FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: THIRD (C.B.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Code	Subject	Workload				Credit				Marks				
										Theory		Practical		Total Marks
		L	P	T	Total	L	P	T	Total	Sess.	Univ.	Sess.	Uni	
1 BE3S1T	Applied Mathematics	4	-	1	5	4	-	1	5	20	80	-	-	100
2 BE3S2T	Advance "C" & Programming Logic Design	4	-	1	5	4	-	1	5	20	80	-	-	100
3 BE3S2P	Advance "C" & Programming Logic Design lab	-	2	-	2	-	1	-	1	-	-	25	25	50
4 BE3S3T	Digital Circuits & Fund. of Microprocessor	4	-	1	5	4	-	1	5	20	80	-	-	100
5 BE3S3P	Digital Circuits & Fund. of Microprocessor lab	-	2	-	2	-	1	-	1	-	-	25	25	50
6 BE3S4T	Ethics in IT	3	-	1	4	3	-	1	4	20	80	-	-	100
7 BE3S5T	Computer Architecture and Organization	4	-	1	5	4	-	1	5	20	80	-	-	100
8 BE3S6P	Computer Workshop - 1 Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
9 BE3S7T	Environmental Engineering (Audit Course)	2	-	-	2	-	-	-	0	-	-	-	-	-
	Total	**21**	**6**	**5**	**32**	**19**	**3**	**5**	**27**	**100**	**400**	**75**	**75**	**650**

FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: FOURTH (C.B.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Sr. No.	Subject	Workload				Credit				Marks				
										Theory		Practical		Total Marks
		L	P	T	Total	L	P	T	Total	Sess	Univ.	Sess.	Uni	
1 BE4S1T	Discrete Mathematics & Graph Theory	3	-	1	4	3	-	1	4	20	80	-	-	100
2 BE4S2T	Data Structures & Program Design	4	-	1	5	4	-	1	5	20	80	-	-	100
3 BE4S2P	Data Structures & Program Design Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
4 BE4S3T	Operating System	4	-	1	5	4	-	1	5	20	80	-	-	100
5 BE4S3P	Operating System lab	-	2	-	2	-	1	-	1	-	-	25	25	50
6 BE4S4T	Theoretical Foundations of Computer Science	4	-	1	5	4	-	1	5	20	80	-	-	100
7 BE4S5T	System Programming	4	-	1	5	4	-	1	5	20	80	-	-	100
8 BE4S6	Computer Workshop -2 Lab	-	2	-	2	-	2	-	2	-	-	25	25	50
	Total	**19**	**6**	**5**	**30**	**19**	**4**	**5**	**28**	**100**	**400**	**75**	**75**	**650**

SYLLABUS: III SEMESTER (Computer Science and Engineering)

Syllabus for

Applied Mathematics- III (CS/CT)

Scheme (Theory: 4 hrs, Tutorial: 1hr.)

UNIT - I: LAPLACE TRANSFORM(12 Hrs)

Definition, Properties, Laplace Transform of Derivatives and Integrals, Evaluation of integrals by Laplace Transform, Inverse Laplace Transform and its Properties, Convolution theorem(Statement only), Laplace Transform of Periodic Functions(Statement only) and Unit Step Function, Applications of Laplace Transform to solve Ordinary Differential Equations, Simultaneous Differential Equations, Integral Equations &Integro-Differential Equations.

UNIT – II: FOURIER SERIES & FOURIER TRANSFORM(08 Hrs)

Periodic Functions and their Fourier Expansions, Even and Odd functions, Change of interval, Half Range Expansions.

Fourier Transform: Definition and Properties (excluding FFT), Fourier Integral Theorem, Relation with Laplace Transform, Applications of Fourier Transform to Solve Integral Equation.

UNIT – III: Z-TRANSFORM(08 Hrs)

Definition , Convergence of Z-transform and Properties, Inverse Z-transform by Partial Fraction Method, Residue Method (Inversion Integral Method) and Power Series Expansion, Convolution of two sequences. Solution of Difference Equation with Constant Coefficients by Z-transform method.

UNIT- IV: FUNCTIONS OF COMPLEX VARIABLE(12 Hrs)

Analytic Function, Cauchy- Riemann Conditions, Harmonic Functions (excluding orthogonal system), Milne-Thomson Method, Cauchy Integral Theorem & Integral Formula (Statement only), Taylor's & Laurent's series (Statement only), Zeros and Singularities of Analytic Function, Residue Theorem (Statement only), Contour Integration (Evaluation of real definite integral around unit circle and semi-circle).

UNIT –V: MATRICES(12 Hrs)

Linear and Orthogonal Transformations, Linear dependence of vectors, Characteristics equation, Eigen values and Eigen vectors, Statement and Verification of Cayley-Hamilton Theorem [without proof], Reduction to Diagonal form, Reduction of Quadratic form to Canonical form by Orthogonal Transformation, Sylvester's theorem[without proof], Solution of Second Order Linear Differential Equations with Constant Coefficients by Matrix method. Largest Eigen value and Eigen vector by Iteration method.

UNIT - VI: THEORY OF PROBABILITY(08 Hrs)

Axioms of Probability, Conditional Probability, Baye's Rule, Random variables: Discrete and Continuous random variables, Probability function and Distribution function, Mathematical Expectation, Variance, Standard Deviation, Moments, Moment generating function, Binomial, Poisson and Normal Distributions.

Text Books

1. Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
2. Advanced Engineering Mathematics by Erwin Kreysizig, 8th Edition, Wiley India
3. Applied Mathematics for Engineers & Physicist by L.R. Pipes and Harville
4. Theory & Problems of Probability and Statistics by M.R. Spiegal , Schaum Series, McGraw Hills

Reference Books

1. A Text Book of applied Mathematics, Volume II by P.N. Wartikar& J.N. Wartikar, Poona VidyarthiGrihaPrakashan
2. Introductory methods of Numerical Analysis by S.S. Sastry, PHI
3. Mathematics for Engineers by Chandrika Prasad
4. A text book of Engineering Mathematics by N. P. Bali & M. Goyal, Laxmi Publication.

BE3S2T: Advanced C Programming and Logic Design

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Practical) 1 hr (Tutorial)	5	100	20	80	100

Unit-I

Arrays: single dimensional arrays, two dimensional arrays, multidimensional arrays, variable length arrays. Array operations. Strings, single dimensional array of string, two dimensional

array of string, operations in "string.h". Structures: array of structures, passing structure to function, structure within structures. Unions, bit-fields, enumerations, sizeof, typedef.

Unit II

Introduction File handling,:-File structure, File handling function, File types, Streams, Text, Binary, File system basics, The file pointer, Opening a file, Closing a file, Writing a character, Reading a character, Using fopen(), getc(), putc(), and fclose(), Using feof(). Using fread() and fwrite(), Direct access file, fseek() and random access I/O, fprintf() and fscanf(), getting file name as Command line arguments.

Unit III

Pointers: pointers operators, pointer arithmetic, Pointers and function, Array of pointers, Pointer and Strings, Pointer to structure, Pointers within structure, Introduction of Static and Dynamic memory allocation, The process of Dynamic memory allocation, DMA functions Malloc() function, Sizeof() operator, Function free(), Function realloc()

Unit IV

Graphics: Graphics and Text mode, Video Adapter, Initialize Graphics Mode and resolution, header file graphics.h. Functions used In Graphics – Drawing a Point on Screen, Drawing – lines, rectangle, circles, arcs, polygon. Functions to fill colors. Display Text in Graphics mode, outtext(), outtextxy(), justifying text.
Advanced Graphics : various functions used for moving of graphical objects vizmoverel(), moveto(), putimage(), putpixel().

Unit V

Introduction to problem solving and programming : Basic model of computation, Notion of Algorithms, Principle of Mathematical Induction, Basics of functional programming, notion of types, Iterative versus recursive style, Correctness and efficiency issues in programming, time and space measures

Unit VI

Introduction to problem solving and programming: Basics of imperative style programming, Assertions and loop invariants, Top down design and examples of step-wise refinement, Programming using structures, introduction to encapsulation and object oriented programming.

Text Books

1. The C Programming Language : Dennis Ritchie & Brain Kernighan [Pearson]
2. Practical "C" Programming: Steve Oualline, O'Reilly Publications
3. Programming with C :K.R.Venugopal&S.R.Prasad [TMH]
3. How to solve it by Computer by R. J. Dromey, Prentice-Hall India EEE Series.

Reference Books

1. The Complete Reference C (4th Edition) : Herbert Schildt [TMH]
2. Structure and Interpretation of Computer Programs by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.

BE3S2P: Advance "C" & Programming Logic Design: Practical based on above syllabus

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	2	50	25	25	50

BE3S3T: Digital Circuits & Fundamental of Microprocessor

Load	Credit	Total marks	Sessional marks	University marks	Total
3 hrs (Practical) 1 hr (Tutorial)	4	100	20	80	100

Unit I:

Motivation for digital systems: Logic and Boolean algebra, Number Systems. Logic Gates & Truth Tables, Demorgan's law, Minimization of combinational circuits using Karnaugh maps upto five variable.

Unit II:

Design procedure: Multiplexers, Demultiplexer , Encoders ,Decoders ,Code Converters, Adders ,Subtractor (Half ,Full),BCD Adder/ Subtractor , ripple and carry look-ahead adder design and their advantages & drawbacks.

Unit III:

Storage elements, Flip-flops and latches: D, T, J/K, S/R flip-flops. Master Slave FF's Sequential circuit Analysis & Design, Input equations, state table, analysis with J-K Flip flops. Design procedure, designing with D & J-K Flip flop.

Unit IV:

Applications of Flip Flops: Registers & Shift registers. Counters, asynchronous and synchronous design using state and excitation tables. Conversion of one of type of F/F to another

Unit V:

Programmable logic Devices: Read only Memory ROM , PLA,PAL, Architecture of 8085 MP and its instruction set.

Unit VI:

Programming of 8085 and interrupt structure and timing diagrams of 8085 and overview of some advanced processors.

Text Books:

1. Digital Logic Design: *2nd edition by M. Mano*
2. Fundamental of Digital Electronics: *A. Anand Kumar*
3. Modern Digital Electronic: *4th edition by R.P.Jain*
4. 8 bit microprocessor & controller: *fifth edition – V.J.Vibhute*

Reference books:

1. Fundamental of Digital Electronics: *A. Anand Kumar*
2. Digital circuit & design: *A.P.Godse*
3. 8 bit Microprocessor: *Ramesh Gaonkar*

BE3S3P: Digital Circuits & Fundamental of Microprocessor: Practical based on above syllabus.

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	2	50	25	25	25

BE3S4T: Ethics in IT

Load	Credit	Total marks	Sessional marks	University marks	Total
3 hrs (Theory) 1 hr (Tutorial)	4	100	20	80	100

BE3S5T: Computer Architecture & Organization

Load	Credit	Total marks	Sessional marks	University marks	Total
3 hrs (Practical) 1 hr (Tutorial)	4	100	20	80	100

UNIT I

BASIC STRUCTURE OF COMPUTERS: Functional units, Von Neumann Architecture, Basic operational concepts, Bus structures Addressing modes, Subroutines: parameter passing, Instruction formats: Three- address Instructions, Two-address instructions, One- address instructions, Zero-address instructions.

BASIC PROCESSING UNIT: Bus architecture, Execution of a complete instruction, sequencing of control signals, Hardwired control, Micro-programmed Control, microinstruction format.

