Study Scheme of

Bachelor of Technology
in
Information Technology

(B.Tech I.T.)

Batch 2018 onwards

Department of Information Technology
BEANT COLLEGE OF ENGINEERING &
TECHNOLOGY, GURDASPUR

Beant College of Engineering & Technology, Gurdaspur
(An Academic Autonomous status by UGC)
Department of Information Technology

B. Tech (I.T)   **(2018 Batch Onward)**

Semester III (Second year) Curriculum
Branch/Course: Information Technology

Sr. No	Type of Course	Course Code	Course Title	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
1.	Engineering Science Course	BTIT-18301	Digital Electronics	3	0	0	40	60	100	3
2.	Professional Core Courses	BTIT-18302	Data structure & Algorithms	3	0	0	40	60	100	3
3.	Professional Core Courses	BTIT-18303	Object Oriented Programming	3	0	0	40	60	100	3
4.	Basic Science Course	BTAM-18301	Mathematics-III	3	1	0	40	60	100	4
5.	Engineering Science Course	BTIT-18304	Computer Architecture	3	0	0	40	60	100	3
6.	Engineering Science Course	BTIT-18305	Digital Electronics Lab	0	0	2	30	20	50	1
7.	Professional Core Courses	BTIT-18306	Data Structure & Algorithms Lab	0	0	4	30	20	50	2
8.	Professional Core Courses	BTIT-18307	Object Oriented Programming Lab	0	0	4	30	20	50	2
9.	Internship	BTIT-18308	Institutional Summer Training*	-	-	-	100	0	100	2
Total Credits				15	1	10	390	360	750	23

*This training of 3-4 weeks will be performed by the students in the college IT laboratory/Central Workshop for learning the programming skills. Certificate will be issued after the successful completion of the training.

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Semester IV (Second year) Curriculum
Branch/Course: Information Technology

Sr. No	Type of Course	Course Code	Course Title	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
1.	Professional Core Courses	BTAM-18401	Discrete Structures	3	1	0	40	60	100	4
2.	Professional Core Courses	BTIT-18402	Computer Networks	3	0	0	40	60	100	3
3.	Professional Core Courses	BTIT-18403	Operating Systems	3	0	0	40	60	100	3
4.	Professional Core Courses	BTIT-18404	Design & Analysis of Algorithms	3	0	0	40	60	100	3
5.	Humanities & Social Sciences Including Management Courses	BTHS-18905	Management-I (Effective Technical Communication)	3	0	0	40	60	100	3
6.	Mandatory Courses	ITMC-I	Environmental Sciences	-	-	-	-	-	-	0
7.	Professional Core Courses	BTIT-18405	Computer Networks Lab	0	0	2	30	20	50	1
8.	Professional Core Courses	BTIT-18406	Operating Systems Lab	0	0	2	30	20	50	1
9.	Professional Core Courses	BTIT-18407	Design & Analysis of Algorithms Lab	0	0	4	30	20	50	2
10.	Professional Core Courses	BTIT-18408	I.T Workshop*	1	0	2	30	20	50	2
Total Credits				16	1	10	320	380	700	22

*Only practical examination will be held. No theory examination is to be held.

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Semester V (Third year) Curriculum
Branch/Course: Information Technology

Sr. No	Type of Course	Course Code	Course Title	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
1.	Professional Core Courses	BTIT-18501	Formal Language & Automata Theory	3	0	0	40	60	100	3
2.	Professional Core Courses	BTIT-18502	Database Management Systems	3	0	0	40	60	100	3
3.	Professional Core Courses	BTIT-18503	Programming in Java	3	0	0	40	60	100	3
4.	Professional Core Courses	BTIT-18504	Software Engineering	3	0	0	40	60	100	3
5.	Humanities & Social Sciences Including Management	BTHS-18902	Humanities I (Entrepreneurship and Project Management)	3	0	0	40	60	100	3
6.	Professional Elective Courses	BTIT-18XXX	Department Elective-I	3	0	0	40	60	100	3
7.	Mandatory Courses	ITMC-II	Constitution of India/Essence of Indian Traditional Knowledge	-	-	-	-	-	-	0
8.	Professional Core Courses	BTIT-18505	Database Management Systems Lab	0	0	4	30	20	50	2
9.	Professional Core Courses	BTIT-18506	Programming in Java Lab	0	0	4	30	20	50	2
10.	Internship	BTIT-18507	Summer Training*	-	-	-	-	100	100	2
Total Credits				18	0	8	300	500	800	24

*The students will take 4-6 weeks summer training in Industry or Entrepreneurship activity after semester 4th.

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Semester VI (Third year) Curriculum
Branch/Course: Information Technology

Sr. No	Type of Course	Course Code	Course Title	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
1.	Professional Core Courses	BTIT-18601	Big Data	3	0	0	40	60	100	3
2.	Professional Core Courses	BTIT-18602	Web Technologies	3	0	0	40	60	100	3
3.	Professional Elective Courses	BTIT-18XXX	Department. Elective-II	3	0	0	40	60	100	3
4.	Professional Elective Courses	BTIT-18XXX	Department Elective-III	3	0	0	40	60	100	3
5.	Open Elective Courses	BTXX-18XXX	Open Elective-I (Humanities)	3	0	0	40	60	100	3
6.	Project	BTIT-18603	Project-1	0	0	4	60	40	100	2
7.	Professional Core Courses	BTIT-18604	Big Data Lab	0	0	4	30	20	50	2
8.	Professional Core Courses	BTIT-18605	Web Technologies Lab	0	0	4	30	20	50	2
Total Credits				15	0	12	320	380	700	21

The students will take 4-6 weeks summer training in the industry or entrepreneurship activity after semester 6th

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Semester VII (Fourth year) Curriculum
Branch/Course: Information Technology

Sr. No	Type of Course	Course Code	Course Title	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
1.	Open Elective Courses	BTXX-18XXX	Open Elective-II	3	0	0	40	60	100	3
2.	Professional Elective Courses	BTIT-18XXX	Department Elective-IV	3	0	0	40	60	100	3
3.	Professional Elective Courses	BTIT-18XXX	Department Elective-V	3	0	0	40	60	100	3
4.	Professional Core Courses	BTIT-18701	Software Testing & Quality Assurance	3	0	0	40	60	100	3
5.	Project	BTIT-18702	Project-II	0	0	8	100	50	150	4
6.	Professional Training	BTIT-18703	Summer Industrial Training*	-	-	-	60	40	100	2
Total Credits				12	0	8	320	330	650	18

*The students will take 4-6 weeks summer training in the industry or entrepreneurship activity after semester 6th.

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Semester VIII (Fourth year) Curriculum
Branch/Course: Information Technology

Sr. No	Type of Course	Course Code	Course Title	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
1.	Open Elective Courses	BTXX-18XXX	Open Elective-III	3	0	0	40	60	100	3
2.	Professional Core Courses	BTIT-18801	Data Analytics	3	0	0	40	60	100	3
3.	Professional Elective Courses	BTIT-18XXX	Department Elective-VI	3	0	0	40	60	100	3
4.	Project	BTIT-18802	Project-III	0	0	12	100	50	150	6
5.	Internship	BTIT-18803	Seminar*	2	-	-	50	0	50	2
Total Credits				11	0	12	270	230	500	17

*The students will prepare and present seminar based on the project.

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LIST OF DEPARTMENT ELECTIVES

Department Elective-I

BTIT 18911	E-Commerce
BTIT 18912	Cyber Laws and IPR
BTIT 18913	Computational Biology
BTIT 18914	Artificial Intelligence

Department Elective-II

BTIT 18921	Fundamentals of Virtualization
BTIT 18922	Distributed Systems
BTIT 18923	Machine Learning
BTIT 18924	Agile Software Development

Department Elective-III

BTIT 18931	Cryptography and Network Security
BTIT 18932	Management Information System
BTIT 18933	Digital Image Processing
BTIT 18934	Cloud Computing

Department Elective-IV

BTIT 18941	Software Project Management
BTIT 18942	Distributed Operating System
BTIT 18943	Soft Computing
BTIT 18944	Human Computer Interaction

Department Elective-V

BTIT 18951	Data Mining
BTIT 18952	Ad-Hoc and Sensor Networks
BTIT 18953	Speech and Natural Language Processing
BTIT 18954	Network Programming

Department Elective-VI

BTIT 18961	Internet of Things
BTIT 18962	Real Time Systems
BTIT 18963	Neural Networks and Deep Learning
BTIT 18964	Modeling and Simulation

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LIST OF OPEN ELECTIVES

Open electives offered by the department:

Courses of odd semesters:

BTIT-18971   Data Structures & Algorithms
BTIT-18972   Object Oriented Programming
BTIT-18973   Database Management System

Courses of even semesters:

BTIT-18981   Computer Architecture
BTIT-18982   Computer Networks
BTIT-18983   Operating System

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3rd

Semester

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18301   Digital Electronics

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.   (8)

Module 2: Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer / Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.   (8)

Module 3: Sequential circuits and systems

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.   (8)

Module 4: A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.   (8)

Module 5: Semiconductor memories and Programmable logic devices. (7Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).   (8)

Suggested Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

BTIT-18302   Data Structure & Algorithms

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Detailed contents:
Module 1:
Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.   (8)

Module 2:
Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.   (9)

Module 3:
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.   (12)

Module 4:
Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.
Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.   (11)

Suggested books:
1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:
1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

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BTIT-18303   Object Oriented Programming

Internal Marks: 40   **L   T   P**
External Marks: 60   **3   0   0**
Total Marks: 100

Pre-requisites: Engineering Science Course (Programming for Problem Solving)

Objectives of the course

The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.

Detailed contents

Module 1:

Abstract data types and their specification, How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.

Comparison between procedural programming paradigm and object-oriented programming paradigm, Features of object-oriented programming-concepts of an object and a class, Abstraction, Encapsulation, object identity, polymorphism, inheritance, overloading, messaging.   (10)

Module 2:

Inheritance in OO design: Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, overriding member functions, order of execution of constructors and destructors.

Design patterns: Introduction and classification. The iterator pattern. Model-view-controller pattern.   (8)

Module 3:

Classes and Objects: Specification of a class, creating class objects, accessing class members, access specifiers, static members, friends of a class, nested classes, abstract classes.

Memory Management: Memory allocation (static and dynamic), dynamic memory management, Garbage Allocation, memory leak and allocation failures.   (8)

Module 4:

Constructors and Destructors: Need for constructors and destructors, copy constructor, destructors, constructors and destructors with static members.

Operator overloading and Type Conversion: Overloading operators, rules for overloading operators, overloading of various operators, type conversion.   (8)

Module 5:

GUIs. Graphical programming with Scala and Swing,

Note: The concepts should be practised using C++ and Java. Pearl may also be introduced wherever possible.

