Curriculum Structure

BTech (Computer Science & Engineering) and B.Tech (Information Technology) Programs

Semester I	L-T- P-C	Semester II	L-T- P-C
Introduction to Discrete Mathematics	3-1-0-4	Calculus	3-1-0-4
Physics	3-1-2-5	Data Structures	3-0-0-3
Introduction to Programming	2-0-0-2	Data Structures Lab	0-1-4-3
Introduction to Programming Lab	0-1-4-3	Basic Electronics Circuits	3-1-2-5
Digital Logic Design	3-0-4-5	Computer Organization	3-0-4-5
Spoken and Written Communication	2-0-0-2	Introduction to Computer Science / Introduction to Information Technology *	2-0-0-2
Semester Credits	**21**	**Semester Credits**	**22**

*** Pass / Fail**

SEMESTER - I

Introduction to Discrete Mathematics (3-1-0-4)

Course Contents:
Foundation: Propositional and predicate logic, logical equivalences, predicates and quantifiers, Translation from language to logical expressions, nested quantifiers, Set theory, set operations, set identities and Functions, inverse and composition functions, graph of functions.
Number theory: division operator, prime factorization, properties of prime numbers, prime number theorem, GCD and LCM, modular arithmetic and applications, sequences and summations.
Counting: permutation and combinations, pigeonhole principle, inclusion-exclusion principle, binomial theorem, Pascal identity and triangle
Mathematical reasoning and induction: rules of inference, direct proof, proof by contradiction, proof by contra-positive, mathematical induction and second law of mathematical induction.
Recursion: definition, recursive algorithm, recurrence relations, solving recurrence relations

Relations: Relations and their properties, applications and representations, equivalence relations, partial ordering, hasse diagram.

Graphs: introduction and terminology, representation, isomorphism, connectivity, Warshall's algorithm, Euler and Hamilton path, shortest path.

Text Book: *Discrete Mathematics and its Application*, 7th Ed, K. Rosen**,** Tata McGraw Hill, 2011.

Reference Books:
1) *Discrete Mathematical Structure*, 4th Ed, B. Kolman, R.C. Busby and S. C. Ross, PHI, 2000.
2) *Discrete Mathematics*, Richard Johnsonbaugh, Prentice Hall, 2007.
3) *Mathematics: A Discrete Introduction*, 3rd Ed., Edward R. Scheinerman, Cengage Learning, 2006.
4) *Mathematical Structure for Computer Science*, J. Gersting, 6th Ed., Freeman, 2006

Physics (3-1-2-5)

Course Contents:
Coordinate System: Cartesian, Cylindrical and Spherical Coordinates. Unit vectors and their time derivatives.
Review of particle dynamics: Inertial and Non-inertial frames of reference, Centrifugal and Coriolis Forces. Conservative force, Work-Energy Theorem. Centre of mass, conservation of momentum, Collision in one and two dimensions. Small oscillations, free, forced and damped oscillations.
Atomic Physics: Rutherford and Bohr's atomic model, Quantum numbers, Atomic spectra, Energy levels.
Elementary Particles: Nuclear model, protons and neutrons, nuclear force, introduction of elementary particles.
Conceptual Foundation of Modern Physics: Electromagnetic waves, Blackbody radiation, Planck's law of radiation, Photoelectric effect, wave-particle duality, Compton wavelength, de-Broglie wave, Heisenberg's Uncertainty Principle, Contribution of Dirac, Pauli, Schrodinger and Born in foundation of quantum mechanics, Topics in Quantum Mechanics.
Introduction to applied physics: A non-mathematical exposure to applied physics such as: Pendulum, heat engine, transformer, Optical microscope, Electron microscope, Scanning Tunneling microscope, Laser diode, Photo detector, Solar cells, transistors.

Text Books:
Concepts of Modern Physics, A.Beiser, Tata McGraw-Hill, New Delhi, 1995.

Reference Books:
1. *Quantum Physics of Atoms , Molecules, Solids, Nuclei and Particles*, 2nd Ed, R.Eisberg and R.Resnick , John-Wiley, 1985.
2. Quantum Mechanics: Theory and Applications 5th Ed, AjoyGhatak, Macmillan, 2004.