UNIT II

ARITHMETIC: Number representations and their operations, Addition and Subtraction with signed-magnitude, Design of Fast Adders, Array multiplier, Signed multiplication: Booth's Algorithm, Bit-pair recoding, Integer Division, Floating-point Arithmetic operations, guard bits and rounding.

UNIT III

THE MEMORY SYSTEM: Various technologies used in memory design, higher order memory design, Memory hierarchy, Main memory, Auxiliary memory, Cache memory, cache optimization techniques ,Memory interleaving, Virtual memory, Address Space and Memory Space, Associative memory, Page table, Page Replacement

UNIT IV

INPUT/OUTPUT ORGANIZATION: I/O mapped I/O and memory mapped I/O, Interrupts and Interrupts handling mechanisms, vectored interrupts, Synchronous vs. Asynchronous data transfer, Direct Memory Access COMPUTER PERIPHERALS: I/O devices such as magnetic disk, magnetic tape, CD-ROM systems.

UNIT V

RISC philosophy, pipelining, basic concepts in pipelining, delayed branch, branch prediction, data dependency, influence of pipelining on instruction set design, multiple execution units, performance considerations,

UNIT VI. Introduction to multiprocessors:

Basic concepts in parallel processing, classification of parallel architectures. Vector Processing, Array Processor, Literature review of multi-core architecture

BOOKS:

- V.C.Hamacher,Z.G.Vranesic and S.G.Zaky, Computer Organisation, McGraw Hill,5th ed,2002.
- Computer Organization, Design and Architecture (IV Ed), Sajjan G. Shiva, CRC Press
- Computer Architecture & Organization III Ed- J.P.Hayes.

REFERENCES BOOKS:

- M Mano,"Computer System and Architecture", PHI, 1993.
- W. Stallings, "Computer Organization & Architecture", PHI, 2001.

BE3S6: COMPUTER WORKSHOP LAB

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	2	50	25	25	50

Unit I:

Basic concepts of HTML: HTML, Web Pages, World Wide Web, Tags in HTML, HTML As a Markup Language, HTML as a Page Formatting Tool, Structure of an HTML Page, Commands Written In Notepad, the <H> TAG, the basic tags, the <P> TAG, The <PRE>Tag**The text attributes**: The <marquee> tag, Example of Text Styles, the images, the list tag: Ordered List, Unordered List, Nested List **The links**: Links between Two Pages, Links in the Same Page, Images as Links, Attributes of Links, the basic web page, **other formatting tags**: sounds and videos, comments, the <XMP> tag, special characters

Unit II:

The tables: The Table, The Rows, The Columns, Cellspacing, Cellpadding, Alignment of the Text Present inside the Cells, Alignment of Table, Border Attributes in the Table, Merging Of Rows and Columns, Colspan, Rowspan, Table within a Table, Empty Cells inside the Table, Links in the Table, **the frames**: Frames with Column Arrangement, Column Size for Frames, Row Size for Frames, Frame Spacing, Margin Width and Height in Frames,

Unit I:

The forms: The<input> Tag, The <textarea></textarea> Tag, The Dropdown List, The Normal List, HTML 5: New Markup Elements of HTML5, Basic Tags, Images, List and Links, Tables and Forms, Audio and Video, Canvas, XHTML, and CSS, design and deploy a web site

Unit IV:

VB script: Introduction to vbscript, Printing Text Using vbscript, Alert / msgbox in vbscript, Variables in vbscript, Arrays in vbscript, Conditional Statements, Looping Statements, Procedures , Events

Unit V:

Java script: Variables , Array, Comments, Operators, Conditional Statements, Looping Statements,

Unit VI:

Working under UNIX /LINUX Operating Systems:

a) Structure: Unix Architecture
b) Features of UNIX operating system
c) Layered model of UNIX operating system (study of kernel and Shell)
d) General file commands and Directory commands
e) File structure and Directory structure

Text Book:

1. **HTML Programming, Freeman and Robson, Oreilly publications**

BE3S7T: Environmental Engineering

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Theory)	0				

SYLLABUS IV SEMESTER (Computer Science & Engineering)

PROPOSED SYLLABUS FOR
DISCRETE MATHEMATICS AND GRAPH THEORY
BE IV Semester (CS/CT/CE/IT)
Scheme (Theory: 4 hrs. & Tutorial:1 hr.)

UNIT-I: Mathematical Logic and Set Theory (08 Hrs)
Propositions and Logical Operations, Quantifiers, Conditional Statements and Tautologies, Methods of Proof, Principle of Mathematical Induction. Basic concepts of set theory, Operations on Sets, The power set.

UNIT-II: Relations and Functions (12 Hrs)
Relations: Ordered pairs and n-tuples, Product Sets and Partitions, Relations and Digraphs, Matrix of Relation, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations & Partitions, Compatible Relation, Manipulation of Relations, Composition of Relations, Transitive Closure of a relation, Partial order relation, Partially ordered set, Hasse Diagrams. **Functions**: Definition, Composition of functions, Types of Functions, Invertible Function, Permutation Function, Characteristics function of a set with Theorems.

UNIT-III: Group Theory (12 Hrs)
Binary Operations, Properties, Semigroups, Monoids,Subsemigroup,Submonoid, Isomorphism & Homomorphism, , Groups (only definitions and examples) Subgroups and Homomorphism, Cosets and Lagrange's Theorem, Normal subgroups.

Unit- IV:Rings, Lattices & Boolean Algebra(10 Hrs)

Rings, Fields, Integral Domain, Ring Homomorphism (definitions & examples), Lattices: Properties, Types of Lattices, Sub lattices, Isomorphic Lattices, Complemented & Modular Lattices (definitions & examples), Boolean Algebra: Definition, Properties, Simplification of Switching Circuits.

Unit-V: Graph Theory (12 Hrs)

Basic concepts of Graph Theory, Digraphs, Basic definitions, Paths and Circuits, Reachability and Connectedness, Matrix representation of graphs, Subgraphs& Quotient Graphs, Isomorphic digraphs & Transitive Closure digraph, Euler's Path & Circuit (only definitions and examples). Trees, Binary Tree, Labeled Trees, Undirected Trees, Spanning Trees of Connected Relations, Prim's Algorithm to

construct Spanning Trees, Weighted Graphs, Minimal Spanning Trees by Prim's Algorithm &Kruskal's Algorithm.

Unit-VI: Combinatorics(06 Hrs)

Generating Functions, Recurrence Relations, Counting: Permutations & Combinations, Pigeonhole Principle with Simple Applications.

Text Books

1. Discrete Mathematical Structures(3rd Edition) by Kolman, Busby & Ross PHI.
2. Discrete Mathematical Structures with Applications to Computer Science by Tremblay &Manohar, Tata McGraw- Hill.
3. Combinatorial Mathematics, C.L. Liu (McGraw Hill)

Reference Books

1. Discrete Maths for Computer Scientists & Mathematicians by Mott, Kandel, Baker.
2. Elements of Discrete Mathematics by C. L. Liu.
3. Discrete Mathematics by Lipschutz.
4. Discrete Mathematics by R.Johnsonbaugh.
5. Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication

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BE4S2T: Data Structures & Program Design

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT I

Introduction to algorithm, Time and space analysis of algorithms, Big oh and theta notations and omega notations, Average, best and worst case analysis, linear and binary search, selection sort,

insertion sort, bubble sort, shell sort, Radix sort. Abstract data structure as an organization of data with specified properties and operations, General concepts of data structures. Representation of Arrays -Single and Multi dimensional.

UNIT II

List: - representation of ordered list using array and operation on it, sparse matrix, polynomial, Linked Lists, Simply linked list, Implementation of linked list using static and dynamic memory allocation, operations on linked list, polynomial representations and manipulations are using linked list, circular linked list, doubly linked list, Generalized list

UNIT III

Stack & Queue: Representation of Stack & queue using array and linked list, , Application of stacks, Conversion from infix to post fix and pre-fix expressions, Evaluation of postfix expression using stacks, Multiple stacks, Circular queues, Priority Queues, Dequeue.

UNIT IV

Trees: General and binary trees, Representations and traversals, Threaded Binary Trees, Binary search trees, Applications, The concept of balancing and its advantages, B-Trees, B+ Trees, AVL Trees.

UNIT V

Graphs and digraphs: Representations, Breadth and depth first searches, connected component, spanning trees, shortest path–single source & all pairs , activity networks, topological sort, Hamiltonian path.

UNIT VI

Symbol Tables: static tree tables, dynamic tree tables, hash tables, hash functions, Collision resolution, overflow handling, Applications

Textbooks:

- Data Structures using C and C++ by Y. Langsam, Pearson Education
- Algorithms in a Nutshell, George H & Garry, O'reilly Publication
- Data Structures using C by Tanenbaum, Pearson Education
- S. Sahani, Data Structures in C,
- Data structures -Robert Kse

BE4S2P: Data Structures & Program Design Lab: Practical will be based on above syllabus

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	2	50	25	25	50

BE4S3T: Operating Systems

Load	Credit	Total marks	Sessional marks	University marks	Total
3 hrs (Theory) 1 hr (Tutorial)	4	100	20	80	100

UNIT-I

Introduction: Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.

UNIT-II

File systems: File concept, Access methods, Disk space management and space allocation strategies, directory structures, Recovery, Log-structured File System, disk arm scheduling strategies.

UNIT-III

Scheduling: Process concept, process control block, Types of scheduler, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms, examples from WINDOWS 2000 & LINUX.

UNIT-IV

Memory management: Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging , page faults and instruction restart , page replacement algorithms , working sets , Locality, Thrashing,Garbage Collection .

UNIT-V

Process cooperation and synchronization: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems.

UNIT-VI

Deadlocks & Protection: Deadlock definition, Prevention, Avoidance, Detection and recovery, Goals of Protection, access matrix, implementation, Security problem.

BOOKS:

- Operating System concepts – Silberchatz& Galvin, Addison Wesley, 6th Edn.
- Modern Operating Systems – Tanenbaum, Pearson Edn. 2nd edn
- Operating Systems – A.Godbole: TMH Pubilcations

Reference Books:

- Operating System –Milan Milenkovik
- Operating Systems, 3rd Edition by Gary Nutt, Pearson Education

BE4S3T: Operating Systems Lab: Practical will be based on above syllabus

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	2	50	25	25	50

BE4S4T: Theoretical Foundations of Computer Sciences

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT 1

Mathematical preliminaries – Sets, operations, relations, strings, closure of relation, countabilityanddiagonalization, induction and proof methods- pigeon-hole principle ,concept of language, formal grammars, Chomsky hierarchy.

UNIT 2

Finite Automaton, regular languages, deterministic & non deterministic finite automata, E-closures, minimization of automata, equivalence, Moore and Mealy machine.

UNIT 3

Regular expression, identities, Regular grammar, right linear, left linear, Arden theorem, Pumping lemma for regular sets, closure & decision properties for regular sets, Context free languages, parse trees and ambiguity, reduction of CFGS, Normal forms for CFG .

UNIT 4

Push down Automata (PDA), non-determinism, acceptance by two methods and their equivalence, conversion of PDA to CFG, CFG to PDAs, closure and decision properties of CFLs, pumping lemma for CFL

UNIT 5

Turing machines, TM as acceptor, TM as transducers, Variations of TM, linear bounded automata, TM as computer of function.