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Suggested books

1. Herbert Schildt, The Complete Reference Java, Seventh Edition, McGraw-Hill.
2. Lafore R., Object Oriented Programming in C++, Waite Group.
3. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.
4. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001

Suggested reference books

1. R. S. Salaria,Mastering Object-Oriented Programming with C++, Salaria PublishingHouse.
2. Bjarne Stroustrup, The C++ Programming Language, AddisonWesley.
3. Herbert Schildt, The Complete Reference to C++ Language,McGraw Hill-Osborne.
4. Deitel and Deitel, Java: How to Program, 6th Edition, Pearson Education.
5. M.P. Bhave, S.A. Patekar, Programming with java, Pearson Education.

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B. Tech (I.T)   (2018 Batch Onward)

BTAM-18301 Mathematics-III

Internal Marks: 40   **L T P**
External Marks: 60   **3 1 0**
Total Marks: 100

Objectives
The objective of this course is to familiarize the students with functions of several variables and to introduce effective mathematical tools for the solutions of ordinary differential equations.

Detailed contents
Module 1:
Multivariable Calculus (Differentiation)
Partial differentiation, total derivative, Composite functions, Implicit functions, Euler's Theorem, Jacobians. Applications: Tangent plane and normal line, Taylor's and Maclaurin Theorem, Application in estimation of error and approximation, Maxima and Minima, Method of Lagrange's multipliers.   (15)

Module 2:
Multivariable Calculus (Integration)
Double Integral, Change of variable in double integral, Change of order of Integration, Triple Integral, Change of variable in Triple Integral, Applications of Double and Triple Integrals   (10)

Module 3:
Ordinary Differential Equations
Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation. Linear differential equations with constant co-efficient, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficient (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficient.   (15)

Suggested Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5. S. L. Ross, Differential Equations, Wiley India
6. T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18304   Computer Architecture

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Objectives of the course:
To expose the students to the following:
1. How Computer Systems work & the basic principles
2. Instruction Level Architecture and Instruction Execution
3. The current state of art in memory system design
4. How I/O devices are accessed and its principles.
 5. To provide the knowledge on Instruction Level Parallelism
6. Concepts of advanced pipelining techniques.

Detailed contents
Module 1:
Basic Structure of Computer: Computer Types, Memory, CPU, Input-Output subsystem, Control Unit, Number Representation and Arithmetic operations, Character representation, historical Perspective.
Computer Arithmetic: Addition and subtraction of signed numbers, Carry look ahead adder, Multiplication of unsigned numbers using array multiplier, The Booth algorithm, Fast multiplication using carry save addition, Division restoring and non-restoring techniques, Floating point Arithmetic   (10)

Module 2:
Instruction Set Architecture: Instruction set characteristics and functions, Addressing modes and Instruction formats with case study of x86 and ARM.
Control Unit: Hardwired and micro programmed control unit.   (10)

Module 3:
Memory Organization: Memory Hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, Virtual memory,, Memory management hardware.
I/O Organization: Input output interface, Asynchronous data transfer, Modes of data transfer, Priority interrupt, Direct memory access, I/O processor. Interconnection standard: USB, SCSI and PCI express. (10)

Module 4:
Pipelining and Parallel Processing: Pipelining Organization, pipeline hazards, Pipeline in CISC processors, Multiprocessor organization, symmetric multiprocessors, Cache coherence and MESI protocol, Clusters, Multicore organization. Heterogeneous Multicore organization.   10)

Suggested books:
1. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
2. "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education. Suggested

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3. "Computer system architecture"3rd edition by M. Morris Mano, Pearson Education.

Suggested Reference books:
1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18305   Digital Electronics Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 2**
Total Marks: 50

Implementation of all experiments with the help of Bread- Board.

1. Study of Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates; Realization of OR, AND, NOT and XOR functions using universal gates.
2. Half Adder / Full Adder: Realization using basic and XOR gates.
3. Half Subtractor / Full Subtractor: Realization using NAND gates.
4. 4-Bit Binary-to-Gray & Gray-to-Binary Code Converter: Realization using XOR gates.
5. 4-Bit and 8-Bit Comparator: Implementation using IC7485 magnitude comparator chips.
6. Multiplexer: Truth-table verification and realization of Half adder and Full adder using IC74153 chip.
7. Demultiplexer: Truth-table verification and realization of Half subtractor and Full subtractor using IC74139 chip.
8. Flip Flops: Truth-table verification of JK Master Slave FF, T-type and D-type FF using IC7476 chip.
9. Asynchronous Counter: Realization of 4-bit up counter and Mod-N counter using IC7490 & IC7493 chip.
10. Synchronous Counter: Realization of 4-bit up/down counter and Mod-N counter using IC74192 & IC74193 chip.
11. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO & Shift left operations using IC7495 chip.
12. DAC Operation: Study of 8-bit DAC (IC 08/0800 chip), obtain staircase waveform using IC7493 chip.
13. ADC Operations: Study of 8-bit ADC.

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18306   Data Structure & Algorithms Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0   0 4**
Total Marks: 50

List of practical exercises, to be implemented using object- oriented approach in C++ Language.

1. Write a menu driven program that linear array: implements following operations (using separate functions) on linear array: Insert a new element at end as well as at a given position, Delete an element from a given whose value is given or whose position is given, To find the location of a given element, To display the elements of the linear array.

2. Write a menu driven program that maintains a linear linked list whose elements are stored in on ascending order and implements the following operations (using separate functions): Insert a new element, Delete an existing element, Search an element, Display all the elements

3. Write a program to demonstrate the use of stack (implemented using linear array) in converting arithmetic expression from infix notation to postfix notation.

4. Program to demonstrate the use of stack (implemented using linear linked lists) in evaluating arithmetic expression in postfix notation.

5. Program to demonstration the implementation of various operations on a linear queue represented using a linear array.

6. Program to demonstration the implementation of various operations on a circular queue represented using a linear array.

7. Program to demonstration the implementation of various operations on a queue represented using a linear linked list (linked queue).

8. Program to illustrate the implementation of different operations on a binary search tree.

9. Program to illustrate the traversal of graph using breadth-first search.

10. Program to illustrate the traversal of graph using depth-first search.

11. Program to sort an array of integers in ascending order using bubble sort.

12. Program to sort an array of integers in ascending order using selection sort.

13. Program to sort an array of integers in ascending order using insertion sort.

14. Program to sort an array of integers in ascending order using radix sort.

15. Program to sort an array of integers in ascending order using merge sort.

16. Program to sort an array of integers in ascending order using quick sort.

17. Program to sort an array of integers in ascending order using heap sort.

18. Program to sort an array of integers in ascending order using shell sort.

19. Program to demonstrate the use of linear search to search a given element in an array.

20. Program to demonstrate the use of binary search to search a given element in a sorted array in ascending order.

BTIT-18307   Object Oriented Programming Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 4**
Total Marks: 50

1. Take a problem and develop the structures to represent objects and the algorithms to perform operations.
2. Write a program to implement an abstract data type.
3. Write a program for implementation of inheritance.
4. Write a program to implement the Iterator pattern interface.
5. Write a program to demonstrate the use of MVC pattern.
6. Write a program for implementation of classes.
7. Write a program for implementation of dynamic memory allocation.
8. Write program to demonstrate the use constructors and destructors.
9. Write a program to demonstrate the overloading of unary operator.
10. Write a program to demonstrate the overloading of binary operator.
11. Write a program to demonstrate type conversion.
12. Write a program to demonstrate graphical programming.

4th

Semester

BTAM-18401 Discrete Structures

Internal Marks: 40 **L T P**
External Marks: 60 **3 1 0**
Total Marks: 100

Objectives
To provide knowledge of combinatorial problems, algebraic structures and graph theory required for building mathematical foundation of computer science.

Detailed Contents

Module 1:
Sets, Relations and Functions
Basic operations and laws on sets, Cartesian products, Binary relation, Partial order relation, Equivalence Relation, different types of functions, their compositions and inverses. (8)

Module 2:
Propositional Logic
Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory. (8)

Module 3:
Partially ordered sets
Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices, Boolean and pseudo Boolean lattices. (8)
Introduction to Counting
Basic counting techniques – inclusion and exclusion, pigeonhole principle, permutation, combination, Introduction to recurrence relation and generating functions.

Module 4:
Algebraic Structures
Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. Algebraic structures with two binary operations- ring, integral domain, and field. Boolean algebra and Boolean ring (Definitions and simple examples only). (8)

Module 5:
Introduction to Graphs
Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees. (8)

Suggested Books:
1. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill
2. C.L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill
3. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific
4. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, Addison-Wesley
5. K. H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill

6. J. L. Hein, Discrete Structures, Logic, and Computability, Jones and Bartlett
7. Narsingh Deo, Graph Theory with Application to Engineering and Computer Science, PHI

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18402   Computer Networks

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Objectives of the course

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Detailed contents

Module 1:
Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.   (8)

Module 2:
Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA   (8)

Module 3:
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.   (8)

Module 4:
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.   (8)

Module 5:
Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography   (8)

Suggested books

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

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Suggested Reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18403   Operating Systems

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Pre- Requisites: Computer Organization & Architecture

Objectives of the course
1. To learn the fundamentals of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication
3. To learn the mechanisms involved in memory management in contemporary OS
4. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
5. To know the components and management aspects of concurrency management
6. To learn to implement simple OS mechanisms

Detailed contents
Module 1:
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.   (8)

Module 2:
Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching
Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,
Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.   (8)

Module 3:
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.   (8)

Module 4:
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.   (6)
Module 5:

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

(8)

Module 6:

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks   (8)

Suggested books:
1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Suggested reference books:
1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison- Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18404   Design & Analysis of Algorithms

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Pre-requisites: Programming for Problem Solving

Objectives of the course
- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Detailed contents:
Module 1:
Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.   (10)

Module 2:
Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.   (8)

Module 3:
Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.   (8)

Module 4:
Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.   (8)

Module 5:
Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE   (6)

Suggested books:
1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTHS-18905 Effective Technical Communication

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.   (7)

Module 2: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.   (7)

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity.   (7)

Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.   (7)

Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.   (7)

Books Recommended-

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
3. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
4. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.

ITMC-I   Environmental Sciences
(Mandatory Course)

Course Objectives: To think across and beyond existing disciplinary boundaries, mindful of the diverse forms of knowledge and experience that arises from human interactions with the world around them.

