5	**Recent trends in smart sensor for day to day life:** Evolving sensors and their architecture. Real world applications for IoT: Industrial IoT, Connected Vehicles, Smart Grid, Agriculture,Healthcare, Smart Cities and Smart Homes.	6	

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals:Networking Technologies, Protocols, and Use Cases for the Internet of Things".
2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017 .

Reference Books:

1. 1.Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing.
2. Jeeva Jose, Internet of Things, Khanna Publishing House.
3. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014. (ISBN: 978-8173719547)
4. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill
5. Education, 2017. (ISBN: 978-9352605224).

Course Outcome:

After completion of this course, the learners will be able to

1. **Define** the impact and challenges posed by IoT leading to new architectural models.
2. **Interpret** major components of IoT and the role of IoT protocols.
3. **Analyze** the deployment of smart objects and the technologies to connect them to network.
4. **Evaluate** the need for data analytics and security in IoT.
5. **Identify** different sensor technologies for sensing real world entities.

Name of the course	**Distributed Database**
Course Code: PEC(CS)705B	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory Contact Hrs.: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
TutorialContact Hrs.: 0 hrs./week	Mid Semester 2 Exam: 15 Marks
PracticalContact Hrs.: 0 hts./week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:	
1.	To understand the basic principles of distributed database systems and its architectures
2.	To evaluate the efficiency of distributed database design and the distributed query processing plans
3.	To handle different concurrency control anomalies and maintain there liability of distributed transactions

Pre-Requisite	
1.	Database Management System [PC(CS/IT)512]
2.	Computer Networks [PC(CS/IT)617]

Unit	Content	Hrs	Marks
1	**Introduction:** Concept of distributed data processing, basic idea of distributed database systems, homogenous, heterogeneous and federated database, distributed database storage- fragmentation, replication and allocation, global schema and local schema, key advantages of distributed database- layers distribution transparency- fragmentation and replication transparency, reliability through distributed transactions, improved performance, complications of distributed database systems, reference architecture for distributed DBMS- client/server, peer-to-peer, and multidatabase systems, global directory issues in distributed DBMS.	8	
2	**Distributed Database Design:** Design issues for distributed database, design alternatives for distributed database- non replicated and non-fragmented, fully replicated, partially replicated, top down approach of distributed database design, reasons for data fragmentation, primary and derived horizontal fragmentation, vertical fragmentation mixed or hybrid fragmentation, correctness	8	

	rules of fragmentation, data fragment allocation and its associated issues, bottom-up approach of distributed database design, view management- views in centralized and distributed database.		
3	**Distributed Query Processing And Optimization:** Basic concept, Query processing issues in distributed database, objectives of distributed query processing, different layers or phases of distributed query processing- query decomposition, data localization, global query optimization, distributed query execution, concept of distributed query optimization and its associated factors, distributed query optimization process and plans- operation, data and hybrid shipping, query trading, semi join based algorithms.	6	
4	**Distributed Transaction Management And Concurrency Control :** Concept of distributed transaction, goals of distributed transaction, distributed transaction processing issues, distributed concurrency control, concurrency control anomalies, distributed concurrency control algorithms- centralized 2PL, distributed 2PL, time stamp-based concurrency control algorithms- basic time stamp ordering, conservative time stamp ordering, mulit-version time stamp ordering.	6	
5	**Reliability And Availability Aspects Of Distributed Database Systems:** Concept of reliability and its main problem areas for distributed database systems, types of failures- transaction failures, site Failure, media failure, communication failure, mean time between failures/mean time to repair, idea of local recovery manager, distributed reliability protocols- centralized 2PC, distributed 2PC, termination protocol for 2PC- coordinator and participant timeout, non-blocking commit protocol, network partitioning- checkpointing and cold restarts, voting based protocol.	8	

Text books:

1. Stefano Ceri, GuiseppePelagatti, "Distributed Databases: Principles and Systems", McGraw Hill Education, Indian Edition, 2017.
2. M. Tamer Ozsu, Patrick Valduriez, "Principles of Distributed Database Systems", Springer, Third edition, 2011.

Reference Books:

1. Saeed K. Rahimi, Frank S. Haug, "Distributed Database Management Systems: A Practical Approach", Wiley-IEEE Computer Society, Aug, 2010, Print ISBN:9780470407455, Online ISBN:9780470602379, DOI:10.1002/9780470602379
2. Chhanda Ray, "Distributed Database Systems", Pearson Education India, 1st Edition, Kindle Edition, 2009, ISBN- 9788131727188, 8131727181.
3. Sachin Deshpande, "Distributed Databases", Dreamtech Press, Kindle Edition, 2014, ISBN 13: 9789351197201

Course Outcome:

After completion of this course, the learners will be able to

1. **Explain** the role of different components in a distributed database system and its architecture
2. **Evaluate** the design strategies of a distributed database system in terms of data storage and views
3. **Determine** the efficiency of different query processing plans for the distributed database systems
4. **Analyze** different concurrency control mechanisms or protocols related to distributed transaction management systems.
5. **Design** some effective protocols for maintaining the reliability aspect of distributed transactions.

Name of the course	**Computer Graphics**
Course Code: PEC(CS)705C	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hr/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:	
1.	Making the student understand how graphics created in computer world is the main goal of this course.
2.	Learning how to rescale, transmit and rotate different graphical objects is another goal.
3.	Using colors in different places and for different objects is also one of the goals of the course.
Pre-Requisite	

Unit	Content	Hrs	Marks
1	**Introduction to computer graphics & graphics systems:** Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.	6	
2	**Scan conversion:** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	6	
3	**2D transformation & viewing** : Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.	10	

4	**3D transformation & viewing:** 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.	8	
5	**Curves:** Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.	3	
6	**Hidden surfaces:** Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry.	3	

Text books:

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education

Reference books

1. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
2. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH

Course Outcome:

After completion of this course, the learners will be able to

1. **Understand** the technique to represent and prepared picture.
2. **Design** line, circle and ellipse drawing technique.
3. **Explain** translation and rotation technique of point and line.
4. **Understand** clipping technique.
5. **Design** carve drawing algorithm.

Name of the course	**Introduction to quantum computing**
Course Code: PEC(CS)705D	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hr/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:	
1.	To understand basic postulates of Quantum Mechanics & quantum state decomposition
2.	To assess various quantum information processing techniques and concepts

3.	To apply quantum algorithms to solve various simple problems.		
Pre-Requisite			
1.	Design and Analysis of Algorithms PC(CS/IT)406		
Unit	Content	Hrs	Marks
1	**Introduction to Hilbert space:** Linear space, Scalar product, Hilbert space, Self adjoint operator, Projection operator, Unitary operator.	4	
2	**Introduction to Quantum mechanics:** Postulates of quantum mechanics, Uncertainty principle, Complementary principle, Unitary Dynamics, Detail study of two-level system. Multipartite quantum system, Quantum entanglement	5	
3	**Quantum state decomposition**: Schmidt decomposition, Non-unique decomposition of mixed state, Hugston-Jozsa-Wooters theorem, No-Cloning Theorem, Distinguishing non-orthogonal quantum states, general quantum operations, Kraus representation theorem, various Quantum gates.	10	
4	**Quantum information processing**: Quantum teleportation, Quantum dense coding, Remote state preparation, Quantum key distribution (Bennett-Brassard{1984} Protocol)	5	
5	**Quantum computing**: Basic idea of quantum parallelism, Qubits, Some basic quantum algorithm, Deutschs algorithm, Deutsch-Jozsa algorithm, Simon's algorithm, Grover's search algorithm, Quantum Fourier Transform and Shor's factoring algorithm.	12	

Text books:

1. Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang,
2. Presskil Lecture notes http://www.theory.caltech.edu/~preskill/ph229/.Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin, The Mc Graw Hill

Reference books

1. An Introduction to Quantum. Computing, Phillip Kaye,. Raymond La amme, and Michele Mosca. Oxford U. Press, New York, 2007.
2. Quantum Computer Science, N. David Mermin, Cambridge University Press 2007.

Course Outcome:

After completion of this course, the learners will be able to

1. **Define** Hilbert space and operators.
2. **Explain** basic concepts of quantum mechanics
3. **Analyze** Quantum state decomposition
4. **Assess** fundamental quantum information processing concepts
5. **Design** quantum algorithms to solve some simple problems