UNIT 6

Recursively enumerable (r.e.) set, recursive sets, Decidability and solvability, Post correspondence Problem (PCP), Introduction to recursive function theory, primitive recursive functions, Ackerman function

Text Books:

- Introduction Of Automata Theory, Languages and computation- Hopcroft, Motwani&Ulman
- Introduction to formal languages and automata – Peter Linz.
- Introduction to Theory of Computation –Michael Sipser.

Reference Books:

- Theory Of Computer Science –Mishra and Chandrashekharan,
- Theory Of Computation –John C. Martin

BE4S5T: SYSTEM PROGRAMMING

Load	Credit	Total marks	Sessional marks	University marks	Total
3 hrs (Theory) 1 hr (Tutorial)	4	100	20	80	100

UNIT 1:

IBM 360/370 & Assembler – Introduction to System Programming & its components, M/c Architecture, Instruction Formats, Data Formats & Register Formats, Concept of assembler, design of single pass and two pass assembler.

UNIT 2:

Macroprocessor – Concept of macro, macro call within macro, macro definition within macro, recursive macro calls, design of macro processor.

UNIT 3:

Linker and Loader – Concept of static and dynamic relocation, external symbols, design of linker, design of object file for different loading schemes.

UNIT 4:

Common Object files format & System Utilities – Structure of object file and executable file, section or segment headers, symbol table, concept of storage class, string, various data types, line insert, character, arrays structures. Source code control system), make, link editor, symbolic debugger, GNU debugger.

UNIT 5:

Unix Device Drivers – Definition, Anatomy and Types, Device programming, Installation, Incorporation of driver routines, Basic device operation, Implementation with Line Printer, Comparative study between device drivers for UNIX & Windows.

UNIT 6:

Compiler – Phases of Compilers, Overview of Databases and Algorithms required for all phases. Role of lexical analyzer, recognition of tokens, Study of LEX & YACC.

Text Books:

1. System Programming- J. J. Donovan, Tata McGraw-Hill Education.
2. UNIX Device Drivers- George Pajari, Pearson Education.
3. UNIX system Utilities manual.
4. UNIX programming Tools LEX and YACC –Levine, Mason and Brown, O'Reilly.

Reference Books:

1. System Programming and Operating systems- D. M. Dhamdhere, Tata McGraw-Hill Education.
2. UNIX programming Environment- Keringham and Pike, PHI.
3. System Software: An introduction to systems programming- Leland L. Beck, Pearson Education.
4. Principles of Compiler Design-Aho and Ullman, Pearson Education.

BE4S6: COMPUTER WORKSHOP – 2 LAB

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	2	50	25	25	50

The contents will be based on LINUX and LINUX Administration. The contents can be revised as per the current trends in Software Industry.

FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: FIFTH (C.B.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Sr. No.	Subject	Workload				Credit				Marks				
										Theory		Practical		Total Marks
		L	P	T	Total	L	P	T	Total	Sess.	Univ.	Sess.	Uni	
1 BECSE301T	Data Communication	3	-	1	4	3	-	1	4	20	80	-	-	100
2 BECSE302T	Object Oriented Programming	4	-	1	5	4	-	1	5	20	80	-	-	100
3 BECSE302P	Object Oriented Programming Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
4 BECSE303T	Database Management System	4	-	1	5	4	-	1	5	20	80	-	-	100
5 BECSE303P	Database Management System Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
6 BECSE304T	Computer Graphics	4	-	1	5	4	-	1	5	20	80	-	-	100
7 BECSE305T	Design & Analysis of Algorithms	4	-	1	5	4	-	1	5	20	80	-	-	100
8 BECSE305P	Design & Analysis of Algorithms lab	-	2	-	2	-	1	-	1	-	-	25	25	50
	Total	**19**	**6**	**5**	**30**	**19**	**3**	**5**	**27**	**100**	**400**	**75**	**75**	**650**

FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: SIXTH (C.B.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Sr. No.	Subject	Workload				Credit				Marks				
										Theory		Practical		Total Marks
		L	P	T	Total	L	P	T	Total	Sess.	Univ.	Sess.	Uni	
1 BECSE306T	Artificial Intelligence	4	-	1	5	4	-	1	5	20	80	-	-	100
2 BECSE307T	Design Patterns	4	-	1	5	4	-	1	5	20	80	-	-	100
3 BECSE307P	Design Patterns lab	-	2	-	2	-	1	-	1	-	-	25	25	50
4 BECSE308T	Software Engineering & Project Management	4	-	1	5	4	-	1	5	20	80	-	-	100
5 BECSE309T	Computer Networks	4	-	1	5	4	-	1	5	20	80	-	-	100
6 BECSE309P	Computer Networks Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
7 BECSE310T	Functional English	2	-	1	3	2	-	1	3	10	40	-	-	50
8 BECSE311P	Mini Project	-	2	-	2	-	2	-	2	-	-	25	25	50
	Total	**18**	**6**	**5**	**29**	**18**	**4**	**5**	**27**	**90**	**360**	**75**	**75**	**600**

SYLLABUS: V SEMESTER (Computer Science and Engineering) (C.B.S.)

BECSE301T: Data Communication

Load	Credit	Total marks	Sessional marks	University marks	Total
3 hrs (Theory) 1 hr (Tutorial)	4	100	20	80	100

UNIT - 1

Analog and digital signals; periodic and non periodic signals analog signals time and frequency domains; COMPOSITE SIGNALS: Frequency spectrum and Bandwidth; TRANSMISSION MODES: Serial and Parallel transmission, Asynchronous and Synchronous Transmission, Simplex, Half-Duplex and Full-Duplex communication.

UNIT - 2

Signal conversions: digital-to-digital conversion, digital-to-analog conversion, analog to digital conversion, analog-to-analog conversion in detail, Basics of Image and Video Compression.

UNIT - 3

COMMUNICATION MEDIA: guided media and unguided media, Radio frequency allocation, Propagation of Radio waves, Terrestrial microwave, Satellite communication, Cellular Telephony

UNIT - 4

Multiplexing and Spread Spectrum, frequency division multiplexing (FDM). Time division multiplexing (TDM): inverse multiplexing, wave-division multiplexing, FHSS AND DSSS multiplexing applications: the telephone system: Common carrier services and hierarchies, Analog services, Digital Services; DIGTAL SUBCRIBER LINE (DSL): ADSL, RADSL, HSDL, SDSL,VDSL

UNIT - 5

Introduction to Image and Video Compression

ImageCompression, JPEG, MPEG compression techniques

Digitizing Audio and Video data representation formats, Compression of Audio and Video files. Comparison of various methods of compression.

UNIT – 6

Image and Video Compression Techniques

Huffman code, Run-Length Encoding, Relative Encoding, Lempel-Ziv Encoding, Real Time Interactive Audio/Video, RTP, HTTP and WWW.

Text / Reference Books:

1. Data Communications and Networking by Behrouz A. Forouzan, 4thEdition, Tata McGraw Hill
2. Packet guide to core network protocol by Bruce Hartpence, Oreilly
3. Understanding Data Communications and Networks by William A. Shay, 2nd Edition, Vikas Publishing House.

4Electronic Communication Systems by Kennedy

BECSE302T: Object Oriented Programming

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: OOP concept, Procedural vs OOP programming, OOP terminology and features(data encapsulation, inheritance, polymorphism and late binding), Tokens, Character set, Keywords, Data-types, Data Types declarations, Constants and variables, expressions, Standard Library and header files. Objects & Classes in C++: Declaring & using classes, Constructors, Objects as functions arguments, Copy Constructor, Static class data. Arrays of objects, C++ String
class.

Unit II: Operator overloading: Overloading unary & binary operators. Data conversion. Pitfalls of operator overloading. Pointers & arrays. Pointers & functions. New& delete operators. Pointers for objects.

Unit III: Inheritance in C++: Derived class & base class, Derived class constructors, Function overloading, class hierarchies, Public and private inheritance, Multiple inheritance. containership: classes within classes.

Unit IV: Virtual functions concepts, Abstracts classes & pure virtual functions. Virtual base classes, Friend functions, Static functions, Assignment and copy initialization, the this pointer. Dynamic type information.

Unit V: Streams & Files in C++: Stream classes, stream errors, disk file I/O with streams, File pointers, Error handling in file I/O. File I/O with members functions, overloading the extractions & insertion operators, Memory as a stream object, command-line arguments, Persistent Objects

Unit VI: Function Template, Class templates, Exception syntax, Multiple exceptions, exception with arguments. Introduction to the Standard Template Library. Algorithms, Sequential Containers, Iterates, Specialized iterates, Associative containers. Function objects.

1. C++: The Complete Reference, by Herbert Schildt4th edition Mc-Graw-Hill
2. Object-Oriented Programming in C++ by Robert Lafore 4th edition Pearson Education
3. The C++ Programming Language by BjarneStroustrupe 3rd edition Pearson Education

Reference books:

1. Object Oriented Programming in C++ by Subhash K U Pearson Education
2. Mastering C++ by K R Venugopal Tata Mc-Graw-Hill Education

BECSE302P: Object Oriented Programming: Practical based on above syllabus using C++

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	25

Some practicals can be conducted on core JAVA

BECSE303T: Database Management System

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Syllabus

UNIT-I

General introduction to database systems, Database-DBMS distinction, Approaches to building a database, Data models, Three-schema architecture of a database, Challenges in building a DBMS, Various components of a DBMS, E/R Data model. SQL, PL/SQL Concept

UNIT-II

Relational Data Model**,** Concept of relations, Schema-instance distinction, Keys, referential integrity and foreign keys, Relational algebra operators, Tuple relation calculus, Domain relational calculus.

UNIT-III

Physical and logical hierarchy. Concept of index, B-trees, hash index, function index, bitmap index. Concepts of Functional dependency, Normalization, Business data analysis, tools & techniques for business data analysis.

UNIT-IV

Overview: Query Processing and Optimization, measures of query cost estimation in query optimization, pipelining and Materialization, Structure of query evaluation plans.

UNIT-V

Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation, Intent locking

UNIT-VI

Recovery System: failure classification, recovery and atomicity, log based recovery, checkpoints, buffer management, advanced recovery techniques. Introduction to Web databases, distributed databases, data warehousing and data mining, Data Security.

TextBooks:

1. Database System Concepts by AviSilberschatz , Henry F. Korth , S. Sudarshan, Tata McGraw Hill, Fifth Edition
2. Fundamentals of Database Systems – Elmasiri and Navathe, Addison Wesley, 2000.
3. An introduction to Database Systems,C J Date,A.Kannan,S.Swamynathan –Eight Edition

Reference Books:

1. Database Management Systems - by Raghu Ramakrishnan and Johannes Gehrke, Tata McGraw Hill Publication, Third Edition
2. Introduction to Database Management Systems by Kahate

BECSE303P: Database Management System: Practical based on above syllabus.