Detailed Contents:

Module 1:
Introduction: Definition, scope and importance of multidisciplinary nature of environment. Need for public awareness.
Natural Resources: Introduction and types of natural Resources and associated problems, use and over exploitation of resources.   **(8)**

Module 2:
Ecosystem and Biodiversity: Concept and types of Ecosystem, Structure and functions of ecosystem , producers , consumers and decomposers , ecological pyramids , Introduction to biodiversity, levels of biodiversity, values of biodiversity, importance (uses) of biodiversity, Hot spots of biodiversity, Threats to biodiversity, Conservation of biodiversity (in situ and ex situ techniques).   (8)

Module 3:
Environmental Pollution: Introduction, definition, sources, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution. Nuclear hazards.
Solid waste Management: Types, sources, causes and effects of solid wastes, Methods of solid waste disposal.
Disaster Management: Introduction, characteristics and types of Disasters, Causes, effects and control measures of Floods, earthquake, cyclone and landslides.   (8)

Module 4:
Global Environment Issues: Concept of sustainable development, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation, Climate change, Global warming (Green house effect), Acid rain, Ozone layer depletion, Wasteland reclamation.   (8)

Module 5:
Legislation for Environmental Protection : Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of pollution) Act, Environment Protection Act, Wildlife Protection Act, Forest Conservation Act, their objectives and salient features.
Environment and Human Population: Population growth, Population explosion, Environment and human health, Human Rights, Value Education, Environmental ethics, Role of Information Technology in Environment and human health.   (8)

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Suggested Text Books

1. Sawyer CN, McCarty PL and Parkin GF, Chemistry for Environmental Engineering and   Science, McGraw Hill (2003)
2. Bharucha, E., Textbook of Environmental Studies, Universities Press (2005).
3. Chapman, J.L. and Reiss, M.J., Ecology-Principles and Application, Cambridge University Press (LPE) (1999).
4. Joseph, B., Environmental Studies, Tata McGraw-Hill (2006).

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B. Tech (I.T) **(2018 Batch Onward)**

BTIT-18405   Computer Networks Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. To study various topologies for establishing computer networks.
2. To learn the usage of various basic tools (crimping, krone etc.) used in establishing a LAN.
3. To familiarize with switch and hub used in networks
4. To learn the usage of connecters and cables (cabling standards) used in networks
5. To make certain copper and fiber patch cords using different standards.
6. To familiarize with routers & bridges
7. Use commands like ping, ipconfig for trouble shooting network related problems.
8. Develop a program to compute the Hamming Distance between any two code words.
9. Develop a program to compute checksum for an 'm' bit frame using a generator polynomial.

BTIT-18406   Operating Systems Lab

Internal Marks: 30 **L T P**
External Marks: 20 **0 0 2**
Total Marks: 50

1. To explore and installation process different operating systems like Linux, Windows etc.
2. Virtualization, Installation of Virtual Machine Software and installation of Operating System on Virtual Machine
3. Execute various basic and advance Linux commands, commands for files and directories, creating and viewing files, File comparisons, Disk related commands.
4. Execute Linux commands for Processes in Linux, connecting processes with pipes, background processes, managing multiple processes.
5. Study and usage of vi Editor.
6. Basics of Shell programming, various types of shell, Shell Programming in bash.
7. Study and implementation of shell variables, shell keywords.
8. Implement conditional statements, looping statement and case statement in Shell programming.
9. Implement parameter passing and arguments in Shell programming.
10. Implement Shell programs for automate system tasks and report printing.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18407   Design & Analysis of Algorithms Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 4**
Total Marks: 50

1. Program to implement Strassen's Matrix multiplication using divide and conquer technique
2. Program to find the median element in an array of integers.
3. Program to find the majority element in an array of integers.
4. Program to sort an array of integers using Heap sort.
5. Program to sort an array of integers using Merge sort.
6. Program to input and Sort an array of integers using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n.
7. Program to implement knapsack algorithm.
8. Program to find the minimum spanning tree in a weighted, undirected graph.

BTIT-18408   IT Workshop

Internal Marks: 30	**L T P**
External Marks: 20	**1 0 2**
Total Marks: 50	

Objective of Course: The objective of this course is to demonstrate the students, the basic features of MATLAB/SCILAB, Python and provide hands on training so that the students could be able to use this tool later on for various projects and thesis work.

Module 1:
Basics of   MATLAB/SCILAB : Introduction,   Basic features, A minimum session, Starting MATLAB/Scilab, using MATLAB/Scilab as a calculator , Quitting MATLAB/SCILAB , creating variables, Overwriting variable, Error messages, Making corrections, Controlling the hierarchy of operations or precedence , Controlling the appearance of floating point number , Managing the workspace, Entering multiple statements per line.   (7)

Module 2:
Basic Graphics and Matrix Algebra: Mathematical functions, Basic plotting, overview, Creating simple plots , Adding titles, axis labels, and annotations , multiple data sets in one plot , Specifying line styles and colors, Entering a vector, Entering a matrix, Matrix indexing, Colon operator, Linear spacing, Colon operator in a matrix, creating a sub-matrix, Deleting row or column, Transposing a matrix , Concatenating matrices.
                                                                                                                                (7)

Module 3:
Array operations and Linear equations: Array operations, Matrix arithmetic operations , Array arithmetic operations , Solving linear equations , Matrix inverse   (7)

Module 4:
Introduction to programming in MATLAB/SCILAB : Introduction , M-File Scripts, Examples, Script side-effects , File functions , Anatomy of a M-File function, Input and output arguments , Input to a script file , Output commands   (7)

Module 5:
Control flow and operators: Introduction ,   Control flow, The ''if...end'' structure, Relational and logical operators , The''for...end''loop , The ''while...end''loop Other flow structures, Saving output to a file.   (7)

Module 6:
Python: Introduction, gitHub, Functions, Booleans and Modules, Sequences, Iteration and String Formatting, Dictionaries, Sets, and Files, Exceptions, Testing, Comprehensions, Object Oriented Programming
                                                                                                                                (7)

Suggested Books:
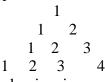1. Stephen J. Chapman . MATLAB- Programming for Engineers, Fourth Edition 2008
2. Holly More.MATLAB-for Engineers,Fourth Edition by Pearson.
3. Introduction to Scilab: For Engineers and Scientists, Sandeep Nagar
4. Scilab: A Free Software to MATLAB, Achuthsankar S. Nair and Hema Ramachandran
5. The Complete Reference to Python, Tata Mc Graw Hill, Martin C. Brown.
6. Programming in Python, Mark Summerfield

List of Experiments: (using MATLAB/SCILAB/Python)

1. Installation of MATLAB/SCILAB.
2. Various Operations of mathematics in MATLAB/SCILAB.
3. Handling of matrices.
4. To plot different types of two dimensional plots.
5. Branching statements-IF,IF-ELSE,Switch.
6. Write a program for printing below mention pattern.

```
            1
         1    2
       1   2   3
     1   2   3    4
```

7. Write a program for calculating whether number is prime or not with the help of function.
8. Write a program for implementation of basic Calculator.
9. Write a program to add to numbers using python language.
10. Write program to make a simple calculator using python.
11. Python Program to check if a Number is Positive, Negative or 0
12. Python Program to Count the Number of Each Vowel
13. Python Program to Sort Words in Alphabetic Order

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5th *to* 8th

Semester

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT- 18501   Formal Language & Automata Theory

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Basics of Strings and Alphabets, Finite Automata – DFA, transition graphs, regular languages, non-deterministic FA, equivalence of DFA and NDFA   (8)

Module 2: Regular Expression and Grammar
Regular grammars, regular expressions, equivalence between regular languages, properties of regular languages, pumping lemma, Context Free Languages, Leftmost and rightmost derivation, parsing and ambiguity, ambiguity in grammar and languages, normal forms   (10)

Module 3: Automata Theory
Pushdown Automata, NDPDA, DPDA, context free languages and PDA, comparison of deterministic and non-deterministic versions, closure properties, pumping lemma for CFL,Turing Machines, variations, halting problem, PCP   (12)

Module 4: Properties of Grammar
Chomsky Hierarchy, LR(k) Grammars, properties of LR(k) grammars, Decidability and Recursively Enumerable Languages   (10)

Suggested Books:

1. K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science, Third Edition", PHI Learning Private Limited.
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory", Languages and Computation, Pearson Education.
3. M. Sipser, "Introduction to the Theory of Computation", Second Edition, Cengage Learning.
4. K. V. N. Sunitha , N. Kalyani, "Formal Languages and Automata Theory", McGraw-Hill.

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B. Tech (I.T)   (2018 Batch Onward)

BTIT-18502 Database Management System

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to Database Concepts
File Systems Versus a DBMS, Advantages of a DBMS, Describing and Storing Data in a DBMS, Database System Architecture, DBMS Layers, Data independence.   (5)

Module 2: Data Models
Relational Model, Network Model, Hierarchical Model, ER Model: Design, issues, Mapping constraints, keys, ER diagram, weak entity sets, extended ER features, Design of an ER Database schema, Reduction of an ER Schema to tables, Comparison of Models.   (8)

Module 3: Relational Query Languages SQL
Basic SQL Select Statements. Table Creation and Management: Create, Alter, Drop and Rename. Constraints: Primary key, Foreign key, Unique, Not null and Check. Data Manipulation: Insert Update and Delete. Restricting rows in Select using Where clause, Comparison operators, Logical Operators, Order by clause.
                                                                                          (10)

Module 4: Physical Data Organization
File Organization and Indexing, Index Data Structures, Hashing, B-trees, Clustered Index, Sparse Index, Dense Index, Fixed length and Variable Length Records.   (7)

Module 5: Database Design Design
Functional Dependencies, Reasoning about Functional Dependencies, Normal Forms, Schema Refinement, First, Second and Third Normal Forms, BCNF, Multivalued Dependency, Join Dependency, Fourth and Fifth Normal Forms, Domain Key Normal Forms, Decompositions.   (5)

Module 6: Transaction Management
ACID Properties, Serializability, Two-phase Commit Protocol, Concurrency Control, Lock Management, Lost Update Problem, Inconsistent Read Problem, Read-Write Locks, Deadlocks Handling, 2PL protocol.(5)

Suggested books:
1. Navathe and Elmasri, Fundamentals of Database Systems, Pearson education
2. Korth and Silberschatz Abraham, Database Concepts, McGraw Hall.
3. An introduction to database system by C.J.Date (Addison Welsey, Publishing house).
4. Bipin Desai, Database System, TMG
5. Prateek Bhatia, Database Management system, Kalayani Publishers

BTIT-18503 Programming in Java

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Module 1: Introduction to Java

Features of Java, Object oriented programming, Date types, Variables, Casting, automatic type promotion in expressions, Arrays.   (3)

Module 2: Operators and Control Statements

Arithmetic operators bit-wise operators, relational operators, Boolean logical operators, operator precedence, Java's selection statements, iteration statements, jump statements.   (3)

Module 3: Introduction to Classes

Class fundamentals, declaring object reference variable, Introducing methods, constructors, this keyword, garbage collection, the finalize() method, Overloading methods, using objects as parameters, recursion.   (4)

Module 4: Inheritance

Inheritance basics, using super, method overriding, dynamic method dispatch, using abstract Classes, Using final with inheritance, Package and Interfaces, Package access protection, importing packages.   (4)

Module 5: Exception Handling

Exception handling fundamentals, Exception types, Uncaught Exceptions Using try and catch, multiple catch clauses, nested try statements, throw, finally Java's built-in exceptions, creating your own exception sub classes, using exceptions.   (3)

Module 6: Multithreaded Programming

The Java thread model, the main thread, creating thread, creating multiple threads, using is alive () and join (), Thread priorities, synchronization, Inter thread communications, suspending resuming and stopping threads.   (5)

Module 7: I/O, Applets and Graphics

I/O Basics, Reading Console Input, Writing Console Output, Reading and Writing Files, Applet Fundamentals, Applet Architecture, Applet initialization and termination, Frame Windows, Drawing Lines, Rectangles, Circles, Ellipses.   (5)

Module 8: Event Handling and Swings

Introduction to Abstract Window Toolkit (AWT) , working with button, text field, check box, radio button, canvas, Event Handling, Delegation event Model, Event classes and event listener interfaces, key events, mouse events, Adapter classes, Database Connectivity with JDBC, Introduction to Swings.