Introduction to Programming (2-0-0-2)

Course contents:
Introduction to programming: Programming methods, Paradigms, Problem solving techniques, Algorithm development, Flow charts.
Linux environment: editor, compiler, debugger.
Basics of Procedural Programming: constants, variables, expressions, operators, assignment, basic input and output, built-in functions, program debugging.
Variables and Operators: basic data types, precedence and order of evaluation, pointers, memory allocation of variables.
Control Structures: selection statements, iteration statements.
Functions and Program structure: return values, actual and formal parameters, parameter passing: call by value versus call by reference, external variables, scope rules, header files, and recursion.
Arrays: character arrays, one and two dimensional arrays; pointer arrays, command-line arguments.
I/O: ASCII data files, file pointers, end-of-file.
Basic Data Structures: structures, defining new types, enumerations, dynamic memory allocation, dynamic arrays, linked lists and other pointer-based structures.

Text Book:

C How to Program, 6th Ed, P Deitel and H Deitel, PHI, 2010.

Reference Books:

1. *C programming language*, 2nd Ed, Kernighan, Brian W. & Ritchie, Dennis M, New Delhi. Prentice Hall of India, 1998.
2. *A Book on C*, 4th Ed, Kelley, A.L. and Pohl Ira, Pearson India, 2002
3. *A Structured Programming Approach Using C*, 1st Ed., Forouzan, Behrouz, Course Technology, 2012.
4. *C: How to Program*, 5th Ed, Deitel, P. J. &Deitel, H. M, New Delhi. PHI Learning, 2009.
5. *Practical C Programming*, 3rd Ed, Oualline, Steve, Mumbai. Shroff Publishers, 2000. 81-7366-030-1
6. *C programming: The essentials for engineering and scientists*, Brooks, David R. New York. Springer, 1999.

Introduction to Programming Lab (0-1-4-3)

Course contents:
Lab and take home assignments based on the course "Introduction to Programming".

Digital Logic Design (3-0-3-4.5)

Course Contents:
Number Systems: Representations, signed, 1's complement, 2's complement, saturation and overflow in fixed point arithmetic.
Boolean Algebra: Axioms and theorems, DeMorgan's law, Universal Gate, Duality, Expression manipulation using axioms and theorems.
Combinational Logic: Introduction to switching algebra, Canonical forms, Two-level simplification, Boolean cube, Logic minimization using K-map method, QuineMcCluskey tabular method, Minimization for product-of-sum form, minimization for sum-of-product form, multiplexers, demultiplexers, decoders, encoders, hazard free synthesis, Arithmetic circuits, adders, half adder, full adder, BCD adder, Ripple carry adder, Carry-lookahead adder, Combinational multiplier.
Sequential Logic: Simple circuits with feedback, Basic Latches, Clocks, R-S latch, Master-slave latch, J-K flip flop, T flip-flop, D flip-flop, Storage registers, Shift register, Ripple counter, Synchronous counters, Finite State Machine (Moore/Mealy Machines), FSM with single/multiple inputs and single/multiple outputs etc.
Hardware Description Language: programming and simulation, Structural specification, Behavioral Specification, Dataflow modelling, Testbench, Testing using test vectors, Testing using waveforms, Design of basic blocks to build larger circuits, Case studies, adder, ALU, counters, Shift registers, Register bank, FSM design example etc.

Text Book:

1. *Digital Fundamentals,* 10th Ed, Floyd T L*,* Prentice Hall, 2009.

Reference Books:

1. *Digital Design - Principles and Practices*, 4th Ed, J F Wakerly, Prentice Hall, 2006.
2. *Digital Design*, Morris Mano, Prentice Hall, 2002.