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	25

Some Practicals can be based on following OPEN SOURCES:

1. **Informatica**
2. **Micro Strategy**
3. **ETL**
4. **HADOOP Technology**

BECSE304T: Computer Graphics

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT I

Introduction to Computer Graphics

Overview of Computer Graphics, Computer Graphics Application and Software, Graphics Areas, Graphics Pipeline, Graphics API's, Numerical issues, Efficiency Display and Hardcopy Technologies, Display Technologies – Raster scan Display System, Video Controller – Vector scan display system, Random Scan Display Processor, Input Devices for Operator Interaction, Image Scanners

UNIT II

Basic Raster Graphics Algorithms for Drawing 2D primitives, aliasing and ant aliasing, Polygon filling methods: Scan Conversion Algorithms: Simple Ordered edge list, Edge Fill, Fence fill and Edge Flag Algorithm. ,Seed fill Algorithms: Simple and Scan Line Seed Fill Algorithm, Halftoning techniques

UNIT III

Graphics Programming using OPENGL: Why OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL – GL, GLU & GLUT, 3D viewing pipeline, viewing matrix specifications, a few examples and demos of OpenGL programs, Amimations in openGL

UNIT IV

2D Clipping algorithms for regular and irregular windows: Sutherland Cohen Outcode, Sutherland Cohen Subdivision, Mid-Point subdivision, Cyrus Beck and Sutherland Hodgman, Cohen-Sutherland Polygon clipping Algorithm. Clipping about Concave regions.

2D Transformations, Translation, Rotation, Reflection, Scaling, Shearing Combined Transformation, Rotation and Reflection about an Arbitrary Line

UNIT V

Normalized Device Coordinates and Viewing Transformations, 3D System Basics and 3D Transformations, 3D graphics projections, parallel, perspective, viewing transformations. 3D graphics hidden surfaces and line removal, painter's algorithm, Z -buffers, Warnock's algorithm.

UNIT VI

Basic Ray tracing Algorithm, Perspective, Computing Viewing Rays, Ray-Object Intersection Shading, A Ray tracing Program, Shadows, Ideal Specular Reflection.

Curves and Surfaces: Polygon Mesh, Parametric Cubic Curves, Parametric Bicubic Surfaces, Quadratic Surface, Bezier Curves and B-spline curves.

Text Books:

1. Fundamentals of Computer Graphics, Peter Shirley and Steve Marschner, Third Edition.(A.K.Peters Publication house)
2. Procedural Elements of Computer Graphics III Edition, Rogers, McGraw Hill.
3. Computer Graphics - Principles and Practice, J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Second Edition in C, Pearson Education.
4. Computer Graphics with OpenGL, Donald D. Hearn, M. Pauline Baker, Warren Carithers, Fourth Edition, Pearson Education.
5. Computer Graphics, Hearn and Baker, PHI, India

BECSE305T: Design & Analysis of Algorithms

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT-I

Mathematical foundations, summation of arithmetic and geometric series, n, n^2, bounding summations using integration, Recursion and Induction: recurrence relations, solutions of recurrence relations using techniques of characteristic equation, generating functions, master method and substitution method.Complexity calculation of various standard functions, principles of designing algorithms.

UNIT-II

Asymptotic notations of analysis of algorithms, analyzing control structures, worst case and average case analysis, amortized analysis, application of amortized analysis, Sorting networks, comparison networks, bio-tonic sorting network, advanced data structures like Fibonacci heap, disjoint set representation

UNIT-III

Divide and conquer basic strategy, binary search, quick sort, merge sort, matrix operations, Multiplication Algorithm Greedy method – basic strategy, Knapsack Problem, application to job sequencing with deadlines problem, minimum cost spanning trees, single source shortest path, Optimal Search Patterns.

UNIT-IV

Dynamic Programming basic strategy, multistage graphs, all pairs shortest path, single source shortest paths, optimal binary search trees, traveling salesman problem, Longest Common Subsequence problem, 0/1 Knapsack Problem, Chained Matrix Multiplication

UNIT-V

Basic Traversal and Search Techniques, breadth first search and depth first search, connected components. Backtracking basic strategy, 8-Queen's problem, graph coloring, Hamiltonian cycles etc, Introduction to Approximation algorithm.

UNIT-VI

NP-hard and NP-complete problems, basic concepts, non-deterministic algorithms, NP-hard and NP-complete, decision and optimization problems, graph based problems on NP Principle.

Text Books:

1. Introduction to Algorithms, Thomas H. Cormen et.al. Prentice Hall of India.
2. Design & Analysis of Algorithms, Horowitz Sahani, University Press.
3. The Design and Analysis of Algorithms Alfred V. Aho, John E. Hopcraft, Jeffrey D. Ullman, Pearson Publication.

BECSE305P: Design & Analysis of Algorithms lab: Practical will be based on above syllabus

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	50

Practicals based on C, C++ or Java

4.

SYLLABUS: VI SEMESTER (Computer Science and Engineering) (C.B.S.)

BECSE306T:**Artificial Intelligence**

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT - I:

Introduction: What is AI? History & Applications, Artificial intelligence as representation & Search, Production system, Basics of problem solving: problem representation paradigms, defining problem as a state space representation, Characteristics.

UNIT - II:

Search Techniques: Uninformed Search techniques, InformedHeuristic Based Search, Generate and test, Hill-climbing, Best-First Search, Problem Reduction, and Constraint Satisfaction.

UNIT - III:

Knowledge representation: Knowledge representation Issues: First order logic, Predicate Logic, Structured Knowledge Representation: Backward Chaining , Backward Chaining , Resolution ,Semantic Nets, Frames, and Scripts, Ontology.

UNIT - IV:

Uncertainty: Handing uncertain knowledge, rational decisions, basics of probability, axioms of probability, Baye's Rule and conditional independence , Bayesian networks , Exact and Approximate inference in Bayesian Networks, Fuzzy Logic .

UNIT - V:

Learning: What is learning?, Knowledge and learning, Learning in Problem Solving, Learning from example, learning probabilistic models, Formal Learning Theory

UNIT - VI:

Expert Systems: Fundamental blocks, Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Automated Reasoning, Understanding Natural language

Text Books:

1. E.Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 2008.
2. Artificial intelligence and soft computing for beginners by Anandita Das Bhattachargee, Shroff Publishers
3. Artificial Intelligence – A Practical Approach : Patterson , Tata McGraw Hill, 3rd Edition

Reference Books:

1. Introduction to Artificial Intelligence – Charniak (Pearson Education)

BECSE307T: Design Patterns

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Practical) 1 hr (Tutorial)	5	100	20	80	100

UNIT – 1

Introduction to Design Patterns and Observer Pattern:Basics of Design patterns, Description of design patterns, Catalog and organization of catalog, design patterns to solve design problems, selection of design pattern, Use of design patterns.

UNIT - 2

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Creational Patterns

UNIT - 3

Structural Pattern:Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy, Discussion of Structural Patterns

UNIT - 4

Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns

UNIT – 5

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation, Summary

UNIT – 6

Complexity Analysis of Design Patterns, Methods to analyze the complexity of design patterns, Implementation techniques and applications of design pattern in game design, product design,

TextBooks:

1. Head First Design Patterns, by Eric Freeman and Elisabeth Freeman
2. Design Patterns Explained, by Shalloway and Trott

Reference Books

3. Introduction to design Patterns in C++ with Qt by Alan Ezust, Paul Ezust

BECSE307P: Design PatternsLab : Practical based on above syllabus using JAVA or .net

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	50

BECSE309T:Software Engineering & Project Management

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT – I

Introduction: Software Characteristics, Software Engineering- A Layered Technology, Software Process Framework, Software Process Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Process Model, Agile Process Models.

UNIT – II

Software engineering Principles and Practice : Communication Practices, Planning Practices, Modeling Practices, Construction Practice & Deployment, System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling, Requirements Engineering.

UNIT – III

System Analysis: Structured Analysis, Data modeling,Object-Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, Class-based Modeling, Behavioral Model, Design Concepts : Abstraction , Pattern modularity, Information hiding, Design classes, Refactoring.

UNIT – IV

Software Testing: Testing Fundamentals, Black-Box Testing, White-Box Testing, Unit Testing, Integration Testing, Validation Testing, System Testing, Debugging.

UNIT – V

Quality Management: Product Metrics, Metrics for Analysis & Design Models, Metrics for Source Code, Metrics for Testing & Maintenance. Quality concepts, Evolution of Quality Management, Quality assurance, Software reviews, Statistical quality assurance.

UNIT – VI

Project management : Introduction to Software Project Management, Project Planning, Project scheduling, Risk management , Change Management, Software reengineering, Restructuring Reverse engineering, Forward Engineering

Text Books:

1. Software Engineering-A Practitioner's Approach (Sixth Edition)-Roger Pressman (TMH)
2. Software Engineering (Ninth Edition)-Ian Summerville (Pearson Education)
3. Software Engineering: Theory and Practice (Fourth Edition – Pfleeger
4. Software Engineering- Mishra /Mohanty (Pearson Education)

Reference Books:

1. Software Engineering-Schaum's Series (TMH)
2. Software Project Management - Sanjay Mohapatra (Cengage Learning)
3. Quantitive techniques in project management byRettyvellayudam

BECSE310T: Computer Networks

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

UNIT-I

Introduction to computer Networks, direction of data flow (simplex,Half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, internet today; Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

UNIT-II

Physical Layer: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;

UNIT-III

Point to point protocol, LCP, NCP, FDDI, token bus, token ring; Reservation, polling, concentration; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, fastEthernet;

UNIT-IV

Routing : techniques, static vs. dynamic routing , routing table for classful address;Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing, Mobile routing basic algorithms.

UNIT-V

Protocols: ARP,RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols. Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets. Congestion control protocols.

UNIT-VI

Process to process delivery; UDP; TCP; Quality of service: techniques to improve Qos.ISDN services &ATM; DSL technology, Cable modem, Sonet.Wireless LAN: IEEE 802.11; Introduction to blue-tooth, VLAN's, Cellular telephony & Satellite network.

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 (8th Ed.)" – PHI/ Pearson Education

Reference Books:

1. Kurose and Rose – "Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Introduction to Data Communications and Networking by Wayne Tomasi-Pearson Edition
3. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

BECSE310P: Computer Networks: Practical
based on above syllabus.

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	25

Practicals based on tools

1. **Omnet**
2. **Castella**

And JAVA, J2EE

R.T.M.N.U Nagpur

Syllabus of B.E 6th Semester,

Computer Science Engineering

BECSE310T **Functional English**

Sr. No.	Subject Code	Subject	Workload				Credit				Marks				
											Theory		Practical		
			Lecture	Practical	Tutorial	Total Hrs/Week	Lecture	Practical	Tutorial	Total	Sessional	University	Sessional	University	Total Marks
1	BECSE310T	Functional English	2	-	1	3	2	-	1	3	10	40	-	-	50

Syllabus:

Unit 1. Functional Grammar: (4 Hours) (3+3+4=10)

Common errors , Transformation of Sentences, Phrases, Idioms & Proverbs. [50 sentences of common errors, 50 examples of Transformation of Sentences, (5 each type), 50 noun/prepositional phrases, 50 idioms/proverbs)

Unit II. English for Competitive Exams & Interview Techniques: (6 Hours) (3+3+4=10)

IPA (vowel & consonant phonemes), Word building [English words /phrases derived from other languages), Technical Jargons, Synonyms/Antonyms, Analogies, Give one word for, Types & Techniques of Interview Assignment :[25 Words for teaching IPA, 25 words/phrases of foreign origin, 25 technical jargons, 25 words for Synonyms/ Antonyms, 25 words for Analogies, 50 examples of give one word for]

Unit III

(A) Formal Correspondence (4 Hours) (5X2=10)

Business Letters, Technical Report Writing, Writing Resumes, e-mail etiquettes
[Orders, Complaints, Enquiries, Job applications & Resume Writing, Writing Memoranda]

(B) Analytical comprehension: (4 Hours)

[Four fictional & four non-fictional unseen texts]