(4)

Suggested Books:

1. Herbert Schildt, The Complete Reference Java, Seventh Edition, McGraw-Hill.
2. M.P. Bhave, S.A. Patekar, Programming with java, Pearson Education.
3. Joyce Farrell, Java for Beginners, Cengage Learning.
4. Deitel and Deitel, Java: How to Program, 6th Edition, Pearson Education.
5. James Edward Keogh, Jim Keogh, J2EE: The complete Reference, McGraw-Hill
6. Khalid A. Mughal, Torill Hamre, Rolf W. Rasmussen, Java Actually, Cengage Learning.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18504   Software Engineering

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Software Development

Evolution of Software Engineering and Terminology, Software Life cycle Model, Waterfall model, Incremental and evolutionary models, component based development, Agile Software development, scrum and agile modelling.   (8)

Module 2: Requirement Analysis

Software Requirements, Characteristics of SRS, Components of SRS, specification language and structure of SRS document, Validation, Size-Function point, Quality Metrics   (6)

Module 3: Software Designing

Design concepts: Abstraction, Architecture, patterns, Separation of Concerns, Modularity, Cohesion, Coupling and Layering, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Design Classes, Function oriented designing, Object oriented designing, DFD, use case diagram, activity chart, state chart, class diagram.   (9)

Module 4: Software Verification and Validation

Software verification and validation, Software testing, White Box testing, Basis path Testing, control Structure Testing, Black box testing, System testing, alpha and beta testing.   (6)

Module 5: Software Project Management

Software Project Estimation, Decomposition Techniques, Empirical Estimation Models. Software Quality Assurance, Software Quality Attributes, PSP and six sigma, Software reengineering, Computer Aided Software Engineering.   (8)

Suggested Books:
1. Software Engineering a Practitioner Approach, 7th Edition by R Pressman
2. Software Engineering An Integerated Approach, 3rd edition by Pankaj Jalote
3. Software Engineering: A Practitioner Approach by Sommerville

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18505 Database Management Systems Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 4**
Total Marks: 50

1. Creation of a database and writing SQL queries to retrieve information from the database.
2. Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.
3. Creation of Views, Synonyms, Sequence, Indexes, Save point.
4. Creating an Employee database to set various constraints.
5. Creating relationship between the databases.
6. Set Operators, Nested Queries, Joins, Sequences.
7. Views, Indexes, Database Security and Privileges: Grant and Revoke Commands, Commit and Rollback Commands.
8. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing NonSQL parameters.
9. Stored Procedures and Exception Handling.
10. Triggers and Cursor Management in PL/SQL.
11. Working with XML databases.
12. Introduction to a data mining tool

BTIT-18506 Programming in Java Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 4**
 Total Marks: 50

1. Implementation of classes.
2. Implementation of inheritance.
3. Implementation of packages and interfaces.
4. Implementation of threads.
5. Using exception-handling mechanisms.
6. Implementation of Applets.
7. Implementation of Frame Window and Graphics
8. Implementation of mouse events, and keyboard events.
9. Implementing basic file reading and writing methods.
10. Connecting to Database using JDBC.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18601 Big Data

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to Big Data

Databases and their evolution, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics. **(10)**

Module 2: NoSQL Data Management

Introduction to NoSQL, Types of NoSQL, aggregate data models, aggregates, key-value, document data models, relationships, graph databases, schema less databases, materialized views. Overview of MongoDB. MapReduce, partitioning and combining, composing map-reduce calculations, MapReduce examples such as matrix multiplication. **(10)**

Module 3: Hadoop

Introduction to Hadoop, Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop distributed file system (HDFS), HDFS concepts, data flow, Hadoop I/O, data integrity, compression, serialization, Avro file-based data structures, Map Reduce workflows, unit tests with MRUnit, test data and local tests – anatomy of Map Reduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats. **(10)**

Module 4: Hadoop Related Tools

Hbase, data model and implementations, Hbase clients, Hbase examples – praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration. Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation – HiveQL queries, Overview of spark. **(10)**

Suggested Readings/Books

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics, "Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Big-Data Black Book, DT Editorial Services, Wiley India
3. Massive Online Open Courses (MOOCS): Big Data University, Udacity and Coursera.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18602 Web Technologies

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Module 1: Internet and World Wide Web
Introduction, Internet Addressing, ISP, types of Internet Connections, Introduction to WWW, WEB Browsers, WEB Servers, URLs, HTTP, WEB Applications, Tools for web site creation.   (3)

Module 2: HTML5
Introduction to HTML5, Lists, adding graphics to HTML5 page, creating tables, linking documents, forms, frames, Cascading Style sheets.   (6)

Module 3: Java Script
Introduction, programming constructs: variables, operators and expressions, conditional checking, functions and dialog boxes, JavaScript DOM, creating forms, Introduction to Cookies, JQuery.   (6)

Module 4: AJAX
Introduction, HTTP Request, XMLHttpRequest, AJAX Server Script.   (4)

Module 5: PHP
Introduction, syntax, statements, operators, PHP and MySQL, PHP and AJAX.   (6)

Module 6: Introduction
ASP.net, J2EE, POJO, Java servlets and JSP.   (6)

Suggested Books:
 1. Deitel, Deitel, Nieto, Lin and Sadhu, XML How to Program, Pearson Education.
 2. Ivan Bayross, Web Enabled Commercial Application Development using HTML, DHTML, JavaScript, Perl CGI, BPB.
 3. Steven M. Schafer, HTML, CSS, JavaScript, Perl, Python and PHP, Wiley India
 4. Paul S. Wang, G. Keller, S. Katila, An Introduction to Web Design + Programming, Cengage Learning.
 5. Jeffery C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18604 Big Data Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 4**
Total Marks: 50

1. Study of Hadoop ecosystem
2. Programming exercise on Hadoop
3. Programming exercise in No SQL
4. Implementing simple algorithms in Map- Reduce (3) - Matrix multiplication, Aggregates, joins, sorting, searching etc.
5. Implementing any one Frequent Itemset algorithm using Map-Reduce
6. Implementing any one Clustering algorithm using Map-Reduce
7. Implementing any one data streaming algorithm using Map-Reduce

BTIT-18605 Web Technologies Lab

Internal Marks: 30   **L T P**
External Marks: 20   **0 0 4**
Total Marks: 50

1. Creation of Web pages using HTML, DHTML.
2. Creation of Web pages using JavaScript.
3. Creation of Web pages using AJAX.
4. Creating Web pages using PHP.
5. Creating Web pages using ASP.
6. Creating Web pages using JSP

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18701 Software Testing and Quality Assurance

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Overview of Software Engineering, Software Process, Process Models, Overview of Project Management Process and its Phases.   (7)

Module 2: Software Quality Assurance Concepts and Standards
Quality Concepts, Quality Control, Quality Assurance, SQA Activities, Software Reviews, Formal Technical Reviews, Review Guidelines, Software Reliability, Software Safety, Quality Assurance Standards, ISO 9000, ISO 9001:2000, ISO 9126 Quality Factors, CMM, TQM, Six Sigma, SPICE, Software Quality Assurance Metrics.   (8)

Module 3: Software Testing
Testing, Verification and Validation, Test Strategies for Conventional and Object Oriented Software, Unit Testing, Integration Testing, Validation Testing, Alpha and Beta Testing, System Testing, Recovery Testing, Security Testing, Stress Testing, Performance Testing, Metrics for Source Code, Metrics for Testing, Debugging Process, Debugging Strategies.   (7)

Module 4: Testing Techniques
Software Testing Fundamentals, Black Box and White Box Testing, Basis Path Testing, Flow Graph Notation, Independent Program Paths, Graph Matrices, Control Structure Testing, Condition Testing, Data Flow Testing, Loop Testing, Graph Based Testing Methods, Equivalence Partitioning, Boundary Value Analysis.   (8)

Module 5: Object Oriented Testing Methods
Applicability of Conventional Test Case Design Methods, Issues in Object Oriented Testing, Fault-Based Testing, Scenario-Based Testing, Random Testing and Partition Testing for Classes, InterClass Test Case Design.   (8)

Module 6: Testing Process and Specialized Systems Testing
Test Plan Development, Requirement Phase, Design Phase and Program Phase Testing, Testing Client/Server Systems, Testing Web based Systems, Testing Offthe- Shelf Software, Testing in Multiplatform Environment, Testing for Real Time Systems, Testing Security.
Case Studies: Design test cases for ERP, Traffic controller, University Management system etc.   (8)

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Suggested Books

1. Ian Sommerville, Software Engineering, Seventh Edition, Pearson Education.
2. R.S. Pressman, Software Engineering: A Practitioner's Approach, Sixth Edition, Tata McGraw-Hill.
3. William E. Perry, Effective Methods for Software Testing, Second Edition, John Wiley & Sons.
4. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Third Edition, Auerbach Publications, Taylor and Francis Group.
5. Yogesh Singh, Software Testing, Cambridge University Press.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18801   Data Analytics

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Descriptive Statics

Descriptive Statistics - Graphical Approaches, Descriptive Statistics - Measures of Central Tendency, Descriptive Statistics - Measures of Dispersion.   (5)