3. *Digital Systems: Principles and Applications,* Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, Pearson Education, Limited, 2011.
4. *Fundamentals of Digital Logic with Verilog Design,* 2nd Ed, S. Brown and Z. Vrsaniec, McGraw Hill, 2007

English (2-0-0-2)

Course Contents:

Unit-I: Course Instructor should make an optimal use of cinema for increasing the students' familiarity with English.Testing be done on the basis of the student's comprehension of the plot and the ability of describe scenes from the film.Class room exercise of asking students to comment on the plot or scenes of a given film – not in writing but by standing before the entire class and speaking in English—be frequently carried out.The aim of this unit is to make the student feel confident about her/his ability to form sentence in English for discursive communication.
Unit-II: Course Instructor should use audio tapes, Ted Lectures, radio news broadcast or celebrated speeches, etc for exposing the students' to a 'real time' and good spoken English.Class room tests be set to check the students' ability to respond to their listening experience in writing. This will help the Course Instructor to continually assess the requirements of the students and provide corrective advise. Testing the writing skills of students will require setting several questions of very short composition tasks, from 50 words to 150 words. The topics chosen for the composition tasks should be selected from the topics covered in the class room discussions or fro the life on the campus.
Unite-III: Students should be provided four to five extended samples of written English such as short stories or newspaper editorials for them to mark their difficulties – words, idioms, sentence structures, etc. This will help the students in improving their ability to do *focused* reading of serious written literature. Testing of the reading comprehension skills be tested by giving them in advance of the test several passages for reading. The Course Instructor may select one or more of those 'seen passages' for the examination purpose.

Text Book: *Prism: Spoken and Written Communication, Prose & Poetry* published by Orient Longman, 2008.

Reading materials:
The Bet – Anton Chekov
Socrates and the Schoolmaster – F. L. Brayne
An Astrologer's Day – R. K. Narayan
The Gift of the Magi – O' Henry
With the Photographer – Stephen Leacock
Speech on Indian Independence – Jawaharlal Nehru

SEMESTER - II

Calculus (3-1-0-4)

Course Contents:

Fundamentals: Limits, continuity, differentiability, mean value theorems, and Taylor's theorem. Fundamental theorem of integral calculus, definite integrals, trapezoidal and Simpson's rule. Sequences and series, tests for convergence: absolute and conditional convergence. Power series and radius of convergence.

Functions of several variables: partial derivatives, chain rule, gradient and directional derivative. Taylor's theorem for functions of several variables.Maxima, minima and saddle points.

Vector calculus: gradient, divergence and curl. Double, triple, line and surface integrals.Theorems of Green, Gauss, Stokes and their applications.

Introduction to Complex variables: complex numbers and the complex plane, derivative and analytic functions.

Differential equations: first order equations, second linear differential equations, partial differential equations – basic concepts and important examples, Laplace and Fourier transforms.

Text Book:

Calculus and Analytical Geometry, 9th Ed, G B Thomas and R L Finney, Addison-Wesley, 1999.

Reference Books:

Differential and Integral Calculus, 3rd Ed, Schaum's Outline Series, McGraw Hill, 1992.

Advanced Engineering Mathematics, 8th Ed, R Kreyszig, John Wiley, 1999.

Data Structures (3-0-0-3)

Course Contents:

Preliminaries: Representation of data on a computer, data types & array and linked list representations ways of representing programs and associated data on computers

Analysis tools: Notion of the running time of an algorithm, Recurrences, Parameters of performance.

Dictionary operations: Find, Max, Min, Successor, Predecessor (querry operations); Insert, Delete (modify operations)

List data: Stacks, queues, variants implementation using arrays and linked lists

Sorting: Comparison based sorting algorithms, other sorting algorithms, lower bounds for comparison-based sorting algorithms Best-case, worst-case and average-case running times. Quicksort, Heap Sort, insertion sort, bubble sort etc.

Order Statistics: Maximum and minimum elements of a set, Finding median, searching for an element of a given rank, finding the rank of a given element, ranks of a subset of elements Maintaining rank information for a dynamic set

Trees: Heaps, Binary search trees (BST), heights of BST

Balanced BSTs: Red Black trees, AVL Trees, 2,3,4-trees, B Trees

Graphs: Representation using adjacency matrices and adjacency lists, Graph searching algorithms BFS and DFS

TextBook:
Data Structures and Algorithms, Aho, Hopcroft and Ullman, Addison-Wesley, 1999

Reference Books:
Introduction to Algorithms, 3rd Ed, Cormen, Lieserson and Rivest, PHI, 2011

Data Structures Lab (0-1-4-3)

Course contents:
Lab and take home assignments based on the course "Data Structure". It is essential for the instructor to use the tutorial hours of this course to give hands on of any object oriented programming language so that students can code the assignments given.

Basic Electronic Circuits (3-0-3-4.5)

Course contents:
Analog Circuit Elements: Resistor, Capacitor, Inductor, Concepts of LLFPB, Non-linear circuit elements, Incremental equivalent of nonlinear elements, Voltage and Current sources, Controlled sources, Active circuits, Practical circuit elements of different types.
Analysis of Linear circuits: Kirchhoff's laws, D-C analysis of resistive circuits ,Time-domain analysis of a-c circuits ,Sinusoidal steady state analysis of a-c circuits –notions of phasors, impedance, transfer function and frequency response, Frequency response vs transient response , Superposition theorem, Thevenin's and Norton's theorems, Two-port parameters, Analysis of circuits having controlled sources.
Amplifiers: Diodes, BJT, FET,Amplifier parameters, Controlled source models, Active devices as controlled sources, Different amplifier configuration using the OPAMP, Frequency response of OPAMP and OPAMP-based amplifiers, Power amplifiers using OPAMP and transistors.
Oscillators: Amplifier with feedback, Condition of harmonic oscillation, RC oscillator circuits.
Waveform Generators: OPAMP as a comparator, Regenerative comparator, Timer, Relaxation oscillator, Non-sinusoidal waveform generator using comparator.
D-C Power Supply: Half-wave and full-wave rectifiers, Shunt capacitor filter, Ripple and voltage regulation, Voltage regulator using zener diode, Active voltage regulator.

Text Books:
1. *Electronic Principles*, 7th Ed, Albert Malvino, and David Bates, Tata McGraw-Hill, 2006.
2. *Microelectronic circuits*, 5th Ed, A Sedra , K Smith, A N Chandorkar, Oxford University Press,2009

References Books:
1. *Network Analysis*, 3rd Ed, Van Valkenburg, PHI, 2000.
2. *Introduction to electric circuits*, 8th Ed, R C. Dorf and J A Svoboda John Wiley, 2000.
3. *Engineering Circuit Analysis*, 6th Ed, William H.Hayt, Jack Kemmerly , Steven Durbin, Tata McGraw-Hill, 2002.
4. *Electric circuit fundamental*s, Sergio Franco, Oxford University Press, 1995.
5. *Foundations of Analog and Digital Electronic Circuits*, AnantAgarwal and Jeffrey Lang, Morgan Kaufman, 2005.

Computer Organization (3-0-3-4.5)

Course Contents:
von Neumann machine: functional units, stored program concept, ALU, data paths, registers, status flags; instruction cycle.
Data representation: Integer data; fixed and floating point systems; representation of non-numeric data (characters, strings, records, and arrays).
Assembly/machine level: instruction sets and types (arithmetic, data movement, and control); instruction formats and addressing modes, subroutine call and return mechanisms; representations of fundamental high-level programming constructs at the assembly language level; Heap vs. Stack vs. Static vs. Code segments.
Memory system: principles of temporal and spatial locality; cache memories (address mapping, block size, replacement and store policy); virtual memory (page table, TLB); disk organization and data access from disk drive.
I/O communication: handshaking, buffering, programmed I/O, interrupt-driven I/O, bus protocols.

Text Books:
1. *Introduction to Computing Systems: From Bits and Bytes to C and Beyond*, 2nd Ed, Yale Patt and Sanjay Patel, Tata McGraw-Hill, 2001.
2. *Computer Systems: A Programmer's Perspective,* 1st Ed. Bryant and O'Hallaron, Pearson, 2002.

Reference Books:
1. *The Essentials of Computer Architecture and Organization,* 3nd Ed, Null and Lobur, Jones & Bartlett/Viva Books, 2011.
2. *Structured Computer Organization,* 6th Ed,Tanenbaum and T Austin, Pearson, 2012.
3. *Computer Organization and Architecture,* 8th Ed,Stallings, Pearson, 2010.
4. *Computer System Organization*, NareshJotwani, Tata McGraw Hill, 2009

Introduction to Computer Science / Introduction to Information Technology (2-0-0-2)

Course contents:
Students of BTech CS and BTechIT, will take this course separately. These courses aim at introducing the broad perspective of computer science and information technology to the respective students. Students get to understand the breadth of the subject area they would be exploring in the coming years.

It is expected that more than one faculty instructor would deliver the lectures of these courses.