Unit 1V. Technical & Scientific Writing: **(4 Hours) (5X2=10)**

Writing Reviews, Features of Technical Writing, Writing Scientific Projects, Writing Research papers. Assignment: (Any one project/review as assignment)

Total number of periods required = 22 for each Branch of Engineering

Reference Books:

1. Effective technical Communication by Barun K. Mitra, Oxford University Press,
2. *Technical Communication-Principles and Practice* by Meenakshi Raman & Sharma, Oxford University Press, 2011, ISBN-13-978-0-19-806529-
3. *The Cambridge Encyclopedia of the English Language* by David Crystal , Cambridge University Press

4. *Contemporary Business Communication* by Scot Ober , Published by Biztantra,
5. *BCOM- A South-Asian Perspective* by C.Lehman, D. DuFrene & M. Sinha, Cenage Learning Pvt. Ltd.2012
6. *Business English*, by Dept of English, University of Delhi, Published by Dorling Kindersley (India), Pvt .Ltd.,2009, ISBN 978 81 317 2077 6
7. *How to Prepare a Research Proposal*: Guidelines for Funding and Dissertations in the Social and Behavioral Sciences by Krathwohl & R David
8. *Technical Writing- Process and Product* by Sharon J. Gerson & Steven M. Gerson, 3rd edition, Pearson Education Asia, 2000
9. *Developing Communication* skills by Krishna Mohan & Meera Banerjee

EVALUATION PATTERN:

Internal Examination: Weightage = 10 marks
Written Examination: 05 marks
Project Seminar : 05 marks

External Examination: Weightage = 40 marks

Question pattern for end semester examination

Unit No	Q. No	Question type	No. of Questions	Weightage
Unit 1	1(A) 1(B) 1(C)	objective objective objective	3 out of 5 3 out of 5 4 out of 6	3+3+4=10
Unit 2	2 (A) 2(B) 2(C)	objective objective subjective	3 out of 5 3 out of 5 1 (no choice)	3+3+4=10
Unit 3 & Unit4	3 (A) 3(B)	Subjective subjective	1 set (out of 2 sets) 1(no choice)	5 5
Unit 5	4(A) 4(B)	subjective subjective	1 out of 2 1 out of 2	5 5

FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: SEVENTH (C.B.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Sr. No.	Subject	Workload				Credit				Marks				
										Theory		Practical		Total Marks
		L	P	T	Total	L	P	T	Total	Sess.	Univ.	Sess.	Uni.	
1 BECSE401T	Data Warehousing & Mining	4	-	1	5	4	-	1	5	20	80	-	-	100
2 BECSE401P	Data Warehousing & Mining Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
3 BECSE402T	Language Processor	4	-	1	5	4	-	1	5	20	80	-	-	100
4 BECSE402P	Language Processor Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
5 BECSE403T	ELECTIVE-I	4	-	1	5	4	-	1	5	20	80	-	-	100
6 BECSE404T	ELECTIVE-II	4	-	1	5	4	-	1	5	20	80	-	-	100
7 BECSE405P	Project and Seminar	-	3	-	3	-	3	-	3	-	-	25	25	50
	Total	**16**	**7**	**4**	**27**	**16**	**5**	**4**	**25**	**80**	**320**	**75**	**75**	**550**

Elective I: TCP and IP, Advanced Computer Architecture, Big Data Analysis & Business Intelligence, Parallel and Network Algorithm.

Elective II: Computational Geometry, Mobile Computing, Real Time Operating System, Software Architecture, Mainframe Technologies.

FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: EIGHTH (C.B.S.)

BRANCH: COMPUTER SCIENCE & ENGINEERING

Sr. No.	Subject	Workload				Credit				Marks				
										Theory		Practical		Total Marks
		L	P	T	Total	L	P	T	Total	Sess.	Univ.	Sess.	Uni.	
1 BECSE406T	Distributed Operating system	4	-	1	5	4	-	1	5	20	80	-	-	100
2 BECSE406P	Distributed Operating system Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
3 BECSE407T	Information & Cyber Security	4	-	1	5	4	-	1	5	20	80	-	-	100
4 BECSE407P	Information & Cyber Security Lab	-	2	-	2	-	1	-	1	-	-	25	25	50
5 BECSE408T	ELECTIVE-III	4	-	1	5	4	-	1	5	20	80	-	-	100
6 BECSE409T	ELECTIVE-IV	4	-	1	5	4	-	1	5	20	80	-	-	100
7 BECSE410P	Project & Seminar	-	5	-	5	-	5	-	5	-	-	75	75	150
	Total	**16**	**9**	**4**	**29**	**16**	**7**	**4**	**27**	**80**	**320**	**125**	**125**	**650**

Elective III: Pattern Recognition, Soft Computing Techniques, Optimization Techniques, Clustering & Cloud Computing.

Elective IV: Advance Wireless Sensor Network, Digital Image Processing, Natural Language Processing, Digital Forensic.

BECSE401T: Data Warehousing & Mining

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

Unit II: Data Warehouse and OLAP Technology for Data Mining**:** Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

Unit III: Mining Frequent Patterns, Associations and Correlations**:** Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining

Unit IV: Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods

Unit V: Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

Unit VI: Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data, Mining Sequence Patterns in Transactional Databases, Mining Sequence Patterns in Biological Data, Graph Mining, Social Network Analysis and Multirelational Data Mining.

Text Book:

1. Data Mining – Concepts and Techniques, Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, 3rd edition, Orient Blackswan/Universities Press, 2013.
2. Data Warehousing Fundamentals, Paulraj Ponnaiah, John Wiley & Sons, 2001.

BECSE401P: Data Warehousing & Mining Lab

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	50

Practical based on the syllabus for the course **BECSE401T.**

BECSE402T: Language Processor

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction to compilers, compilers and translators, Cross Compiler, Phases of compilation and overview.

Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, scanner generator (lex, flex).

Unit II: Syntax Analysis: Syntax specification of programming languages, Design of top-down & bottom-up parsing technique, Design of LL(1) parser. LR parsing: Design of SLR, CLR, LALR parsers. Dealing with ambiguity of the grammar, Parser generator (yacc, bison)

Unit III: Syntax directed definitions, implementation of SDTS, Intermediate code representations (postfix, syntax tree, TAC), Intermediate code generation using syntax directed translation schemes for translation of controls structures, declarations, procedure calls, and Array reference.

Unit IV: Table Management: Storage allocation and run time storage administration, symbol table management.

Error detection and recovery: Error recovery in LR parsing, Error recovery in LL parsing, automatic error recovery in YACC.

Unit V: Code optimization: Sources of optimization, loop optimization, control flow analysis, data flow analysis, setting up data flow equations to compute reaching definitions, available expressions, Live variables, Induction Variable, Common sub expression elimination.

Unit VI: Code generation: Problems in code generation, Simple code generator, Register allocation and assignment, Code generation from DAG, Peephole optimization.

Text Books:

1. Aho, Sethi, and Ullman; Compilers – Principles, Techniques and Tools; Second Edition, Pearson Education, 2008.
2. Alfred V. Aho and Jeffery D. Ullman; Principles of Compiler Design; Narosa Publishing House, 1977.
3. Vinu V. Das; Compiler Design using Flex and Yacc; PHI Publication, 2008.

Reference Books:

1. Compiler Design, O. G. Kakde, Laxmi Publications, 2006.
2. Principles of Compiler Design, V. Raghavan, Tata McGraw Hill, 2009.

BECSE402P: Language Processor Lab

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	50

Practical based on the syllabus for the course **BECSE402T.**

BECSE403T: Elective I: TCP & IP

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Network architecture-Standards, TCP/IP Model Overview, Networking Technologies: LANS, WANS, Connecting Devices. Internetworking concept, Internet Backbones, NAP, ISPs, RFCs and Internet Standards.

Unit II: Classful Internet address, CIDR-Subnetting and Supernetting, ARP, RARP, OOTP, DHCP.

Unit III: IP Datagram-IP Package-IP forwarding and routing algorithms, computing paths, RIPOSPF, ICMP, IGMP.

Unit IV: TCP header, services, Connection establishment and termination, Interactive data flow, Bulk data flow, Flow control and Retransmission, TCP timers, Urgent Data processing, Congestion control, Extension headers.

Unit V: Switching technology, MPLS fundamentals, signaling protocols, LDP, IP traffic engineering, ECMP, SBR, Routing extensions for traffic engineering, Traffic engineering limitations and future developments.

Unit VI: IP security protocol-IPv6 addresses, Packet format, Multicast, Anycast, ICMPv6, Interoperation between IPv4 and IPv6-QoS, Auto configuration.

Text Books:

1. TCP/IP Network Administration, Craig Haut, 3rd Edition, Shroff Publications, 2002.
2. Internetworking with TCP/IP - Principles, Protocols, and Architecture, Douglas E. Comer, 5th edition Volume-1, Prentice Hall, 2006.
3. The Internet and its Protocols- A Comparative approach, Adrian Farrel, Morgan Kaufmann, 2004.

4. TCP/IP Illustrated - the Protocols, W. Richard Stevens, Volume I, Pearson Education, 2003.
5. TCP/IP Protocol Suite, Behrouz A. Forouzan, 3rd edition, Tata McGraw Hill, 2006.

Reference Books:

1. IPv6 Theory, Protocol and Practice, Pete Loshin, 2nd edition, Morgan Kaufmann, 2003.
2. Internetworking TCP/IP, Comer D.E and Stevens D.L, Volume III, Prentice Hall of India, 1997.

BECSE403T: Elective I: Advanced Computer Architecture

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (theory) 1 hr (tutorial)	5	100	20	80	100

Unit I: Fundamentals of Computer Design: Defining computer architecture, trends in technology, trends in power in integrated circuits, trends in cost, dependability, and measuring, reporting and summarizing performance.

Unit II: Instruction-Level Parallelism: Concepts and challenges in ILP, basic compiler techniques for Exposing ILP – reducing branch costs with prediction, overcoming data hazards with dynamic scheduling, hardware-based speculation, exploiting ILP using static and dynamic scheduling, limitations of ILP, using ILP support to exploit thread-level parallelism.

Unit III: Vector architecture: SIMD instruction set, extensions for multimedia, graphics processing units, detecting and enhancing loop-level parallelism, centralized shared-memory architectures, performance of shared-memory, multiprocessors, distributed shared memory, directory based coherence, basics of synchronization, models of memory consistency.

Unit IV: Memory Hierarchy Design: Cache performance: Eleven advanced cache optimizations, Protection via virtual memory and virtual machine, Impact of virtual machines on virtual memory and I/O, memory hierarchies, design of memory hierarchies.

Unit V: Introduction to Message passing Architecture: Routing in message passing architecture, message passing programming model, processor support for message passing, message passing versus shared memory architecture.

Unit VI: Storage Systems: Advanced topics in disk storage, definition and examples of real faults and failures, i/o performance, reliability measures and benchmarks – designing and evaluating an i/o system.

Text Books:

1. Computer Organization and Architecture - Designing for Performance, William Stallings, 8th Edition, Prentice Hall, 2010.
2. Advanced Computer Architecture, Kai Hwang, 2nd Edition, Tata McGraw-Hill, 2011.
3. Advanced Computer Architecture and Parallel Processing, Hesham El-Rewini and Mostafa Abd-El-Barr, Wiley, 2005.

Reference Books:

1. Parallel Computing architecture: A hardware / software approach, David E. Culler and Jaswinder Pal Singh, Morgan Kaufmann, 1998.
2. Computer Architecture and Organization, 3rd Edition, J. P. Hayes**,** McGraw Hill, 1999.