Module 2: Probability Distributions & Inferential Statistics

Random Variables and Probability Distributions, Inferential Statistics - Motivation, Inferential Statistics - Single sample tests, Two Sample tests, Type 1 and Type 2 Errors, Confidence Intervals, ANOVA and Test of Independence, Short Introduction to Regression.   (10)

Module 3: Machine Learning

Introduction to Machine Learning, Supervised Learning, Unsupervised Learning, Ordinary Least Squares Regression, Simple and Multiple Regression, Regularization/ Coefficients Shrinkage, Data Modelling and Algorithmic Modelling Approaches.   (10)

Module 4: Regression and Classification problem

Logistic Regression, Training a Logistic Regression Classifier, Classification and Regression Trees, Bias Variance Dichotomy, Model Assessment and Selection, Support Vector Machines, Support Vector Machines for Non Linearly Separable Data, Support Vector Machine and Kernal Transformations, Decision Trees, Ensemble Methods and Random Forests, Artificial Networks and Deep learning.   (10)

Module 5: Association Rule Mining and Big Data

Association Rule Mining, Big Data – Small Introduction, Clustering Analysis, Introduction to experimentation and Active Learning, Introduction to online learning – Reinforcement Learning.   (5)

Suggested Books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010

Department Elective - I

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT 18911 E-Commerce

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Web commerce concepts- the e commerce phenomenon, electronic market place technologies, web based tools for e commerce, e commerce software hosting services and packages. Impact of e commerce on business, e commerce models, Drop- Shipping.   (5)

Module 2: Security issues
Security issues on web- World Wide Web & security. Importance of firewall and components of firewall, transaction security client server network.   (8)

Module 3: Electronic transactions.
Secure electronic transaction, secure online payment, micropayments, Industrial E-payment system, challenges and opportunities of e payment.   (10)

Module 4: Internet marketing.
The PROs and CONs of online shopping, the cons of online shopping, Internet marketing techniques.   (8)

Module 5: Mobile commerce.
Introduction to mobile commerce, mobile computing application, wireless application protocols.   (9)

Suggested Books:
1. Ravi kalakota Andrew Winston," Frontiers of electronic commerce", Addison Wesley.
2. Goel ritendra "E-commerce ", New age international.
3. Greenstein and feinman,"E- commerce"

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT 18912 Cyber Laws and IPR

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Basics of computer and Internet technology
Internet, ISP& Domain name, network security, encryption techniques and algorithms, Digital signatures.(8)

Module 2: Introduction to Cyber world
Introduction to cyberspace and cyber law, Different components of cyber law, Cyber law and Netizens. (8)

Module 3: Ecommerce
Introduction to Ecommerce, Different e commerce models, Ecommerce trends and prospects, ecommerce and taxation, legal aspects of e commerce.   (8)

Module 4: Intellectual Property Rights IPR
Copyright and Patents, International Treaties and Conventions, Business Software Patents, Domain Name Disputes and Resolution.   (8)

Module 5: Ethical hacking
Need, penetration testing: Information gathering tools like nmap, vulnearibility detection scanners like nessus, nexpose, information analysis and planning, attack and penetration tools like metasploit, results analysis and reporting.   (8)

Suggested books:
1. Cyber Security - Understanding cyber crimes,computer forensics and legal perspectives by Nina Godbole and Sunit Belapure.
2. System Forensics by Ankit Fadia.
3. Hacking Exposed: network security secrets and solutions by Stuart McClure, Scambray and Kurtz. Tata Mc Graw hill.

BTIT-18913   Computational Biology

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Bio Molecular Structure Dynamics
Computational Methods for Pathways and Systems Biology, Databases of Metabolic Pathways, Kyoto Encyclopedia of Genes and Genomes (KEGG), Analysis of Pathways, Glycolysis, Signaling Pathways, Genetic Pathways.   (5)

Module 2: Gene Prediction
Computational Gene Mapping and Gene Hunting, Genetic Mapping, Physical Mapping, Sequencing Similarity Search, Gene Prediction, Mutational Analysis, Introduction to Restriction Mapping and Map Assembly, Gene Prediction Methods, Gene Prediction Tools, Gene Expression.   (5)

Module 3: Gene Mapping
DNA Double Digest Problem, Multiple Solutions To Double Digest Problem, Alternating Cycles In Colored Graphs, Physical Maps And Alternating Eulerian Cycles, Transformations In Eulerian Cycles, Partial Digest Problem, Probed Partial Digest Problem, Homometric Sets. Gene Mapping, Mapping With Unique and Non-Unique Probes, Optical Mapping, Interval Graphs, Mapping With Restriction Fragment Fingerprints, Lander-Waterman Statistics, Screening Clone Libraries, Radiation Hybrid Mapping.   (8)

Module 4: Computer Aided Drug Design
Computer Aided Drug Design, Methods Of Computer Aided Drug Design, Ligand Design Methods, Docking Algorithms And Programs, Drug Design Approaches, Absorption, Distribution, Metabolism, And Excretion (ADME) Property Prediction, Computer Based Tools For Drug Design.   (5)

Module 5: Soft Computation
Introduction to Hidden Markov Model (HMM), Neural Networks, Machine Learning, Support Vector Machines, Fuzzy Logic, Evolutionary Computing And Genetic Algorithms –Application To Data Mining And Bioinformatics, Machine Learning Tools (MATLAB).   (5)

Module 6: Structure Databases
PDB And MMDB, Structure File Formats, Visualizing Information, Advance Structure Modeling, Internal And External Co-Ordinate System And Cylindrical Polar Co-Ordinate System, Potential Energy Calculations Using Semiempirical Potential Energy Function, Electrostatic Energy Surface Generation, Three Dimensional Structure Using Dynamic Programming Methods, Molecular Mechanics And Dynamics.

                                                                                (7)
Module 7: RNA Secondary Structure and Perl Language
RNA Secondary Structure – Combinatories, Minimum Free –Energy Structures, Consensus Folding, Unusual DNA Structures, Perl Language And Perl Programming.   (5)

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B. Tech (I.T)   **(2018 Batch Onward)**

Suggested Books:

1. Computation Biology and Bioinformatics: Gene regulation by Ka- Chun Wong. CRC Press, Taylor and Francis group, Science Publisher book.

2. Bioinformatics Algorithm: An elective learning Approach, 2nd Edition, Vol. 1 by Phillip Compeau and Pavel Pevzner. Active Learning Publishers.

3. Algebraic Stastics for Computational Biology edited by Lior Patcher and Bernd Sturmfels, Cambridge Publishers.

4. Computaional Molecular Biology: An Algorithm approach by P.A. Pevzner. Publisher MIT Press, London.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18914   Artificial Intelligence

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.   (8)

Module 2: Search Algorithms
Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.   (8)

Module 3: Probabilistic Reasoning
Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.   (8)

Module 4: Markov Decision process
MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.   (8)

Module 5: Reinforcement Learning
Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.   (8)

Suggested Books:
1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
3. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India.
5. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press.

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B. Tech (I.T)   **(2018 Batch Onward)**

Department Elective - II

BTIT-18921 Fundamentals of Virtualization

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: File System
Memory and Storage, File systems, Distributed file systems, Map and Reduce, Hadoop File Systems, Google File System, Big table.   (5)

Module 2: Introduction to Virtualization
Physical and virtual machines, Traditional and virtual computing, Understanding virtualization, Need and Applications of virtualization, Limitations, Simulations and Emulations, Challenges in Virtualized environment, tools and technologies in virtualized environments.   (5)

Module 3: Types of Virtualization
Various forms of virtualization: Desktop, Application, Server, Hardware, Storage, Memory and I/O virtualization.   (3)

Module 4: Server Virtualization
Server consolidation, Privileged instructions, Binary translation, Hypervisors, Types of Hypervisors, Hypervisor architecture, Full Virtualization, Para Virtualization , Hardware Assisted Virtualization, Implementation of Hardware Assisted Virtualization, Algorithms for implementation of Virtualization, Challenges.   (10)

Module 5: Network and Memory Virtualization
IP addressing, virtual LAN, Memory addressing, Paging, Memory mapping, virtual memory, complexities and solutions of memory virtualization.   (5)

Module 6: VM Management
VM lifecycle, Process and system level VMs, VM configurations, VM migrations, Migration types and process, VM provisioning, Scaling,VM scheduling, Load balancing: Significance, Types and Algorithms.   (5)

Module 7: Storage virtualization
RAID, SCSI, iSCSI, Direct attached storage, Network Attached storage, Storage Area network.   (3)

Module 8: Virtualization performance and Security
Performance issues, Virtual machine sprawling, Hypervisor vulnerabilities, Hypervisor attacks, VM attacks, VM migration attacks, Security solutions.   (4)

Suggested Books
1. Chris Wolf and Erick M. Halter, "Virtualization" A press.
2. LatifaBoursas (Editor), Mark Carlson (Editor), Wolfgang Hommel (Editor), Michelle Sibilla (Editor), KesWold (Editor), "Systems and Virtualization Management: Standards and New Technologies".

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3. Massimo Cafaro (Editor), Giovanni Aloisio (Editor), "Grids, Clouds and Virtualization" Springer.

4. Gaurav Somani, "Scheduling and Isolation in Virtualization", VDM VerlagDr.Müller [ISBN: 978-3639295139], Muller Publishers, Germany.

5. Edward Haletky, "VMware ESX and ESXi in the Enterprise – Planning Deployment of Virtualization Servers" [ISBN: 978-0137058976]., Prentice Hall.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18922 Distributed Systems

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Distributed computing systems (DCS)
Introduction, DCS design goals: Transparencies, Fundamental issues. Distributed Coordination: Temporal ordering of events, Lamport's logical clocks, Vector clocks; Ordering of messages, Physical clocks, Global state detection   **(7)**

Module 2: Process synchronization
Distributed mutual exclusion algorithms, Performance matrix, Inter-process communication   **(7)**

Module 3: Deadlocks, Load scheduling and balancing techniques
Deadlock in distributed systems, Round robin load balancing, client side load balancing, server side load balancing, applications (such as routers)   **(7)**

Module 4: Distributed System Models
System Architectures & Client-Server Models   **(4)**

Module 5: Distributed Algorithms and Programming Systems
Search Engines, Page ranking, leader election, Hashing, Caching, Remote Procedure Call.   **(5)**

Module 6: Discussion on distributed computing platforms
CORBA/ DCOM/ Java RMI/ Hadoop Map-Reduce, Workflow Systems: Grid Computing , Cloud Computing , Virtualization , IaaS Clouds , Filesystems, Networked Filesystems, Parallel Filesystems   **(8)**

Module 7: Distributed File systems
Data-Intensive Computing, Distributed Hash Tables, Consistency Models, Fault Tolerance, Many-core Computing   **(4)**

Suggested Books
1. G. Coulouris, J. Dollimore, "Distributed Systems Concepts and Design," Addison Wesley. 2. Hwang & Dongarra & Fox,"Distributed and Cloud Computing, From Parallel Processing to the Internet of Things,"
3. M. Singhal, N.G. Shivarathri , "Advanced Operating Systems,", McGraw Hill.
4. Randy Chow, T. Johnson, "Distributed Operating Systems and Algorithms," Addison Wesley.
5. A.S. Tanenbaum,"Distributed Operating Systems," Prentice Hall.
6. M. Tamer Ozsu, PatrickValduriez, "Principles of Distributed Database Systems," Prentice Hall International

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18923   Machine Learning

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Introduction to Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning Machine Learning. Use-Cases, Machine Learning Process Flow, Machine Learning Categories, Linear regression and Gradient descent.   (5)

Module 2: Supervised Learning
Classification and its use cases, Decision Tree, Algorithm for Decision Tree Induction, Creating a Perfect Decision Tree, Confusion Matrix, Random Forest. What is Naïve Bayes, How Naïve Bayes works, Implementing Naïve Bayes Classifier, Support Vector Machine, Illustration how Support Vector Machine works, Hyper parameter Optimization, Grid Search Vs Random Search, Implementation of Support Vector Machine for Classification.   (10)

Module 3: Clustering
What is Clustering & its Use Cases, K-means Clustering, How does K-means algorithm work, C-means Clustering, Hierarchical Clustering, How Hierarchical Clustering works.   (8)

Module 4: Reinforcement   Learning
Why Reinforcement Learning, Elements of Reinforcement Learning, Exploration vs Exploitation dilemma, Epsilon Greedy Algorithm, Markov Decision Process (MDP) Q values and V values, Q – Learning, α values.   (10)

Module 5: Artificial Neural Networks
Fundamentals of Artificial Neural Networks, Perceptrons, model of neuron in an ANN, Learning in feed forward multiple layer ANN- backpropagation, recurrent neural networks, Hebbian learning and associative memory, Hopfield networks and Boltzman machine, Convolution neural networks and deep learning.   (7)

Suggested Books:
1. Pattern Reorganization and Machine learning by Christopher M. Bishop.
2. The elements of Statistical learning by Jeromeh. Friedman, Robert Tivshirani and Trevorhaspie.
3. Introduction to Machine Learning by Ethem Alpaydin. PHI Publisher.
4. Machine Learning, A practical approach on the statistical learinging theory by Rodrigo fernandes de Mello and Moacir Antonelli Ponti.
5. Machine Learning A probabilistic prospective by Kevin P. Murphy
6. William Mckinney, "Python for Data Analysis:Data wrangling with Pandas, NumPy, and Ipython", 2nd edition, O'Reilly.

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7. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn & TensorFlow", O'Reilly.
8. Raul Garreta, "Learning scikit-learn: Machine Learning in Python", Packt.

BTIT-18924   Agile Software Development

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Fundamentals of Agile

The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools.   (8)

Module 2: Agile Scrum Framework

Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management.   (8)

Module 3: Agile Testing

The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.   (8)

Module 4: Agile Software Design and Development

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.   (10)

Module 5: Industry Trends

Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies.   (6)

Suggested Books:
1. Software Engineering a Practitioner Approach, 7th Edition by R Pressman
2. Software Engineering An Integerated Approach, 3rd edition by Pankaj jalote

Department Elective - III

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18931 Cryptography and Network Security

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Network Security
Overview: Services, Mechanisms and Attacks, The OSI Security Architecture, Network security at various layers. A Model of Network Security. System Security- Intruders, Malicious Software, Viruses and Related Threats, Counter Measures, Firewalls and its Design Principles.   (6)

Module 2: Symmetric Cryptography
Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. Block Cipher and the Data Encryption Standard: Simplified DES, Block Cipher Principles, The DES, The Strength of DES, Differential and Linear Cryptanalysis. Symmetric Ciphers: Triple DES, Blowfish. Confidentiality using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.   (8)

Module 3: Asymmetric Cryptography
Public Key Encryption, Digital Signatures - Number Theory, Prime Numbers Formats and Euler's Theorems, Testing for Primality. Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, The RSA Algorithms, Key Management, Diffie Hellman Key Exchange.   (7)

Module 4: Authentication
IP Security: Overview, IP Security Architecture, Authentication Header, Encapsulation Security Payload. Web Security: Web Security Requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction, Authentication Applications: Kerberos, X.509 Directory Authentication Service. Electronic Mail Security: Pretty Good Privacy.   (7)

Module 5: Authentication Protocols
Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, MD5 Message Digest Algorithms, Digital Signatures and Authentication Protocols: Digital Signatures, Authentication Protocols, Digital Signature Standards, digital certificates.   (8)

Suggested Books:
1. William Stallings, Network Security Essentials, Applications and Standards Pearson Education.

2. William Stallings, Cryptography and Network Security Principles and practice. 2/e,Pearson Education.
3. Bishop, Matt, Introduction to Computer Security. Addison-Wesley, Pearson Education, Inc.
4. Michael. E. Whitman and Herbert J. Mattord Principles of Information Security,
5. Cengage Learning Atul Kahate Cryptography & Network Security, TMH,

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18932 Management Information System

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to Systems and Basic Systems Concepts

Elements (Components) of System, Characteristics of System, Types of Systems, System Approach. Information Systems: Definition & Characteristics, Types of Information, Role of Information in Decision-Making, Levels of Management. Introduction to different kinds of Information Systems: Executive Support System, Executive Information System, Decision Support System, Management Information System, Knowledge Work System, Transaction Processing System.   (12)

Module 2: An overview of Management Information System

Definition & Characteristics, Components of MIS, Frame Work for Understanding MIS: Robert Anthony's Hierarchy of Management Activity, Structured Vs Unstructured Decisions, Formal Vs. Informal Systems, Pitfalls in MIS Development.   (10)

Module 3: Simon's Model of Decision Making

DSS Concept, Characteristics and Components, Gorry & Scott Morton Grid, Introduction to Group Decision Support System. Developing Information Systems: Analysis & Design of Information Systems: Implementation & Evaluation.   (10)

Module 4: Functional MIS

A Study of Marketing, Personnel, Financial and Production MIS.   (8)

Suggested Books

1. Management Information Systems, Goyal, D.P.Third Edition, Macmillan.
2. Management Information Systems, Oz, Effy, Thomson Press Indian Edition.
3. Management Information Systems, Kanter, J.,Third Edition, PHI.
4. Management Information Systems , Davis, Gordan B.& Olson, M.H, Second Edition
5. Information Systems for Modern Management",Murdick, RobertG.,& Ross,JoelE.,&Claggett, James R.,Third Edition, PHI.

BTIT-18933   Digital Image Processing

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Model, Sampling and Quantization, Some Basic Relationships between Pixels.   (5)

Module 2: Image Enhancement in the Spatial Domain
Basic Gray-Level Transformation, Histogram Processing, Arithmetic and Logic Operators, Basic Spatial Filtering, Smoothing and Sharpening Spatial Filters.   (8)

Module 3: Image Restoration
A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the image enhance in frequency domain.   (8)

Module 4: Image Compression
Need of Image Compression, Image Compression Models, Error-Free Compression, Lossy Predictive Coding, Image Compression Standards.   (5)

Module 5: Morphological Image Processing
Preliminaries, Dilation, Erosion, Open and Closing, Basic Morphologic Algorithms, The Hit-or-Miss Transformation   (5)

Module 6: Image Segmentation
Detection of Discontinuous, Edge Linking and Boundary Detection, Thresholding, Hough Transform Line Detection And Linking, Region–Based Segmentation.   (5)

Module 7: Object Recognition
Patterns and Patterns Classes, Matching, Classifiers.   (4)

Suggested Books:
1. Rafael. C. Gonzalez & Richard E.Woods.- Digital Image Processing, 2/e Pearson Education.
2. W.K.Pratt.-Digital Image Processing ,3/e Edn., John Wiley & sons.
3. M. Sonka et.al Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition.
4. Digital Image Processing, Kenneth R Castleman, Pearson Education.
5. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education.
6. Fundamentals of Digital image Processing, Anil Jain.K, Prentice Hall of India.

BTIT-18934 Cloud Computing

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Cloud computing concepts

Concepts of cloud computing, Cloud computing leverages the Internet, Positioning cloud to a grid infrastructure, Elasticity and scalability, Virtualization, Characteristics of virtualization, Benefits of virtualization, Virtualization in cloud computing, Hypervisors, Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services , Economies of scale, Management, tooling, and automation in cloud computing, Management: Desktops in the Cloud, Security.   (8)

Module 2: Cloud service delivery

Cloud service, Cloud service model architectures, Infrastructure as a service (IaaS) architecture, Infrastructure as a service (IaaS) details, Platform as a service (PaaS) architecture, Platform as a service (PaaS) details, Platform as a service (PaaS), Examples of PaaS software, Software as a service (SaaS) architecture, Software as a service (SaaS) details, Examples of SaaS applications, Trade-off in cost to install versus , Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform.   (8)

Module 3: Cloud deployment scenarios

Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment.   (8)

Module 4: Security in cloud computing

Cloud security reference model, How security gets integrated , Cloud security , Understanding security risks, Principal security dangers to cloud computing, Virtualization and multitenancy, Internal security breaches, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches, Steps to reduce cloud security breaches, Reducing cloud security, Identity management: Detection and forensics, Identity management: Detection and Identity management, Benefits of identity, Encryption techniques, Encryption & Encrypting data , Symmetric key encryption, Asymmetric key encryption, Digital signature, SSL.   (12)

Module 5:

IBM Smart Cloud, Amazon Web Services, Google Cloud platform, Windows Azure platform, Comparison of Cloud Computing Platforms, Common building Blocks.   (6)

Suggested Books

1. Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski, Cloud Computing: Principles and paradigms.
2. Michael Miller, Cloud Computing.
3. Judith Hurwitz, Robin Bllor, Marcia Kaufman, Fern Halper, Cloud Computing for dummies.

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4. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud Computing: A practical ApproachMcGraw Hill.