BECSE409T: Elective I: Big Data Analytics and Business Intelligence

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction to Big Data Analytics: Big Data Overview, State of the Practice in Analytics, Data Analytics Lifecycle, data analytics problems. Understanding features of R language, Understanding different Hadoop modes, Understanding Hadoop features, The HDFS and MapReduce architecture.

Unit II: Understanding the basics of MapReduce, The Hadoop MapReduce, The Hadoop MapReduce fundamentals, writing a Hadoop MapReduce example, learning the different ways to write MapReduce in R. Integrating R and Hadoop – the RHIPE architecture and RHadoop.

Unit III: Learning Data Analytics with R and Hadoop – The data analytics project cycle, the data analytics problems (web page categorization, stock market change), supervised and unsupervised machine-learning algorithms.

Unit IV: Introduction to Business Intelligence : evolution of BI, BI value chain, introduction to business analytics, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities

Unit V: Basics of Data Integration: Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, data integration technologies, Introduction to data quality, data profiling concepts and applications, the multidimensional data model, star and snowflake schema.

Unit VI: BI Project Lifecycle: Typical BI Project Lifecycle, Requirements Gathering and Analysis - Functional and Non-Functional Requirements, Testing in a BI Project, BI Project Deployment , Post Production Support.

Text Books:

1. Big Data Analytics with R and Hadoop, Vignesh Prajapati, PACKT Publishing, 2013.
2. Fundamentals of Business Analytics, R N Prasad and S Acharya, Wiley India, 2011
3. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph; David Loshin, Morgan Kaufmann, 2013.

Reference Books:

1. Business Intelligence - A Managerial Approach, 2nd Edition, Efraim Turban, Ramesh Sharda, Dursun Delen and David King, Prentice Hall, 2010.
2. Business Intelligence for Dummies, Swain Scheps, Wiley Publishing, 2007.

BECSE403T: Elective I: Parallel and Network Algorithm

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: Parallel computation models, Parallel architectures and topologies, Notion of space and time complexity in parallel and interconnect network environment.

Unit II: Dependence Concept: Single Loop, Double Loop and Perfect Loop Nest. Loop carried and Loop independence dependence, Preliminary loop transformation techniques.

Unit III: Parallel Algorithms and Techniques 1: Parallel Searching and Sorting Techniques. Hyper quick sort.

Unit IV: Parallel Algorithms and Techniques 2: Parallel solutions to linear system of equations, finding roots of non-linear equations, Parallel discrete Fourier transforms.

Unit V: Graph and Network Theory 1: Introduction, Shortest Paths, Spanning Trees, Connected Components.

Unit VI: Graph and Network Theory 2: Parallel Breadth First Search and Depth First Search, Greedy Algorithms and matroids, Coloring and Matching, Network Flow.

Text Books:

1. Graphs, Networks, and Algorithms, Dieter Jungnickel, Third Edition, Springer, 2010.
2. The Design and Analysis of Parallel Algorithms, S.G.Akl, PHI, 1989.
3. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Second edition, Addison Wesley, 2003.

Reference Books:

1. An Introduction to Parallel Algorithms, J. JaJa, Addison Wesley, 1992.
2. Parallel Programming in C with MPI and OpenMP, M.J.Quinn, McGraw Hill, 2003.

BECSE404T: Elective II: Computational Geometry

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	4	100	20	80	100

Unit I: Introduction to Computational Geometry; Line Segment Intersection – The Doubly-Connected Edge List, Computing Overlay of Two Subdivisions, Boolean Operations; Polygon Triangulation – Guarding and triangulations, Partitioning a polygon into monotone pieces, triangulating a monotone polygon.

Unit II: Linear Programming – The geometry of casting, Half-plane intersection, Incremental and Randomized linear programming; Orthogonal range Searching – One Dimensional range searching, kd-trees, Range trees, higher dimensional range trees.

Unit III: Point location – Point location and trapezoidal maps, a Randomized incremental algorithm, dealing with degenerate cases; Voronoi Diagrams – Definition and basic properties, computing the Voronoi diagram; Arrangemnets and Duality – Computing the discrepancy, duality, arrangements of lines, levels and discrepancy.

Unit IV: Delaunay Triangulations – Triangulations of planar point sets, the Delaunay triangulation, computing the Delaunay triangulation, the analysis; Geometric Data Structures – Interval trees, priority search trees, segment trees.

Unit V: Convex Hulls – The complexity of convex hulls in 3-space, computing convex hulls in 3-space, the analysis, convex hulls and half-space intersection; Binary Space Partitions – the definition of BSP trees, BSP trees and the Painter's algorithm, constructing a BSP tree, the size of BSP tree in 3-space.

Unit VI: Quadtrees – Uniform and non-uniform meshes, quadtrees for point sets, from quadtree to meshes; Simplex Range Searching – Partition trees, multi-level partition trees, cutting trees.

Text Books:

1. Computational Geometry – Algorithms and Applications, Second Revised Edition, Mark de Berg, et al., Springer, 1998.
2. Discrete and Computational Geometry, Satyan L. Devadoss and Joseph O'Rourke, Princeton University Press, 2011.

Reference Books:

1. Computational Geometry – an Introduction, Franco Preparata and Michael Shamos, Springer-Verlag, 1985.

BECSE404T: Elective II: Mobile Computing

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	4	100	20	80	100

Unit I: History of Wireless Communication, Applications of Wireless Communication, A simplified Reference Model, A second generation 2G services systems, radio link, channel types, antennas and its types. Advantages of Wireless Network over Wired Network.

Unit II: Introduction to Cellular system,(Wireless) Medium Access Control: Motivation for a specialized MAC Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Comparison of SDMA/FDMA/TDMA/CDMA.

Unit III: Introduction to GSM system, GSM background, GSM operational and technical requirements. cell layout and frequency planning, mobile station, base station systems, switching sub systems, home locations register(HLR), Visiting Location Register (VLR), equipment identity register, echo canceller. GSM network structure, Protocols, Localization and calling, Handovers,

Unit IV: Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol (DHCP). TCP over Wireless Networks – Traditional TCP, Indirect TCP, Snooping TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

Unit V: Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, multicast routing, security in MANETs.

Unit VI: Protocols and Tools: Wireless Application Protocol-WAP; Introduction, protocol architecture, and treatment of protocols of all layers; Bluetooth – User scenarios, physical layer, MAC layer, networking, security, link management; Wireless LAN and J2ME.

Text Books:

1. Mobile Computing for beginners, Raksha Shende, Arizona Business Alliance, 2012.
2. Mobile Communications, Jochen Schiller, Second edition, Addison-Wesley, 2004.
3. Handbook of Wireless Networks and Mobile Computing, Stojmenovic and Cacute, Wiley, 2002.

Reference Books:

1. Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Reza Behravanfar, Cambridge University Press, 2004.
2. Fundamentals of Mobile and Pervasive Computing, Adelstein, Frank, Gupta and Sandeep KS, McGraw-Hill, 2005.
3. Principles of Mobile Computing, Hansmann, Merk and Nicklous, Stober, Springer, Second Edition, 2003.
4. Mobile and Wireless Design Essentials, Martyn Mallick, Wiley DreamTech, 2003.

BECSE404T: Elective II: Real Time Operating System

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction to Real Time Systems: Real time systems, soft vs. hard real time systems, Concept of computer control, sequence, loop and supervisor control, centralized, hierarchical and distributed systems, applications of real time systems, hardware requirement for real time applications, specialized processors, interfaces, communications.

Unit II: Real Time Scheduling: Clock Driven approach, Weighted Round robin approach, Priority Driven approach, Concept of effective release time and deadline, Optimality and non optimality of EDF & LST.

Real Time operating System: Task management, Real Time Clock Handler, Code sharing, Resource Control, Inter task Communication and control.

Unit III: Design of Real Time System: Specification, Preliminary Design, multitasking Approach, monitors, Rendezvous.

Design Analysis: Introduction, Petri nets, Analysis of Petri Nets, Scheduling problem, Real Time Database, Real Time Vs General Purpose Databases, Transaction priorities and Aborts, Concurrency Control, Disk Scheduling Algorithms, Maintaining Serialization Consistency.

Unit IV: Programming Language and Tools: Desired language characteristics, Data typing, Control structures, Facilitating hierarchical decomposition , packages, Run time error handling, Overloading and generics, Multitasking, Low level programming, Task scheduling, Timing specifications, Programming environments, Run time support.

Unit V: Fault Tolerance Techniques: Introduction, Faults, Errors and Failures, Fault types, Detection and Containment, Redundancy, Integrated Failure Handling.

Unit VI: Reliability Evolutions: Introduction, Parameters, Reliability Models for Hardware, Software Error Models.

Commercial Real Time Systems: General concepts, Unix and Windows as RTOS.

Text Book:-

1. Real-Time Systems, Jane W. Liu, Pearson Education, 2001.

Reference Books:

1. Real-Time Systems: Theory and Practice, Rajib Mall, Pearson, 2008.

2. Real-Time Systems, Jane W. Liu, Pearson Education, 2001.

3. Real-Time Systems, Krishna and Shin, Tata McGraw Hill. 1999.

BECSE404T: Elective II: Software Architecture

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: Software process and the role of modeling and analysis, software architecture and software design, architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, architectural description languages and tools, scalability and interoperability issues, web application architectures, case studies.

Unit II: Quality Attributes: Introduction to Quality Attributes, Need of quality attributes, Understanding quality attributes, architecture and quality attributes, achieving quality attributes. Quality attributes in software architecture templates. Deriving duality attributes for software architectures.

Unit III: Design patterns: Pattern Systems, Patterns and Software architecture. Software architecture and maintenance management; Design Patterns: history, principles and expectations. Study of representative patterns like Singleton, Factory, Adaptor, Facade, Proxy, Iterator, Observer, Mediator, Composite, chain of ways of using patterns.

Unit IV: Architectural styles: Conventional Architectural styles, Applied Architectures and Styles: Distributed and Networked, Architectures for Network-Based Applications Architectures, Decentralized Architectures, Service-Oriented Architectures and Web Services.

Unit V: Introduction to Middleware: Middleware components, programming models, implementation, systems qualities Moving from qualities to architecture and views ,Components and COTS, Economics- Driven Architecture, Software product line, Software architecture future.

Unit VI: Web Architecture: Introduction to Web Architectures, Client side technologies, Need of Client side technology in multi-tier architectures, Need of server side technology in multi-tier architectures, Server side technologies.

Text Book:

1. Software Architecture: Foundations, Theory, and Practice, Richard N. Taylor, Nenad Medvidovic and Eric Dashofy, Wiley, 2008.
2. Software Architecture - Perspectives on an Emerging Discipline, M. Shaw, Prentice Hall, 1996.
3. Software Architecture in Practice, Len Bass, Paul Clements and Rick Kazman, Pearson Education, 3rd Edition, 2012.

Reference Books:

1. Beginning J2EE 1.4: From Novice to Professional, James L. Weaver, Kevin Mukhar, Apress, 2004.
2. Design and Use of Software Architectures, Jan Bosch, Addison-Wesley, 2000.
3. Software Architecture: Organizational Principles and Pattern, Dikel D. M, et Al, Pearson, 2001.

BECSE404T: Mainframe Technologies

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Evolution of Mainframe computer, key features , benefits ,Basic IBM Mainframe Architecture, Input/output Devices, Virtual/Real/Auxiliary Storage Concepts, MVS Storage & Control Blocks , Mainframe Operating System.

Unit II: Z/OS Operating System, concepts of Address space, Buffer management, Dataset organization, Virtual Storage Access Method, VSAM overview, VSAM Advantage and Disadvantage, CLUSTER, Data organization of VSAM, Internal Organization of VSAM, Accessing VSAM Data Set, Introduction to CICS , Execution of CICS Application.

Unit III: Job Control language, Basic concept of JCL, Job Processing, JCL Statements and procedures, Data Definition Statements, JOB Statement, EXEC Parameter Coding Data Sets and I/O on DD statement, In-Stream and Catalog Procedures , Generation Data Group (GDG) ,IBM utility programs. SORT/MERGE Utilities.

Unit IV: COBOL Programming Introduction, Evolution & features, COBOL divisions & sections COBOL statements, Redefines Rename & Usage clause, COBOL program structure, data types, COBOL verbs, conditional & sequence control verbs.

Unit V: COBOL File processing, File concepts, Physical & logical records, File Organization, File handling verbs, Sorting & merging of files, Table handling, Character handling, , COBOL subroutines.

Unit VI: Introduction to DB2 , DB2 Objects & Data Types, Structured Query Language, DB2 Interfaces, DB2 application development overview, Embedded SQL Programming, Cursor programming, SQL execution validation, Locking and Concurrency.

Text Book:

1. Introduction to the New Mainframe: z/OS Basics, Mike Ebbers, John Kettner, Wayne O' Brien and Bill Ogden, IBM Redbooks, 2011.
2. Information Systems through COBOL, Andreas Philippakis and Leonard Kazmier, McGraw-Hill, 1978.
3. DB2: The Complete Reference, Paul C. Zikopoulos and Roman B. Melnyk, Tata McGraw Hill, 2002.

Reference Books:

1. A Complete Guide to DB2 Universal Database, Don Chamberlin, Morgan Kauffman, 1998.
2. Structured COBOL Programming, 8th Edition, Stern, Wiley and Sons, 2007.

VIII SEMESTER CSE

BECSE406T: Distributed Operating System

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Fundamentals: Introduction, Models and Features, Concept of Distributed Operating system, Issues in Design of a Distributed Operating System.

Foundations of Distributed System: Limitations of Distributed Systems, Lamport's logical clocks, Vector clocks, Causal ordering of messages, Global state recording, Cuts of a Distributed Computation, Termination Detection.

Unit II: Distributed Mutual Exclusion: Requirement of Mutual Exclusion Algorithm, Non Token Based Algorithms: Lamport's Algorithm, Ricard-Agrawala Algorithm, Maekawa's Algorithm, Token Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal's Heuristic Algorithm, Raymond's Tree-Based Algorithm, Comparative Performance Analysis.

Unit III: Distributed Deadlock Detection: Introduction, Deadlock Handling strategies in Distributed System, Centralized and Distributed Deadlock Detection Algorithms.

Agreement protocols: Introduction, System Model, Classification of Agreement Problems, Solutions to the Byzantine Agreement Problem.

Unit IV: Distributed File system: Introduction to Distributed File System, Architecture, and Mechanism for Building Distributed File System.

Distributed Shared Memory: General Architecture of DSM systems, Algorithm for Implementing DSM, Memory coherence and Coherence Protocols.

Unit V: Distributed Scheduling: Introduction, Issues in Load Distributing, Components of a Load Distributing Algorithm, Load Distributing Algorithms: Sender-Initiated Algorithm, Receiver-Intiated algorithm, Symmetrically Initiated

Algorithm, Adaptive Algorithm, Requirements for Load Distributing Task Migration, Issues in Task Migration.

Unit VI: Failure Recovery: Recovery in concurrent systems, Consistent set of Checkpoints, Synchronous check pointing and Recovery, Asynchronous check pointing and Recovery.

Fault Tolerance: Introduction, Commit Protocols, Static Voting Protocol, Dynamic Voting Protocol.

Text Books:

1. Advanced Concepts in Operating Systems, Mukesh Singhal and Niranjan Shivaratri, Tata McGraw Hill, 2001.
2. Distributed Systems - Concepts and Design, Coulouris, Dollimore and Kindberg, 5th Edition, Addison-Wesley, 2012.

Reference Books:

1. Distributed Operating System, Andrew S. Tanenbaum, Pearson Education, 2003.

BECSE406P: Distributed Operating System Lab

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	50

Practical based on the syllabus for the course **BECSE406T.**

BECSE407T: Information & Cyber Security

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Need of Information Security: Legal, Ethical and Professional Issues Attributes of security- authentication, access control, confidentiality, authorization, integrity, non-reproduction.

OSI Security Architecture: attacks, services and mechanisms. Security Attacks, Security services, A model of Internetwork Security.

Conventional Encryption: Classical Encryption Techniques and Problems on classical ciphers, Security architecture.

Unit II: Introduction to Secret key and cryptography, Encrypt given messages using DES, AES, IDEA, Problems on cryptography algorithms, Principles, finite fields, stream cipher, block cipher modes of operation, DES, Triple DES, AES, IDEA, RC5, key distribution.

Unit III: Introduction to Public key and Cryptography, Encrypt given messages using ECC, Problems on key generation, cryptography algorithms Principles, Introduction to number theory, RSA- algorithm, security of RSA, Key management- Diffie-Hellman key exchange, man-in-the-middle attack, Elliptical curve cryptography

Unit IV: Message Authentication and Hash Functions: Authentication Requirements and Functions, Hash Functions and their Security, MD5 Message Digest Algorithm, Kerberos.

Key Management: Digital Certificates-Certificate types, X.509 Digital Certificate format, Digital Certificate in action, Public Key Infrastructure-Functions, PKI Architecture, Certificate Authentication.

Unit V: Introduction to Network, Transport and Periphery Security, Study of IPSEC, TLS, and SSL. Firewalls - design principles, trusted systems, Intrusion Detection System, Intrusion Prevention System. Implementation and analysis of IPSEC, TLS and SSL, Introduction to cryptography - Classical cryptography.

Unit VI: Software Vulnerability: Phishing, Buffer Overflow, Cross-site Scripting (XSS), SQL Injection.

Electronic Payment: Payment Types, Enabling Technologies-Smart Cards and Smart Phones, Cardholder Present E-Transaction-Attacks, Chip Card Transactions, Payment over Internet-Issues and Concerns, Secure Electronic Transaction, Online Rail Ticket Booking.

Electronic Mail Security: Pretty Good Privacy, S/MIME

Text Book:

1. Cryptography and network security - principles and practices, William Stallings, Pearson Education, 2002.

Reference Books:

1. Network Security and Cryptography, Bernard Menezes, Cengage Learning.
2. Information System Security, Nina Godbole, Wiley India, 2008.
3. Network security, private communication in a public world, Charlie Kaufman, Radia Perlman and Mike Speciner, Prentice Hall, 2002.
4. Security architecture, design deployment and operations, Christopher M. King and Curtis Patton, RSA press, 2001.
5. Network Security - The Complete Reference, Robert Bragg and Mark Rhodes, Tata McGraw Hill, 2004.

BECSE407P: Information & Cyber Security Lab

Load	Credit	Total marks	Sessional marks	University marks	Total
2 hrs (Practical)	1	50	25	25	50

Practical based on the syllabus for the course **BECSE407T.**

BECSE408T: Elective-III: Pattern Recognition

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: Pattern Recognition Systems, Design Cycle, Applications of pattern recognition, Learning and Adaption-Supervised, Unsupervised and Reinforcement Learning.

Unit II: Probability: Introduction to Probability, Probability of events, Random variables, Probability Distributions, Joint Distribution and Densities, Moments of Random Variables, Estimation of Parameters from samples, Minimum Risk Estimators.

Unit III: Statistical Decision Making: Bayes' Decision Theory, Multiple Features, Conditionally Independent Features, Decision Boundaries, Unequal costs of Error, Estimation of Error Rates, Leaving-one-out Technique, Confusion Matrix, Characteristic Curves.

Unit IV: Classifiers: Hidden Markov Model, Support Vector Machine, Artificial Neural network-back Propagation Algorithm and Fuzzy based classifiers.

Unit V: Non Parametric Decision Making: Introduction**,** Histograms, Kernel and window Estimators, Nearest Neighbor classification Technique, Adaptive Decision Boundaries, Adaptive Discriminate Functions, Minimum Squared Error Discriminate Functions.

Unit VI: Clustering: Introduction, Hierarchical clustering, Partitional Clustering.

Text Book:

1. Pattern Recognition and Image Analysis, Earl Gose, Richard Johnsonbaugh and Steve Jost, PHI, 1996.

Reference Book:

1. Pattern Classification, Richard O Duda, Peter E. Hart and David G. Stork, John Wiley, 2000.

BECSE408T: Elective III: Soft Computing Techniques

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction to Neuro: Fuzzy and Soft Computing**:** Soft Computing Constituents and Conventional AI; Neuro-Fuzzy and Soft Computing Characteristics.

Fuzzy Sets: Introduction Set Theoretic Operations, MF Formulation and Parameterization, Fuzzy Union, Intersection and Complement.

Fuzzy Rules and Fuzzy Reasoning: Extension Principles and Fuzzy Relations, Fuzzy If-Then Rules; Fuzzy Reasoning.

Unit II: Fuzzy Inference Systems: Mamdani Fuzzy Models; Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Other Considerations.

Derivative-Free Optimization: Introduction, Genetic Algorithms; Simulated Annealing; Random Search, Downhill Simplex Search.

Unit III: Adaptive Networks: Introduction, Architecture; Feed-forward Network; Extended Back-propagation for Recurrent Networks; Hybrid Learning Rule. Supervised Learning Neural Networks, Perceptrons, Back-propagation Multi-layer Perceptrons, Radial Basis Function Networks.

Unit IV: Unsupervised Learning and Other Neural Networks: Competitive Learning Networks, Kohonen Self-Organizing Networks; Learning Vector Quantization; Hebbian Learning, Principal Component Networks, Hopfield Networks.

Unit V: Adaptive Neuro-Fuzzy Inference System**:** ANFIS Architecture, Hybrid Learning Algorithm, ANFIS as Universal Approximator.

Data Clustering Algorithms: K-Means Clustering; Fuzzy C-Means Clustering, Mountain Clustering Method; Subtractive Clustering.

Unit VI: Rulebase Structure Identification: Input Selection, Input Space partitioning, Rulebase Organization, Focus Set-based Rule Combination.

Applications: Printer Character Recognition, Hand-written Numeral Recognition, GA-based Fuzzy Filters.

Text Books:

1. Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence; Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani; Prentice Hall, 2004.
2. Artifical Intelligence and Soft Computing, Anindita Das, Shroff Publication.

Reference Books:

1. Fuzzy Logic with Engineering Applications; Timothy J. Ross; McGraw-Hill; 1997.
2. Genetic Algorithms: Search, Optimization and Machine Learning; Davis E. Goldberg; Addison Wesley; 1989.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms; S. Rajasekaran and G. A. V. Pai; Prentice Hall of India; 2003.

BECSE408T: Elective III: Optimization Techniques

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: Engineering applications of optimization. Design variables. Constraints, objectives function, variable bounds, statement and formulation of an optimization problem, Example of Optimization problems, classification of optimization problems, different optimization algorithms.

Unit II: Optimal Point: Local optimal point, global optimal point and inflection point.

Unit III: Single Variable Optimization Techniques: Optimality criterion, Bracketing method (Bounding phase method), Region elimination methods (Internal halving method, Golden section search method), Point estimation method (successive quadratic estimation methods), Gradient-based methods (Newton-Raphson method, Bisection method, secant, Cubic search method.), Root finding using optimization techniques.

Unit IV: Multivariable Optimization Techniques: Optimality criterion, Unidirectional search method, Direct Search method (Hooke-Jeeves Pattern Search method, Powell's conjugate direction method), Gradient-based methods (Steepest descent method, Newton's method, and Marquardt's methods)

Unit V: Constrained Optimization Algorithms**:** Kuhn-Tucker conditions, Transformation method (Penalty function method), direct search for constrained minimization (variable elimination method, complex search method)

Unit VI: Linear Programming: Linear programming problems, Simplex method of linear programming techniques.

Text Book:

1. Optimization for Engineering Design: Algorithms and Examples, Kalyanmoy Deb, PHI Learning, 2004.

Reference Books:

1. Engineering Optimization: Theory and Practice, Singiresu S. Rao, John Wiley 2009.
2. Optimization of Chemical Processes, T.I. Edgar & D.M. Himmelblau, McGraw Hill.
3. Optimization: Theory and Practice, Beveridge and Schecter, McGraw Hill.

BECSE408T: Elective III: Clustering & Cloud Computing

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages of Cloud Computing, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing. Legal issues when using cloud models, challenges in cloud computing, Overview of Mobile Cloud.

Unit II: Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS), Infrastructure as a Service (IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization, Infrastructure as a Service (Iaas)using OpenStack/OwnCloud.

Unit III: Big Data Analysis, Hadoop and Map Reduce: Introduction, Clustering Big Data, Classification of Big Data, Hadoop MapReduce Job Execution, Hadoop scheduling, Hadoop cluster setup, configuration of Hadoop, starting and stopping Hadoop cluster.

Unit IV: Security in Cloud: Cloud Security Challenges, Infrastructure Security, Network level security, Host level security, Application level security, data privacy, data security, application security, virtual machine security, Identity Access Management, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.

Unit V: Application Development using C#: Understand object oriented concepts in C#.NET, Creation of UI and event handling, web page creation using ASP.NET, ADO.NET architecture, implementation of data seta, using ADO.NET in console application, using ADO.NET in web application.

Unit VI: Creating Cloud Application using Azure: Creating simple cloud application, configuring an application, creating virtual machine, deployment of application to Windows Azure Cloud, using Azure Storage Services, using Azure Table Service, deployment of application to the production environment.

Text Books:

1. Google Compute Engine, Mark Cohen and K. Hurley, O'Reilly, 2014.
2. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011
3. Cloud Computing, A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2014.
4. Microsoft Azure: Enterprise Application Development, R. J. Dudley and N. A. Duchene, SPD Publication.

Reference Books:

1. Cloud Computing using Windows Azure, B. M. Harwani, SPD Publication.
2. Cloud Computing, Implementation, Management and Security, J. W. Rittinghouse and J. F. Ransome, CRC Press.

BECSE409T: Elective IV: Advanced Wireless Sensor Networks

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction to Sensor networks: application Examples of available sensor nodes, Challenges for WSN's, Mobile ad hoc networks and wireless sensor networks, single node architecture. Sensor node hardware overview, Sensors and actuators, Energy consumption of sensor nodes

Unit II: Operating systems and execution environments: Programming paradigms and application programming interfaces, Structures of operating system and protocol stack. Dynamic energy and power management, TinyOS and neSc examples

Unit III: Network Architecture: Sensor network scenarios, Design principles for WSNs, Services interfaces of WSNs, Gateway concepts, Mac protocols: Fundamentals, Low duty cycle and Wakeup concepts, contention and schedule based protocols, IEEE 802.15.4 MAC Protocol.

Unit IV: Naming and Addressing: Fundamentals Address and Name management in WSN, assignment in MAC Addresses, content based and geographical addressing. Hierarchical networks by clustering, Adaptive node activity: geographic adaptive Fidelity (GAF).

Unit V: Routing protocols and content based networking: Broadcast and multicast protocols Geographic Routing, Mobile nodes, Data centric Routing, Distribution versus gathering of data-In-network processing, Data Aggregation, data centric storage.

Unit VI: **Application specific support:** Advanced in-network processing, security, Target detection and tracking, contour/edge detection.

Text Books:

1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl, and Andreas Willig, Wiley, 2005.
2. Wireless Sensor Networks, Cauligi S. Raghavendra, Krishna Sivalingam and Taieb M. Znati, Springer, 2005.
3. Introduction to Wireless and Mobile Systems, Third edition, Dharma Prakash Agrawal and Qing-An Zeng, Thomson/Cengage Learning, 2010.

Reference Books:

1. Wireless and Personal Communications Systems, Vijay K. Grag and Joseph E. Wilkes, Prentice Hall, 1995.
2. Routing in the Internet, Christian Huitema, Prentice Hall, 1995.

BECSE409T: Elective IV: Digital Image Processing

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: What is Digital Image Processing, Applications of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, Image Sampling and Quantization, Basic Relationships between Pixels.

Intensity Transformations: Basic Intensity Transformation Functions, Piecewise-Linear Transformations.

Unit II: Spatial Filtering: Histogram Processing – Histogram Equalization, Histogram Specification, Using Histogram Statistics for Image Enhancement, Fundamental of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Color Image Processing: Color Fundamentals, Color Models – RGB Model, CMY and CMYK Model, HSI Model, Pseudo-color Image Processing – Intensity Slicing, Intensity-to-Color Transformations.

Unit III: Filtering in Frequency Domain: Preliminary Concepts, Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of 2-D DFT, Basics of Filtering in Frequency Domain, Image Smoothing using Frequency Domain Filters, Image Sharpening using Frequency Domain Filters; Selective Filtering.

Unit IV: Image Restoration and Reconstruction: Model of Image Degradation/Restoration Process, Noise Model, Restoration in the Presence of Noise only – Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position Invariant Degradations, Inverse Filtering, Wiener Filtering; Constrained Least Squares Filtering, Geometric Mean Filter.

Unit V: Image Compression: Fundamentals – Coding Redundancy, Spatial-Temporal Redundancy, Measuring Image Information, Fidelity Criteria, Image

Compression Models, Basic Compression Methods – Huffman Coding, Arithmetic Coding, Run-length Coding, LZW Coding; Digital Image Watermarking.

Unit VI: Image Segmentation: Point, Line and Edge Detection – Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, The Marr-Hildreth Edge Detector, The Canny Edge Detector, Edge Linking and Boundary Detection; Thresholding – Basic Global Thresholding, Otsu's Method; Region-Based Segmentation – Region Growing, Region Splitting and Merging.

Representation and Description: Boundary Following; Chain Codes; Polygonal Approximations using MPP; Signatures; Skeletons; Shape Numbers; Topological Descriptors.

Text Books:

1. Digital Image Processing; Rafael C. Gonzalez and Richard E. Woods; Third Edition; Pearson Education (India); 2014.
2. Digital Image Processing and Analysis; B. Chanda and D. Dutta Majumdar; Prentice Hall of India, 2001.
3. Digital Image Processing; S. Jayaraman, S. Essakkirajan and T. Veerakumar; Tata McGraw Hill; 2009.

Reference Books:

1. Digital Image Processing and Computer Vision; Milan Sonka, Vaclav Hlavac and Roger Boyle; Cengage Learning; 2008.
2. Digital Image Processing; Kenneth R. Castleman; Pearson Education (India); 1996.
3. Fundamentals of Digital Image Processing; Anil K. Jain; PHI Learning; 2013.

BECSE409T: Elective IV: Natural Language Processing

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction: NLP tasks in syntax, semantics, and pragmatics, Key issues &Applications such as information extraction, question answering, and machine translation, the problem of ambiguity, the role of machine learning, brief history of the field.

Unit II: N-gram Language Models : Role of language models, Simple N-gram models, Estimating parameters and smoothing, Evaluating language models, Part Of Speech Tagging and Sequence Labeling Lexical syntax, Hidden Markov Models, Maximum Entropy models.

Unit III: Syntactic parsing: Grammar formalisms and tree banks, Efficient parsing for context-free grammars (CFGs), Statistical parsing and probabilistic CFGs (PCFGs), Lexicalized PCFGs.

Unit IV: Semantic Analysis: Lexical semantics and word-sense disambiguation, Compositional semantics, Semantic Role labeling and Semantic Parsing.

Unit V: Information Extraction (IE): Named entity recognition and relation extraction, IE using sequence labeling, automatic summarization Subjectivity and sentiment analysis.

Unit VI: Machine Translation (MT): Basic issues in MT, Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

Text Books:

1. Speech and Language Processing, D. Jurafsky and R. Martin, 2nd edition, Pearson Education, 2009.
2. Language Implementation Patterns, Terence Parr, Pragmatic Programmers, 2010.

Reference Books:

1. Natural Language Understanding, Allen James, Second Edition, Benjamin/Cumming, 1995.
2. NLP: A Paninian Perspective, Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, Prentice Hall, New Delhi, 1994.

BECSE409T: Elective IV: Digital Forensics

Load	Credit	Total marks	Sessional marks	University marks	Total
4 hrs (Theory) 1 hr (Tutorial)	5	100	20	80	100

Unit I: Introduction & evidential potential of digital devices – Key developments, Digital devices in society, Technology and culture, Comment, Closed vs. open systems, evaluating digital evidence potential. Device Handling & Examination Principles: Seizure issues, Device identification, Networked devices, Contamination, Previewing, Imaging, Continuity and hashing, Evidence locations.

Unit II: A seven element security model, A developmental model of digital systems, Knowing, Unknowing, Audit and logs, Data content, Data context. Internet & Mobile Devices, The ISO / OSI model, the internet protocol suite, DNS, Internet applications, Mobile phone PDAs, GPS, Other personal technology.

Unit III: Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources / Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?, Case Histories, Case Studies.

Unit IV: Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised, Internet Tracing Methods.

Unit V: Homeland Security Systems, Occurrence of Cyber Crime, Cyber Detectives, Fighting Cyber Crime with Risk Management Techniques, Computer Forensics Investigative Services, Forensic Process Improvement, Case Histories.

Unit VI: The violation of privacy during information words. The individual exposed. Advanced computer Forensics systems and future directions-advanced, encryption, hacking, advanced trackers, case studies.

Text Books:

1. Digital Forensics, Angus M. Marshall, 2nd Edition, Wiley-Blackwell, John Wiley and Sons, 2008.
2. Computer forensics: Computer Crime Scene Investigation, John R. Vacca, 2nd Edition, Charles River Media, 2002.

Reference Books:

1. Recovering and examining computer forensic evidence, Michael G. Noblett; Mark M. Pollitt and Lawrence A. Presley, 2000.
2. A Formalization of Digital Forensics, R Leigland, 2004.
3. Evaluating Commercial Counter-Forensic Tools, M. Geiger, DFRWS-2005.
4. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, Albert J. Marcella and Robert S. Greenfield, Auerbach Publications, 2007.
5. Handbook of Computer Crime Investigation: Forensic Tools and Technology, Eoghan Casey, Academic Press, 2001.
6. Privacy Protection and Computer Forensics, Second Edition, Michael Caloyannides, Artech House, 2004.
7. Computer Forensics: Incident Response Essentials, Warren G. Kruse and Jay G. Heiser, Addison Wesley, 2001.