5. Barrie Sosinsky, Cloud Computing Bible, Wiley.

6. Borko Furht, Armando Escalante (Editors), Handbook of Cloud Computing, Springer.

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Department Elective – IV

BTIT-18941   Software Project Management

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Project Management Concepts The management spectrum, the people, the product, the process, the project, stakeholders, W5HH Principle, critical practices, the SPM plan, project-planning steps.   (4)

Module 2: Process and Project Metrics
Metrics in the Process and Project Domains, Software Measurement, Size-Oriented Metrics, Function Oriented Metrics, Reconciling LOC and FP Metrics, Object-Oriented Metrics, Use Case-Oriented Metrics, Web App Project Metrics, Metrics for Software Quality, Integrating Metrics within the Software Process.(6)

Module 3: Project Scheduling
Basic Concepts of Project Scheduling, The Relationship between People and Effort, Effort Distribution, Defining a Task Set for the Software Project, Refinement of Major Tasks, Time-Line Charts, Tracking the Schedule, Tracking Progress for an OO Project, Scheduling for Web App and Mobile Projects, Earned Value Analysis, Project Monitoring and Control.   (7)

Module 4: Risk Management
Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Assessing Overall Project Risk, Risk Projection, Assessing Risk Impact, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan.   (5)

Module 5: Configuration Management
Elements of a Configuration Management System, Baselines, Software Configuration Items, Management of Dependencies and Changes, The SCM Repository, The SCM Process, Version Control, Change Control, Configuration Audit, Status Reporting, Configuration Management for Web and Mobile Apps   (5)

Module 6: Maintenance and Reengineering
Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering Process Model, Reverse Engineering, Restructuring, Forward Engineering, The Economics of Reengineering. Overview of ISO-12207.   (6)

Suggested books:
1. Software Engineering a Practitioner Approach, 7th Edition by R Pressman
2. Software Project Management Bob Hughes and Mike Cotterell Latest edition, McGraw Hill

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18942   Distributed Operating System

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Distributed Operating System, Architectures, Issues in Distributed Operating Systems, Limitations of Distributed Systems, Lamport's Logical Clock, Global States, Chandy-Lampert's Global State Recording Algorithm,Basic Concepts of Distributed Mutual Exclusion ,Lamport's Algorithm, Ricart- Agrawala Algorithm. Basic Concepts Of Distributed Deadlock Detection, Distributed File System, Architecture, Design Issues, SUN Network File System Basic Concepts of Distributed Shared Memory, Basic Concepts of Distributed Scheduling, Load Balancing, Load Sharing.   (8)

Module 2: Distributed Resource Management
Distributed File Systems, Architecture, Mechanisms, Design Issues, Distributed Shared Memory, Architecture, Algorithm, Protocols - Design Issues. Distributed Scheduling, Issues, Components, Algorithms.
(7)

Module 3: Distributed OS Implementation
Models, Naming, Process migration, Remote Procedure Calls.   (5)

Module 4: Failure Recovery and Fault Tolerance
Basic Concepts-Classification of Failures, Basic Approaches to Recovery; Recovery in Concurrent System; Synchronous and Asynchronous Check Pointing and Recovery; Check pointing in Distributed Database Systems; Fault Tolerance; Issues - Two-phase and Nonblocking Commit Protocols; Voting Protocols; Dynamic Voting Protocols   (7)

Module 5: Multiprocessor System
Definition, Classification, Multiprocessor Interconnections, Types, Multiprocessor OS functions & requirements; Design & Implementation Issue; Introduction to parallel programming; Multiprocessor Synchronization.   (7)

Module 6: Real Time Operating Systems
Fundamentals of real time operating systems, real time multitasking, embedded application, preemptive task scheduling, inter-task communication and synchronization.   (3)

Module 7: Analytic Modelling
Introductions, Queuing Theory, Markov Process.   (3)

Suggested Books:
1. Operating Systems Concepts &Design-Milan Milenkovic, TMH
2. Operating System- H.M. Deitel,Pearsons.

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3. Advanced Concepts In Operating Systems – Mukesh Singhal and Niranjan G. Shivaratri, TMH
4. Abraham Silberschatz, Peter B. Galvin, G. Gagne, "Operating System Concepts", Tenth Addison n Wesley Publishing Co.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18943   Soft Computing

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction Soft Computing
What is Soft Computing? Difference between Hard and Soft Computing, Requirement of Soft Computing, Major Area of Soft Computing, Application of Soft Computing. (8)

Module 2: Neural Networks
An introduction. Artificial Neural Network: An introduction, Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, Back Propagation Network and other networks, Associative memory networks, Unsupervised Learning Networks. (8)

Module 3: Fuzzy Logic System
Introduction to Fuzzy logic, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Membership functions, Defuzzification, Fuzzy Arithmetic and Fuzzy measures, Fuzzy Rule base and approximate reasoning, Fuzzy decision making (8)

Module 4: Genetic Algorithm
An introduction, Traditional Optimization and Search Techniques, GA and Search Space, General GA, Operators in GA, Stopping Condition and GA flow, Constraints in GA, Classification of GA, and Genetic Programming. (8)

Module 5: Hybrid Soft Computing Techniques
An Introduction, Neuro-Fuzzy Hybrid Systems, Genetic Neuro-Hybrid systems, Genetic fuzzy Hybrid and Fuzzy Genetic Hybrid Systems. (8)

Suggested Books:
3. Principals of Soft Computing by Sivanandam and S. N. Deepa, Wiley Publication.
4. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications by S. Rajasekaran, G. A. Vijayalakshmi, PHI.
5. Introduction to Soft Computing By Samir Roy and Udit Chakraborty, Pearson.

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18944 Human Computer Interaction

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Modue1: Fundamentals of HCI

Introduction to Human Computer Interaction, Human input output channels, human memory, reasoning and problem solving, individual differences, Psychology of everyday thing, Psychopathology of everyday things, concept of designing everyday things psychology and design of interactive system.   (8)

Module2: Designing and Evaluation

User Oriented designing and prototyping, assumptions, participatory design, method of involving the user, low fidelity prototypes, medium fidelity prototypes, wizard of OZ examples, Task oriented system design, development of tasks example, evaluation of design. Methods of evaluation, approaches, ethics, introspection, extracting the conceptual model, constructive interaction, choosing an evaluation method.   (10)

Module 3: Beyond Screen design

Characteristics of good representation, information visualization, Tufte's Guidelines, visual variables, metaphor, direct manipulation, graphical screen design, graphical designing concepts, components of visible language, graphical design by grids, principal of support usability, golden rules of heuristics, , HCI patterns, HCI process oriented design standards, Product oriented design standards.   (10)

Module 4: Past and Future

Strength and limitations of HCI standards, Perceptual interfaces, context awareness and perception.   (6)

Suggested Books:

1. Human Computer Interaction by Dix Alan et.al, Printice hall.
2. Interaction design: beyond human computer interaction, rogers helen and jenny, Wiley.

Department Elective - V

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B. Tech (I.T)   (2018 Batch Onward)

BTIT - 18951 Data Mining

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Introduction to RDBMS, data warehouse, transactional databases, data mining functionalities, classification of data mining system, major issues in data mining. (8)

Module 2: Data Mining
Functionalities, classification data mining systems, Multidimensional data model, data cubes, Schemas for multidimensional databases, OLAP operations, Data Marts, Metadata. (8)

Module 3: Applications and Trends in Data Mining
Commercial Importance of DW, applications of data mining, data mining in business process, embedded data mining. (8)

Module 4: Introduction to Mining Complex Types of Data
Complex data objects, Mining spatial databases, Multimedia databases, Time Series and sequence databases, Text databases and World Wide Web. (8)

Module 5:
Data Pre-processing, Data cleaning, integration and transformation, Data reduction, Discretization and Concept Hierarchy Generation. (8)

Suggested books:

1. Jiawei Han and MichelineKamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers.
2. Ian H. Witten and Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques with Java implementations", Morgan Kaufmann Publishers, San Fransisco, CA.
3. Dorian Pyle, "Data Preparation for Data Mining", Morgan Kaufmann.
4. Korth, Silbertz, Sudarshan, "Database Concepts", McGraw Hill 5. Elmasri, Navathe, "Fundamentals of Database Systems", Addision Wesley

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B. Tech (I.T) **(2018 Batch Onward)**

BTIT-18952   Ad hoc and Sensor Networks

Internal Marks: 40 **L T P**
External Marks: 60 **3   0   0**
Total Marks: 100

Module 1: Introduction of Ad hoc and Sensor Networks

Introduction of MANET, Evolution, Characteristics and advantages, applications, Designing issue and Technical Challenges. Introduction to sensor networks, Sensing and communication range, Designing issue, Energy consumption, clustering of sensors, Applications. (10)

Module2: Ad hoc Networks Outing Protocols

Topology vs Position based routing, Proactive Reactive and hybrid routing, Position based routing, Power aware routing, associatively based routing, QoS routing. (10)

Module 3: WSN Protocols

Architecture of sensor networks, MAC layer protocols of WSN, Hybrid TDMA/FDMA and CSMA based MAC-IEEE 802.15.4, Query based routing, and Location based routing, High-level application layer support. (10)

Module4: Operating System

TinyOS, TinyGALS, Noe level simulators, Overview of network simulator and its sensor network extensions. (10)

Suggested books:

1. Ad hoc and sensor networks: Theory and applications by Carlos de Morais, World Scientific.
2. Ad hoc wireless networks: architecture an protocol by C siva Ram Murthy Printice hall.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT 18953   Speech and Natural Language Processing

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Components of natural language processing, lexicography, syntax, semantics, pragmatics: word level representation of natural languages prosoty & natural languages.   (10)

Module 2: Semantics knowledge Representation, Semantic Network Logic and inference. Pragmatics, Graph Models and Optimization. Prolog for natural semantic.   (10)

Module 3: Computation Linguistics, Recognition and parsing of natural language structures: ATN & RTN; General techniques of parsing: CKY, Earley & Tomita's Algorithm.   (10)

Module 4: Application of NLP, Intelligent Work Processors: Machine Translation; User Interfaces; Man-Machine Interfaces: Natural language Querying Tutoring and Authoring Systems. Speech Recognition Commercial use of NLP.   (10)

Suggested Readings/Books:

1. J.Allen, Natural Language understanding, Benjamin/Cunnings.
2. G.Gazder, Natual Language processing in Prolog , Addison Wesley.
3. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming.
4. Charniack, Eugene, Statistical Language Learning, MIT Press.

B. Tech (I.T)	(2018 Batch Onward)

BTIT-18954   Networks Programming

Internal Marks: 40	**L T P**
External Marks: 60	**3 0 0**
Total Marks: 100	

Module 1: Network Models and UNIX Architecture
OSI Model, Client Server Model, TCP/IP Protocols, Introduction to UNIX; Process, Groups, Job Control and Non-Job Control Shells, Reliable and Unreliable Signals, Shell Programming.   (5)

Module 2: Inter process communication
Inter Process Communication In Unix, Pipes, Half Duplex and Full Duplex Pipes, FIFOs, Properties Of Pipes And FIFOs, POSIX Message Queues, System V Message Queues, Semaphores, Shared Memory, RPC, Authentication, Timeout And Retransmission, Call Semantics, XDR.   (10)

Module 3: Communication Protocol
Introduction, TCP, IP, XNS, SNA, NetBIOS, OSI Protocols Comparisons.   (5)

Module 4: Socket Programming
Introduction to Berkeley Sockets, Socket Addressing, TCP and UDP Socket Functions, Sockets and UNIX Signals, Socket Implementation, Client and Server Examples for TCP and UDP.   (7)

Module 5: Network Programming in Python/Java
Network basics, TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI)-Basic RMI Process, Implementation details-Client-Server Application.   (8)

Module 6: Socket Options and I/O Models
IPv4, IPv6, TCP, I/O Multiplexing, UNIX I/O Models, Select and Poll Functions   (5)

Module 7: System V Transport Layer and Interface
Introduction Transport End Point address, TLI   (2)

Suggested Books:
   References Books:
   1. W. R. Stevens, B. Fenner & A. M. Rudoff, UNIX Network Programming, Vol. I, 3rd Ed., Pearson Education
   2. W. R. Stevens , Unix Network Programming, Vol. II, 2nd Ed., Pearson Education
   3. Comer and Stevens, Internetworking with TCP/IP, Vol. I, II and III, PHI
   4. Christian Benvenuti, Understanding Linux Network Internals, O'Reilly
   5. W. R. Stevens , Advanced Programming in Unix Environment, Pearson Education

Department Elective - VI

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT - 18961 Internet of Things

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to Internet of Things
Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT. (8)

Module 2: Elements of IoT
Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP. (10)

Module 3: IoT application development
Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices. (12)

Module 4: IoT case studies
IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation (10)

Suggested Books:
1. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
7. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18962   Real Time Systems

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction

Real time system characteristics an application, Digital control, high level control, signal processing, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.   (7)

Module 2: Real Time Scheduling

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.   (8)

Module 3: Resources Sharing

Resource Contention and Resource Access Control (RAC), Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module Resources.   (6)

Module 4: Real Time Communication

Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols.   (6)

Module 5: Real Time Operating Systems and Databases

Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Con-currency Control, Overview of Commercial Real Time databases.   (6)

Suggested Books:
1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication
2. Real Time Systems – Mall Rajib, Pearson Education
3. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18963   Neural Networks and Deep Learning

Internal Marks: 40   **L T P**
External Marks: 60   **3   0   0**
Total Marks: 100

Module 1: Introduction
Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.   (5)

Module 2: Feedforward neural network
Artificial Neural Network, activation function, multi-layer neural network. Training Neural Network - Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.   (8)

Module 3: Conditional Random Fields
Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.   (7)

Module 4: Deep Learning
Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.   (8)

Module 5: Probabilistic Neural Network
Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.   (7)

Module 6: Deep Learning research
Object recognition, sparse coding, computer vision, natural language processing. Deep Learning Tools: Caffe, Theano, Torch.   (5)

Suggested Books:
1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press.
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education.
6. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc.
7. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer.

BTIT-18964   Modelling and Simulation

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to Simulation
System & System Environment, Components of a System, Discrete and Continuous Systems, Model of a System and Types of Models, Discrete Event System Simulation, Advantages and Disadvantages of Simulation, Areas and Applications of Simulation   (5)

Module 2: Techniques of Simulation
Monte Carlo Method, Types of System Simulations, Real Time Simulation, Stochastic Variables, Discrete Probability Functions   (4)

Module 3: General Principles
Concepts in Discrete Event Simulation, Event Scheduling /Time Advance Algorithm, List Processing, Using Dynamic Allocation & Linked List   (5)

Module 4: Simulation Software
History of Simulation Software, Selection of Simulation Software, Simulation in C++, GPSS, Simulations Packages, Trends in simulation Software.   (3)

Module 5: Statistical Models in Simulation
Useful Statistical Models, Discrete Distributions, Continuous Distributions, Poisson Process, Empirical Distributions   (5)

Module 6: Queuing Models
Characteristics of Queuing systems, Queuing Notation, Long Run Measures of performance of Queuing Systems, Steady State Behaviour of infinite Population Markovian Models, Steady State Behaviour of finite Population Models, Networks of Queues   (5)

Module 7: Random Number Generation
Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers, Inverse transform Techniques, Convolution Methods, Acceptance –Rejection Techniques   (5)

Module 8: Input Modelling
Data Collection, Identifying the Distribution with Data, Parameter Estimation, Chi – Square Test, Selecting Input Models with Data   (5)

Module 9: Verification & Validation of simulation Modelling
Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models.   (3)

Suggested Books:

1. Gordon G, "System Simulation", PHI 2nd Edition.
2. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi.
3. K S Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Application", PHI.
4. Subranranian, K R V and Sudaresan R Kadayam, "System simulation: Introduction to GPSS", CBS, New Delhi.
5. W Feller, "An introduction to Probability Theory and its Applications," Val 182, Wiley Eastern Ltd. ND.

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B. Tech (I.T)   **(2018 Batch Onward)**

Open electives offered by the department

Courses of odd semesters:

BTIT-18971   Data Structure & Algorithms

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching, Linear Search and Binary Search Techniques and their complexity analysis.   (8)

Module 2: Stacks and Queues

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue.   (10)

Module 3: Linked Lists

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue.
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.   (12)

Module 4: Sorting and Hashing

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort.
Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.   (10)

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
2. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
3. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18972   Object Oriented Programming

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to OOPs
Comparison between procedural programming paradigm and object-oriented programming paradigm Features of object-oriented programming-concepts of an object and a class, Abstraction, Encapsulation, object identity, polymorphism, inheritance, overloading, messaging.   (8)

Module 2: Inheritance in OO design
Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, overriding member functions, order of execution of constructors and destructors.
Design patterns: Introduction and classification. The iterator pattern. Model-view-controller pattern.   (8)

Module 3: Classes and Objects
Specification of a class, creating class objects, accessing class members, access specifiers, static members, friends of a class, nested classes, abstract classes.
Memory Management: Memory allocation (static and dynamic), dynamic memory management, Garbage Allocation, memory leak and allocation failures.   (8)

Module 4: Constructors and Destructors
Need for constructors and destructors, copy constructor, destructors, constructors and destructors with static members.   (8)

Module 5: Operator overloading and Type Conversion
Overloading operators, rules for overloading operators, overloading of various operators, type conversion.
                                          (8)
Note: The concepts should be practised using C++ and Java. Pearl may also be introduced wherever possible.

Suggested books
1. Herbert Schildt, The Complete Reference Java, Seventh Edition, McGraw-Hill.
2. Lafore R., Object Oriented Programming in C++, Waite Group.
3. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.
4. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18973 Database Management System

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction to Database Concepts
File Systems Versus a DBMS, Advantages of a DBMS, Describing and Storing Data in a DBMS, Database System Architecture, DBMS Layers, Data independence.   (5)

Module 2: Data Models
Relational Model, Network Model, Hierarchical Model, ER Model: Design, issues, Mapping constraints, keys, ER diagram, weak entity sets, extended ER features, Design of an ER Database schema.   (8)

Module 3: Relational Query Languages SQL
Basic SQL Select Statements. Table Creation and Management: Create, Alter, Drop and Rename. Constraints: Primary key, Foreign key, Unique, Not null and Check. Data Manipulation: Insert Update and Delete.   (10)

Module 4: Physical Data Organization
File Organization and Indexing, Index Data Structures, Hashing, B-trees, Clustered Index, Sparse Index, Dense Index, Fixed length and Variable Length Records.   (8)

Module 5: Database Design Design
Functional Dependencies, Reasoning about Functional Dependencies, Normal Forms, Schema Refinement, First, Second and Third Normal Forms, BCNF, Multivalued Dependency.   (6)

Module 6: Transaction Management
ACID Properties, Serializability, Two-phase Commit Protocol, Concurrency Control, Lock Management, Lost Update Problem, Inconsistent Read Problem.   (6)

Suggested books:
1. Navathe and Elmasri, Fundamentals of Database Systems, Pearson education
 2. Korth and Silberschatz Abraham, Database Concepts, McGraw Hall.
3. An introduction to database system by C.J.Date (Addison Welsey, Publishing house).
4. Bipin Desai, Database System, TMG 5. Prateek Bhatia, Database Management system, Kalayani Publishers

B. Tech (I.T)   **(2018 Batch Onward)**

Courses of even semesters:

BTIT-18981 Computer Architecture

Internal Marks: 40   **L T P**
External Marks: 60   **3   0 0**
Total Marks: 100

Module 1: Basic Structure of Computer
Computer Types, Memory, CPU, Input-Output subsystem, Control Unit, Number Representation and Arithmetic operations, Character representation, historical Perspective. **Computer Arithmetic:** Addition and subtraction of signed numbers, Carry look ahead adder, Multiplication of unsigned numbers using array multiplier, The Booth algorithm, Fast multiplication using carry save addition, Division restoring and non-restoring techniques, Floating point Arithmetic   (10)

Module 2: Instruction Set Architecture
Instruction set characteristics and functions, Addressing modes and Instruction formats with case study of x86 and ARM. **Control Unit:** Hardwired and micro programmed control unit.   (8)

Module 3: Memory Organization
Memory Hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, Virtual memory,, Memory management hardware.
I/O Organization: Input output interface, Asynchronous data transfer, Modes of data transfer, Priority interrupt, Direct memory access.   (12)

Module 4: Pipelining and Parallel Processing
Pipelining Organization, pipeline hazards, Pipeline in CISC processors, Multiprocessor organization, symmetric multiprocessors.   (10)

Suggested Books:
4. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
5. "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education. Suggested
6. "Computer system architecture"3rd edition by M. Morris Mano, Pearson Education.

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B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18982 Computer Networks

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Data communication Components
Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN.   (6)

Module 2: Data Link Layer and Medium Access Sub Layer
Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking.   (8)

Module 3: Network Layer
Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.   (8)

Module 4: Transport Layer
Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service.   (8)

Module 5: Application Layer
Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography   (10)

Suggested Books
3. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
4. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
5. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
6. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
7. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

B. Tech (I.T)   **(2018 Batch Onward)**

BTIT-18983 Operating Systems

Internal Marks: 40   **L T P**
External Marks: 60   **3 0 0**
Total Marks: 100

Module 1: Introduction
Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.   (5)

Module 2: Processes
Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching
Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.   (8)

Module 3: Process Scheduling
Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive.
                                                                                            (8)

Module 4: Inter-process Communication
Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing. (8)

Module 5: Deadlocks
Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.   (5)

Module 6: Memory Management
Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.
                                                                                            (8)

Suggested books:
3. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
4. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
5. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
6. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison- Wesley
7. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
8. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates