

# **PUNJAB TECHNICAL UNIVERSITY**

Scheme & Syllabus of  
B. Tech. Computer Science &  
Engineering [CSE]  
3<sup>rd</sup> to 8<sup>th</sup> Semester for affecting Batch 2011

By

**Board of Studies Computer Science Engineering/ Information Technology**

## Third Semester

Contact Hours: 30 Hrs.

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCS301	Computer Architecture	3	1	-	40	60	100	2
BTCS302	Discrete Structures	3	1	-	40	60	100	2
BTCS303	Digital Circuits & Logic Design	3	1	-	40	60	100	2
BTCS304	Data Structures	3	1	-	40	60	100	2
BTCS305	Object Oriented Programming using C++	3	1	-	40	60	100	2
BTCS306	Data Structures Lab	-	-	4	30	20	50	1
BTCS307	Institutional Practical Training	-	-	-	60	40	100	1
BTCS308	Digital Circuits & Logic Design Lab	-	-	2	30	20	50	1
BTCS309	Object Oriented Programming using C++ Lab	-	-	4	30	20	50	2
<b>Total</b>		<b>15</b>	<b>5</b>	<b>10</b>	<b>350</b>	<b>400</b>	<b>750</b>	<b>14</b>

## Fourth Semester

Contact Hours: 30 Hrs

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCS401	Operating Systems	3	1	-	40	60	100	2
BTCS402	Mathematics -III	3	1	-	40	60	100	2
BTCS403	Computer Networks-I	3	1	-	40	60	100	2
BTCS404	Microprocessor & Assembly Language Programming	3	1	-	40	60	100	2
BTCS405	System Programming	3	1	-	40	60	100	2
BTCS406	Operating System Lab	-	-	4	30	20	50	1
BTCS407	Computer Networks-I Lab	-	-	2	60	40	100	1
BTCS408	Microprocessor & Assembly Language Programming Lab	-	-	2	30	20	50	1
BTCS409	System Programming Lab	-	-	4	30	20	50	2
	General Fitness	-	-	-	100	-	100	-
<b>Total</b>		<b>15</b>	<b>5</b>	<b>10</b>	<b>450</b>	<b>400</b>	<b>850</b>	<b>14</b>

**Fifth Semester**

**Contact Hours: 29 Hrs**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCS501	Computer Networks –II	3	1	-	40	60	100	4
BTCS502	Relational Database Management System	3	1	-	40	60	100	4
BTCS503	Design & Analysis of Algorithms	3	1	-	40	60	100	4
BTCS504	Computer Graphics	3	1	-	40	60	100	4
BTCS505	Computer Peripherals & Interfaces	3	0	-	40	60	100	3
BTCS506	RDBMS Lab	-	-	4	30	20	50	2
BTCS507	Computer Networks –II Lab	-	-	2	30	20	50	1
BTCS508	Design & Analysis of Algorithms Lab	-	-	2	30	20	50	1
BTCS509	Computer Graphics Lab	-	-	2	30	20	50	1
BTCS510	Industrial Training*	-	-	-	60	40	100	1
<b>Total</b>		<b>15</b>	<b>4</b>	<b>10</b>	<b>380</b>	<b>420</b>	<b>800</b>	<b>25</b>

\*The marks will be awarded on the basis of 06 weeks industrial training conducted after 4<sup>th</sup> semester

**Sixth Semester**

**Contact Hours: 30 Hrs**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTCS601	Simulation and Modeling	3	-	-	40	60	100	3
BTCS602	RDBMS -II	3	1	-	40	60	100	4
BTCS603	Software Engineering	3	-	-	40	60	100	3
BTCSXXX	Elective –I	3	1	-	40	60	100	4
BT***	Open Elective	3	1	-	40	60	100	4
BTCS604	RDBMS-II Lab	-	-	4	30	20	50	2
BTCS605	Free/ Open Source Software Lab	-	-	4	30	20	50	2
BTCS606	Software Engineering Lab	-	-	2	30	20	50	1
BTCS607	Simulation and Modeling Lab	-	-	2	30	20	50	1
<b>General Fitness</b>					100	-	100	
<b>Total</b>		<b>15</b>	<b>3</b>	<b>12</b>	<b>420</b>	<b>380</b>	<b>800</b>	<b>24</b>

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits			
		L	T	P	Internal	External					
BTCS701	Artificial Intelligence	3	-	-	40	60	100	3			
BTCS702	Theory of Computation	3	1	-	40	60	100	4			
BTCS 703	Project	-	-	12	150	150	300	6			
BTCSYYY	Elective –II	3	1	-	40	60	100	4			
BTCSZZZ	Elective –III	3	1	-	40	60	100	4			
BTCS704	Artificial Intelligence Lab	-	-	2	30	20	50	1			
<b>General Fitness</b>					100	-	100				
<b>Total</b>					<b>12</b>	<b>03</b>	<b>14</b>	<b>440</b>	<b>410</b>	<b>850</b>	<b>22</b>

Course Code	Course Name	Marks Distribution		Total Marks	Credits
		Internal	External		
BTCS801	Software Training	150	100	250	8
BTCS802	Industry Oriented Project Training	300	200	500	10
<b>Total</b>		<b>450</b>	<b>300</b>	<b>750</b>	<b>18</b>

#### Elective –I BTXS XXX

- BTCS 901 Web Technologies
- BTCS 902 Mobile Applications Development
- BTCS 903 Ethical Hacking
- BTCS 904 Information Security

#### Elective –II BTCS YYY

- BTCS 905 Software Testing and Quality Assurance
- BTCS 906 Object Oriented Analysis and Design
- BTCS 907 Software Project Management
- BTCS 908 Business Intelligence
- BTCS 909 Agile Software Development

#### Elective -III BTCS ZZZ

- BTCS 910 Multimedia and Application
- BTCS 911 Soft Computing
- BTCS 912 Cloud Computing
- BTCS 913 Compiler Design
- BTCS 914 Big Data
- BTCS 915 Digital Image Processing
- BTCS 916 Enterprise Resource Planning

# *Third Semester*

**BTCS 301 Computer Architecture****PART-A**

- 1. Register Transfer and Microoperations:** Register transfer language & operations, arithmetic microoperations, logic microoperations, shift microoperations, arithmetic logic shift unit. Design of a complete basic computer and its working. [5]
- 2. Basic Computer Organisation and Design:** Instruction codes, Computer registers, Computer Instructions, Timing and control, Instruction Cycle, Memory reference instructions, Input/ Output and Interrupt, Design of basic Computer, Design of Accumulator Logic. [6]
- 3. Design of Control Unit:** Control memory, design of control unit - microprogrammed, hardwired, and their comparative study. [3]
- 4. Central Processing Unit:** General Register Organisation, Stack Organisation, Instruction formats, Addressing Modes, Data transfer and manipulations, Program control, RISC and CISC architecture. [6]

**PART-B**

- 5. Input-Output Organisation:** Peripheral devices, I/O Interface, asynchronous data transfer, modes of transfer, priority interrupt, DMA, I/O processor, serial communication. [5]
- 6. Memory Organisation:** Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory, memory management hardware. [6]
- 7. Advanced concepts of Computer Architecture:** Concept of pipeline, Arithmetic pipeline, Instruction , vector processors and array processors. Introduction to parallel processing, Interprocessor communication & synchronization. [5]

**Suggested Readings/ Books:**

1. M. Moris Mano, **Computer System Architecture**, Pearson Education.
2. William Stallings, **Computer Organisation and Architecture**, Pearson Education.
3. David A Patterson, **Computer Architecture**, Pearson Education.
4. P. Pal Choudhri, **Computer Organisation and Design**, PHI.
5. J. P. Hayes, **Computer System Architecture**, Pearson Education.
6. Kai Hawang, **Advanced Computer Architecture**, Tata McGraw Hill.

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**BTCS302 Discrete Structures****Objective/s:**

The objective of this course is to provide the necessary back ground of discrete structures with particular reference to the relationships between discrete structures and their data structure counterparts including algorithm development.

**PART-A**

- 1. Sets, relations and functions:** Introduction, Combination of Sets, ordered pairs, proofs of general identities of sets, relations, operations on relations, properties of relations and functions, Hashing Functions, equivalence relations, compatibility relations, partial order relations. [7]
- 2. Rings and Boolean algebra:** Rings, Subrings, morphism of rings ideals and quotient rings. Euclidean domains Integral domains and fields Boolean Algebra direct product morphisms Boolean sub-algebra Boolean Rings Application of Boolean algebra (Logic Implications, Logic Gates, Karnaugh-map) [8]
- 3. Combinatorial Mathematics:** Basic counting principles Permutations and combinations Inclusion and Exclusion Principle Recurrence relations, Generating Function, Application. [7]

**PART-B**

- 4. Monoids and Groups:** Groups Semigroups and monoids Cyclic semigroups and submonoids, Subgroups and Cosets. Congruence relations on semigroups. Morphisms. Normal subgroups. Dihedral groups. [7]
- 5. Graph Theory:** Graph- Directed and undirected, Eulerian chains and cycles, Hamiltonian chains and cycles Trees, Chromatic number Connectivity, Graph coloring, Plane and connected graphs, Isomorphism and Homomorphism. Applications.

**Suggested Readings/ Books:**

1. Discrete Mathematics (Schaum series) by Lipschutz (McGraw Hill).
2. Applied Discrete Structures for Computer Science by Alan Doerr and Kenneth Levarseur.
3. Discrete Mathematics by N Ch SN Iyengar, VM Chandrasekaran.

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**BTCS303 Digital Circuits & Logic Design**

**Objective/s and Expected outcome:** Demonstrate the operation of simple digital gates, identify the symbols, develop the truth table for those gates; combine simple gates into more complex circuits; change binary, hexadecimal, octal numbers to their decimal equivalent and vice versa, demonstrate the operation of a flip-flop. Design counters and clear the concept of shift registers. Study different types of memories and their applications. Convert digital into analog and vice versa.

**PART-A**

- 1. Number Systems:** Binary, Octal, Decimal, Hexadecimal. Number base conversions, 1's, 2's, rth's complements, signed Binary numbers. Binary Arithmetic, Binary codes: Weighted BCD, Gray code, Excess 3 code, ASCII - conversion from one code to another. [5]
- 2. Boolean Algebra :** Boolean postulates and laws - De-Morgan's Theorem, Principle of Duality, Boolean expression - Boolean function, Minimization of Boolean expressions - Sum of Products (SOP), Product of

Sums (POS), Minterm, Maxterm, Canonical forms, Conversion between canonical forms, Karnaugh map Minimization, Quine-McCluskey method - Don't care conditions. [5]

3. **Logic GATES:** AND, OR, NOT, NAND, NOR, Exclusive-OR and Exclusive-NOR. Implementations of Logic Functions using gates, NAND-NOR implementations. Study of logic families like RTL, DTL, DCTL, TTL, MOS, CMOS, ECL and their characteristics. [5]

4. **Combinational Circuits:** Design procedure - Adders, Subtractors, Serial adder/Subtractor, Parallel adder/Subtractor Carry look ahead adder, BCD adder, Magnitude Comparator, Multiplexer/Demultiplexer, encoder/decoder, parity checker, code converters. Implementation of combinational logic using MUX. [6]

### PART-B

5. **Sequential Circuits:** Flip flops SR, JK, T, D and Master slave, Excitation table, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops. Asynchronous/Ripple counters, Synchronous counters, Modulo-n counter, Ring Counters. Classification of sequential circuits-Moore and Mealy, Design of Synchronous counters: state diagram, Circuit implementation. Shift registers. [4]

6. **Memory Devices:** Classification of memories, RAM organization, Write operation, Read operation, Memory cycle. Static RAM Cell-Bipolar, RAM cell, MOSFET RAM cell, Dynamic RAM cell. ROM organization, PROM, EPROM, EEPROM, Field Programmable Gate Arrays (FPGA). [4]

7. **Signal Conversions:** Analog & Digital signals. A/D and D/A conversion techniques (Weighted type, R-2R Ladder type, Counter Type, Dual Slope type, Successive Approximation type). [5]

#### Suggested Readings/ Books:

1. Morris Mano, **Digital Design**, Prentice Hall of India Pvt. Ltd
2. Donald P. Leach and Albert Paul Malvino, **Digital Principles and Applications**, 5 ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
3. R.P. Jain, Modern **Digital Electronics**, 3 ed., Tata McGraw-Hill publishing company limited, New Delhi, 2003.
4. Thomas L. Floyd, **Digital Fundamentals**, Pearson Education, Inc, New Delhi, 2003
5. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, **Digital System -Principles and Applications**, Pearson Education.

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## BTCS 304 Data Structures

### PART-A

1. **Dynamic Memory Management:** Understanding pointers, usage of pointers, arithmetic on pointers, memory allocation, memory management functions and operators, debugging pointers - dangling pointers, memory leaks, etc. [2]

2. **Introduction:** Concept of data type, definition and brief description of various data structures, data structures versus data types, operations on data structures, algorithm complexity, Big O notation. [2]



3. **Arrays:** Linear and multi-dimensional arrays and their representation, operations on arrays, sparse matrices and their storage. [3]
4. **Linked List:** Linear linked list, operations on linear linked list, doubly linked list, operations on doubly linked list, application of linked lists. [4]
5. **Stacks:** Sequential and linked representations, operations on stacks, application of stacks such as parenthesis checker, evaluation of postfix expressions, conversion from infix to postfix representation, implementing recursive functions. [4]
6. **Queues:** Sequential representation of queue, linear queue, circular queue, operations on linear and circular queue, linked representation of a queue and operations on it, deque, priority queue, applications of queues. [4]

### PART-B

7. **Trees:** Basic terminology, sequential and linked representations of trees, traversing a binary tree using recursive and non-recursive procedures, inserting a node, deleting a node, brief introduction to threaded binary trees, AVL trees and B-trees. [4]
8. **Heaps:** Representing a heap in memory, operations on heaps, application of heap in implementing priority queue and heap sort algorithm. [2]
9. **Graphs:** Basic terminology, representation of graphs (adjacency matrix, adjacency list), traversal of a graph (breadth-first search and depth-first search), and applications of graphs. [3]
10. **Hashing & Hash Tables:** Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing. [3]
11. **Searching & Sorting:** Searching an element using linear search and binary search techniques, Sorting arrays using bubble sort, selection sort, insertion sort, quick sort, merge sort, heap sort, shell sort and radix sort, complexities of searching & sorting algorithms. [5]

#### Suggested Readings/ Books:

1. Sartaj Sahni, **Data Structures, Algorithms and Applications in C++**, Tata McGraw Hill.
  2. Tenenbaum, Augenstein, & Langsam, **Data Structures using C and C++**, Prentice Hall of India.
  3. R. S. Salaria, **Data Structures & Algorithms Using C++**, Khanna Book Publishing Co. (P) Ltd.
  4. Seymour Lipschutz, **Data Structures**, Schaum's Outline Series, Tata McGraw Hill
  5. Kruse, **Data Structures & Program Design**, Prentice Hall of India.
  6. R. S. Salaria, **Test Your Skills in Data Structures**
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**BTCS 305 Object Oriented Programming Using C++****PART-A**

1. **Object-Oriented Programming Concepts:** Introduction, comparison between procedural programming paradigm and object-oriented programming paradigm, basic concepts of object-oriented programming — concepts of an object and a class, interface and implementation of a class, operations on objects, relationship among objects, abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism, messaging. [2]
2. **Standard Input/Output:** Concept of streams, hierarchy of console stream classes, input/output using overloaded operators >> and << and member functions of i/o stream classes, formatting output, formatting using ios class functions and flags, formatting using manipulators. [3]
3. **Classes and Objects:** Specifying a class, creating class objects, accessing class members, access specifiers, static members, use of *const* keyword, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, bit fields and classes. [4]
4. **Pointers and Dynamic Memory Management:** Declaring and initializing pointers, accessing data through pointers, pointer arithmetic, memory allocation (static and dynamic), dynamic memory management using *new* and *delete* operators, pointer to an object, *this* pointer, pointer related problems - dangling/wild pointers, null pointer assignment, memory leak and allocation failures. [5]
5. **Constructors and Destructors:** Need for constructors and destructors, copy constructor, dynamic constructors, explicit constructors, destructors, constructors and destructors with static members, initializer lists. [2]
6. **Operator Overloading and Type Conversion:** Overloading operators, rules for overloading operators, overloading of various operators, type conversion - basic type to class type, class type to basic type, class type to another class type. [4]

**PART-B**

7. **Inheritance:** Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, virtual base class, object slicing, overriding member functions, object composition and delegation, order of execution of constructors and destructors. [5]
8. **Virtual functions & Polymorphism:** Concept of binding - early binding and late binding, virtual functions, pure virtual functions, abstract classes, virtual destructors. [3]
9. **Exception Handling:** Review of traditional error handling, basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, rethrowing an exception, specifying exceptions. [2]

**10. Templates and Generic Programming:** Template concepts, Function templates, class templates, illustrative examples. [3]

**11. Files:** File streams, hierarchy of file stream classes, error handling during file operations, reading/writing of files, accessing records randomly, updating files. [3]

**Suggested Readings/ Books:**

1. Lafore R., **Object Oriented Programming in C++**, Waite Group.
  2. E. Balagurusamy, **Object Oriented Programming with C++**, Tata McGraw Hill.
  3. R. S. Salaria, **Mastering Object-Oriented Programming with C++**, Salaria Publishing House.
  4. Bjarne Stroustrup, **The C++ Programming Language**, Addison Wesley.
  5. Herbert Schildt, **The Complete Reference to C++ Language**, McGraw Hill-Osborne.
  6. Lippman F. B, **C++ Primer**, Addison Wesley.
  7. R. S. Salaria, **Test Your Skills in Object-Oriented Programming With C++**, Salaria Publishing House.
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### BTCS306 Data Structures Lab

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

1. Write a menu driven program that implements following operations (using separate functions) on a 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 givenTo 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 demonstrate 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.

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### BTCS 308 Digital Circuits & Logic Design Lab

Implementation all experiments with 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.
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**BTCS 309 Object Oriented Programming Using C++ Lab**

1. **[Classes and Objects]** Write a program that uses a class where the member functions are defined inside a class.
  2. **[Classes and Objects]** Write a program that uses a class where the member functions are defined outside a class.
  3. **[Classes and Objects]** Write a program to demonstrate the use of static data members.
  4. **[Classes and Objects]** Write a program to demonstrate the use of const data members.
  5. **[Constructors and Destructors]** Write a program to demonstrate the use of zero argument and parameterized constructors.
  6. **[Constructors and Destructors]** Write a program to demonstrate the use of dynamic constructor.
  7. **[Constructors and Destructors]** Write a program to demonstrate the use of explicit constructor.
  8. **[Initializer Lists]** Write a program to demonstrate the use of initializer list.
  9. **[Operator Overloading]** Write a program to demonstrate the overloading of increment and decrement operators.
  10. **[Operator Overloading]** Write a program to demonstrate the overloading of binary arithmetic operators.
  11. **[Operator Overloading]** Write a program to demonstrate the overloading of memory management operators.
  12. **[Typecasting]** Write a program to demonstrate the typecasting of basic type to class type.
  13. **[Typecasting]** Write a program to demonstrate the typecasting of class type to basic type.
  14. **[Typecasting]** Write a program to demonstrate the typecasting of class type to class type.
  15. **[Inheritance]** Write a program to demonstrate the multilevel inheritance.
  16. **[Inheritance]** Write a program to demonstrate the multiple inheritance.
  17. **[Inheritance]** Write a program to demonstrate the virtual derivation of a class.
  18. **[Polymorphism]** Write a program to demonstrate the runtime polymorphism.
  19. **[Exception Handling]** Write a program to demonstrate the exception handling.
  20. **[Templates and Generic Programming]** Write a program to demonstrate the use of function template.
  21. **[Templates and Generic Programming]** Write a program to demonstrate the use of class template.
  22. **[File Handling]** Write a program to copy the contents of a file to another file byte by byte. The name of the source file and destination file should be taken as command-line arguments,
  23. **[File Handling]** Write a program to demonstrate the reading and writing of mixed type of data.
  24. **[File Handling]** Write a program to demonstrate the reading and writing of objects.
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# *Fourth Semester*

**BTCS 401 Operating Systems****PART-A**

1. Introduction to Operating system, Role of Operating System as resource manager, function of kernel and shell, operating system structures, views of an operating system. [5]
2. **Process management:** CPU scheduling, Scheduling Algorithms, PCB, Process synchronization, Deadlocks, Prevention, Detection and Recovery [5]
3. **Memory Management:** Overlays, Memory management policies, Fragmentation and its types, Partitioned memory managements, Paging, Segmentation, Need of Virtual memories, Page replacement Algorithms, Concept of Thrashing [8]

**PART-B**

4. **Device Management:** I/O system and secondary storage structure, Device management policies, Role of I/O traffic controller, scheduler [5]
5. **File Management:** File System Architecture, Layered Architecture, Physical and Logical File Systems, Protection and Security: [5]
6. Brief study to multiprocessor and distributed operating systems. [4]
7. **Case Studies:** LINUX / UNIX Operating System and Windows based operating systems [4]

**Suggested Readings/ Books:**

1. A Silberschatz and Peter B. Galvin, “**Operating System Concepts**” Addison” Wesley Publishing Company
2. Dhamdhere, —**Systems Programming & Operating Systems**” Tata McGraw Hill
3. Gary Nutt, “**Operating Systems Concepts**”, Pearson Education Ltd. 3<sup>rd</sup> Edition
4. **Operating System** by Madnick Donovan
5. **Operating System** by Stallings

**BTCS402 Mathematics-III**

**Objective/s and Expected Outcome:** To teach computer based Engineering Mathematics to students.

After this course the student will be able to solve complex computer oriented problems.

**Part- A**

1. **Fourier series:** Periodic Functions, Euler’s Formula. Even and odd Functions, Half range expansions, Fourier series of different waveforms. [4]
2. **Laplace transformations:** Laplace transforms of various standard functions, properties of Laplace transform. [4]

3. **Partial Differential Equations:** Formation of Partial Differential Equations, linear Partial Differential Equations, Homogeneous Partial Differential Equations with constant coefficients. [5]
4. **Functions of complex variables:** Limits, continuity and derivatives of the function of complex variables, Analytic function, Cauchy- Riemann equations, conjugate functions. [5]

#### Part- B

5. **Linear Systems and Eigen- Values:** Gauss - elimination method, gauss- Jordan method, Gauss- Seidel iteration method, Rayleigh's Power method for Eigen values and Eigenvectors. [4]
6. **Differential Equations:** Solutions of Initial values problems using Eulers, modified Eulers method and Runge- kutta (upto fourth order) methods. [4]
7. **Probability distribution:** Binomial, Poisson and Normal distribution. [4]
8. **Sampling Distribution & testing of Hypothesis:** Sampling, Distribution of means and variance, Chi-Square distribution, t- distribution, F- distribution. General concepts of hypothesis, Testing a statistical Hypothesis, One and two tailed tests, critical region, Confidence interval estimation. Single and two sample tests on proportion, mean and variance. [5]

#### Suggested Readings/ Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 5<sup>th</sup> Edition, Wiley Enstern 1985.
2. P. E. Danko, A. G. Popov, T. Y. A. Kaznevnikova, Higher Mathematics in Problems and Exercise, Part 2, Mir Publishers, 1983.
3. Bali, N. P., A Text Book on Engineering Mathematics, Luxmi Pub., New Delhi.

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### BTCS 403 Computer Networks-I

**Objective/s and Expected Outcome:** This course provides knowledge about computer network related hardware and software using a layered architecture.

#### PART-A

##### 1. Introduction to Computer Networks:

Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and wired networks, broadcast and point to point networks, Network topologies, Network software: concept of layers, protocols, interfaces and services, ISO-OSI reference model, TCP/IP reference model. [7]

##### 2. Physical Layer:

Concept of Analog & Digital Signal, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Data rate limits : Nyquist formula, Shannon Formula, Multiplexing : Frequency Division, Time Division, Wavelength Division, Introduction to Transmission Media : Twisted pair, Coaxial cable, Fiber



optics, Wireless transmission (radio, microwave, infrared), Switching: Circuit Switching, Message Switching, Packet Switching & their comparisons. [6]

### 3. Data Link Layer:

Design issues, Framing, Error detection and correction codes: checksum, CRC, hamming code, Data link protocols for noisy and noiseless channels, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP. [6]

### 4. Medium Access Sub-Layer:

Static and dynamic channel allocation, Random Access: ALOHA, CSMA protocols, Controlled Access: Polling, Token Passing, IEEE 802.3 frame format, Ethernet cabling, Manchester encoding, collision detection in 802.3, Binary exponential back off algorithm. [6]

## PART-B

### 5. Network Layer:

Design issues, IPv4 classful and classless addressing, subnetting, Routing algorithms: distance vector and link state routing, Congestion control: Principles of Congestion Control, Congestion prevention policies, Leaky bucket and token bucket algorithms [6]

### 6. Transport Layer:

Elements of transport protocols: addressing, connection establishment and release, flow control and buffering, multiplexing and de-multiplexing, crash recovery, introduction to TCP/UDP protocols and their comparison. [3]

### 7. Application Layer:

World Wide Web (WWW), Domain Name System (DNS), E-mail, File Transfer Protocol (FTP), Introduction to Network security [2]

### Suggested Readings/ Books:

1. **Computer Networks**, 4<sup>th</sup> Edition, Pearson Education by Andrew S. Tanenbaum
2. **Data Communication & Networking**, 4th Edition, Tata McGraw Hill. By Behrouz A. Forouzan.
3. **Computer Networking**, 3<sup>rd</sup> Edition, Pearson Education by James F. Kurose and Keith W. Ross
4. **Internetworking with TCP/IP, Volume-I**, Prentice Hall, India by Douglas E. Comer.

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## BTCS404 Microprocessors and Assembly Language Programming

**Objective/s:** The course is intended to give students good understanding of internal architectural details and functioning of microprocessors.

### PART-A

1. **Introduction:** Introduction to Microprocessors, history, classification, recent microprocessors. [5]
2. **Microprocessor Architecture:** 8085 microprocessor Architecture. Bus structure, I/O, Memory &

System buses, concept of address Bus, Data Bus & Control Bus, Synchronous & Asynchronous buses.

Instruction execution sequence & Data Flow, Instruction cycle. [5]

3. **I/O memory interface:** Data transfer modes: Programmable, interrupt initiated and DMA. Serial & parallel interface, Detail study of 8251 I/O Processor & 8255 programmable peripheral interfaces. [6]

### PART-B

4. **Instruction set & Assembly Languages Programming:** Introduction, instruction & data formats, addressing modes, status flags, 8085 instructions, Data transfer operations, Arithmetic operations, Logical operations, Branch operations. [7]
5. **Case structure & Microprocessor application:** Interfacing of keyboards and seven segment LED display, Microprocessor controlled temperature system (MCTS), Study of traffic light system, stepper motor controller, Microprocessor based micro computers. [8]
6. **Basic architecture of higher order microprocessors:** Basic introduction to 8086 family, motorola 68000, Pentium processors. [5]

#### Suggested Readings/ Books:

1. **8085 Microprocessor** by Ramesh Gaonkar, PHI Publications.
2. Daniel Tabak, **Advanced Microprocessors**, McGraw- Hill, Inc., Second Edition 1995.
3. Douglas V. Hall, **Microprocessors and Interfacing: Programming and Hardware**, Tata McGraw Hill Edition, 1986.
4. Charles M.Gilmore, **Microprocessors: Principles and Applications**, McGraw Hill.

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## BTCS 405 System Programming

**Objective/s and Expected Outcome:** This course provides knowledge to design various system programs.

1. **Introduction:** Introduction to system programming and different types of system programs - editors, assemblers, macroprocessors, compilers, linkers, loader, debuggers. [2]
2. **Assemblers:** Description of single pass and two pass assemblers, use of data structures like OPTAB and SYMTAB, etc. [9]
3. **Macroprocessors:** Description of macros, macro expansion, conditional and recursive macro expansion. [5]
4. **Compilers:** Various phases of compiler - lexical, syntax and semantic analysis, intermediate code generation, code optimization techniques, code generation, Case study : LEX and YACC. [9]
5. **Linkers and Loaders:** Concept of linking, different linking schemes, concept of loading and various loading schemes. [5]
6. **Editors:** Line editor, full screen editor and multi window editor, Case study MS-Word, DOS Editor and vi editor. [4]

7. **Debuggers:** Description of various debugging techniques.

[2]

**Suggested Readings/ Books:**

1. Donovan J.J., Systems Programming, New York, Mc-Graw Hill, 1972.
2. Dhamdhare, D.M., Introduction to Systems Software, Tata Mc-Graw Hill, 1996.
3. Aho A.V. and J.D. Ullman Principles of compiler Design Addison Wesley/ Narosa 1985.

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**BTCS 406 Operating System Lab**

1. Installation Process of various operating systems
2. Virtualization, Installation of Virtual Machine Software and installation of Operating System on Virtual Machine
3. Commands for files & directories: cd, ls, cp, md, rm, mkdir, rmdir. Creating and viewing files using cat. File comparisons. Disk related commands: checking disk free spaces. Processes in linux, connecting processes with pipes, background processing, managing multiple processes. Manual help. Background process: changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep. Printing commands, grep, fgrep, find, sort, cal, banner, touch, file. File related commands ws, sat, cut, grep.
4. Shell Programming: Basic of shell programming, various types of shell, Shell Programming in bash, conditional & looping statement, case statements, parameter passing and arguments, shell variables, shell keywords, creating shell programs for automate system tasks, report printing.

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**BTCS 407 Computer Networks-I Lab**

1. Write specifications of latest desktops and laptops.
  2. Familiarization with Networking Components and devices: LAN Adapters, Hubs, Switches, Routers etc.
  3. Familiarization with Transmission media and Tools: Co-axial cable, UTP Cable, Crimping Tool, Connectors etc.
  4. Preparing straight and cross cables.
  5. Study of various LAN topologies and their creation using network devices, cables and computers.
  6. Configuration of TCP/IP Protocols in Windows and Linux.
  7. Implementation of file and printer sharing.
  8. Designing and implementing Class A, B, C Networks
  9. Subnet planning and its implementation
  10. Installation of ftp server and client.
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**BTCS408 Microprocessor and Assembly Language Programming Lab**

1. Introduction to 8085 kit.
2. Addition of two 8 bit numbers, sum 8 bit.
3. Subtraction of two 8 bit numbers.
4. Find 1's complement of 8 bit number.
5. Find 2's complement of 8 bit number.
6. Shift an 8 bit no. by one bit.
7. Find Largest of two 8 bit numbers.
8. Find Largest among an array of ten numbers (8 bit).
9. Sum of series of 8 bit numbers.
10. Introduction to 8086 kit.
11. Addition of two 16 bit numbers, sum 16 bit.
12. Subtraction of two 16 bit numbers.
13. Find 1's complement of 16 bit number.
14. Find 2's complement of 16 bit number.

**References:**

Microprocessor by B. Ram, Dhanpat Rai Publications.

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**BTCS 409 System Programming Lab**

1. Create a menu driven interface for
  - a) Displaying contents of a file page wise
  - b) Counting vowels, characters, and lines in a file.
  - c) Copying a file
2. Write a program to check balance parenthesis of a given program. Also generate the error report.
3. Write a program to create symbol table for a given assembly language program.
4. Write a program to create symbol table for a given high-level language program.
5. Implementation of single pass assembler on a limited set of instructions.
6. Exploring various features of debug command.
7. Use of LAX and YACC tools.

*Fifth Semester*

## BTCS 501 Computer Networks –II

*Objectives: The objective of the course is to offer good understanding of the concepts of network security, wireless, Adhoc and various emerging network technologies.*

### Course Contents:

1. **Network Security:** Fundamentals of network security, Basics of IPv6, IPsec: overview of IPsec, IP and IPv6, Authentication header (AH), Encapsulating Security Payload (ESP). [6]
2. **Internet Key Exchange (IKE):** History, Photuris, Simple Key-management for Internet protocols (SKIP), IKE phases, IKE encoding. [6]
3. **Adhoc networks:** Features, advantages and applications, Adhoc versus Cellular networks, Network architecture, Protocols: MAC protocols, Routing protocols, Technologies. [6]
4. **Wireless Communication Systems:** Evolution, examples of wireless communication systems, 2G Cellular networks, Evolution for 2.5G TDMA Standards, IS-95B for 2.5G CDMA. [6]
5. **3G wireless networks:** wireless local loop (WLL), Local Multipoint Distribution System (LMDS), Wireless local Area Networks (WLANs), Bluetooth and Personal Area Networks. [6]
6. **Wireless System Design:** Introduction, Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems. [6]

### Suggested Readings/Books:

- 1.Theodore S. Rappaport, Wireless Communication: Principles and Practices (2<sup>nd</sup>Edition), Pearson Education.
- 2.Charlie Kaufman, Radio Perlman, Mike Speciner, Network security, 2<sup>nd</sup> ed., PHI.
- 3.Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, Wireless and mobile networks: concepts and protocols, Wiley India.
- 4.Michael A. Gallo & William M. Hancock, “Computer Communications and Networking Technologies”, Cengage Learning / Thomson Brooks / Cole
- 5.S. Keshav, “An Engineering Approach to Computer Networking“, Pearson Education.
6. Mayank Dave, “Computer Networks”, Cengage Learning

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## BTCS 502 Relational Database Management System-I

**Objectives:** This course offers a good understanding of database systems concepts and prepares the student to be in a position to use and design databases for different applications.

### Introduction to Database Systems:

File Systems Versus a DBMS, Advantages of a DBMS, Describing and Storing Data in a DBMS, Database System Architecture, DBMS Layers, Data independence. [6]

### 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.[6]

### **Data Models:**

Relational Model, Network Model, Hierarchical Model, ER Model: Entities, Attributes and Entity Sets, Relationships and Relationship Sets, Constraints, Weak Entities, Class Hierarchies, Aggregation, Conceptual Database Design with the ER Model, Comparison of Models.[5]

### **The Relational Model:**

Introduction to the Relational Model, ER to Relational Model Conversion, Integrity Constraints over Relations, Enforcing Integrity Constraints, Relational Algebra, Relational Calculus, Querying Relational Data.[5]

### **Relational Query Languages:**

SQL: Basic SQL Query, Creating Table and Views, SQL as DML, DDL and DCL, SQL Algebraic Operations, Nested Queries, Aggregate Operations, Cursors, Dynamic SQL, Integrity Constraints in SQL, Triggers and Active Database, Relational Completeness, Basic Query Optimization Strategies, Algebraic Manipulation and Equivalences.[7]

### **Database Design:**

Functional Dependencies, Reasoning about Functional Dependencies, Normal Forms, Schema Refinement, First, Second and Third Normal Forms, BCNF, Multi-valued Dependency, Join Dependency, Fourth and Fifth Normal Forms, Domain Key Normal Forms, Decompositions.[5]

### **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.[6]

### **Database Protection:**

Threats, Access Control Mechanisms, Discretionary Access Control, Grant and Revoke, Mandatory Access Control, Bell LaPadula Model, Role Based Security, Firewalls, Encryption and Digital Signatures.[5]

### **Suggested Readings/Books:**

1. Ramez Elmasri, Shamkant Navathe, Fundamentals of Database Systems, Fifth Edition, Pearson Education, 2007.
2. C.J. Date, An Introduction to Database Systems, Eighth Edition, Pearson Education
3. Alexis Leon, Mathews Leon, Database Management Systems, Leon Press.
4. S. K. Singh, Database Systems Concepts, Design and Applications, Pearson Education.
5. Raghuram Ramakrishnan, Johannes Gehrke, Database Management Systems, Tata McGraw-Hill.
6. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Tata McGraw-Hill.

**Objective:** To learn the ability to distinguish between the tractability and intractability of a given computational problem. To be able to devise fast and practical algorithms for real-life problems using the algorithm design techniques and principles learned in this course.

**Prerequisites:** Data Structures

**Introduction.** What is an algorithm ? Time and space complexity of an algorithm. Comparing the performance of different algorithms for the same problem. Different orders of growth. Asymptotic notation. Polynomial vs. Exponential running time.

**Basic Algorithm Design Techniques.** Divide-and-conquer, greedy, randomization, and dynamic programming. Example problems and algorithms illustrating the use of these techniques.

**Graph Algorithms.** Graph traversal: breadth-first search (BFS) and depth-first search (DFS). Applications of BFS and DFS. Topological sort. Shortest paths in graphs: Dijkstra and Bellman-Ford. Minimum spanning trees.

**Sorting and searching.** Binary search in an ordered array. Sorting algorithms such as Merge sort, Quick sort, Heap sort, Radix Sort, and Bubble sort with analysis of their running times. Lower bound on sorting. Median and order statistics.

**NP-completeness.** Definition of class NP. NP-hard and NP-complete problems. 3SAT is NP-complete. Proving a problem to be NP-complete using polynomial-time reductions. Examples of NP-complete problems.

**Coping with NP-completeness.** Approximation algorithms for various NP-complete problems.

**Advanced topics.** Pattern matching algorithms : Knuth-Morris-Pratt algorithm. Algorithms in Computational Geometry : Convex hulls. Fast Fourier Transform (FFT) and its applications. Integer and polynomial arithmetic. Matrix multiplication : Strassen's algorithm.

**Suggested Readings/Books:**

1. Algorithm Design by J. Kleinberg and E. Tardos.
2. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
3. Algorithms by S. Dasgupta, C.H. Papadimitriou, and U.V. Vazirani.
4. Algorithm Design: Foundations, Analysis, and Internet Examples by Michael T. Goodrich and Roberto Tamassia.
5. The Design and Analysis of Computer Algorithms by A. V. Aho, J. E. Hopcroft, and J. D. Ullman.
6. The Art of Computer Programming, Volumes 1, 2, and 3, by Donald Knuth.

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## BTCS 504 Computer Graphics

### OBJECTIVES:

Understanding the fundamental graphical operations and the implementation on computer, Get a glimpse of recent advances in computer graphics, Understanding user interface issues that make the computer easy for the novice to use.

### COURSE CONTENTS:



1. **Introduction:** Computer Graphics and its applications, Elements of a Graphics, Graphics Systems: Video Display Devices, Raster Scan Systems, Random Scan Systems, Input devices.
2. **Basic Raster Graphics:** Scan conversion- Point plot technique, Line drawing, Circle generating and Ellipse generating algorithms.
3. **Two-dimensional Geometric Transformations :** Basic Transformations-Translation, Rotation and Scaling, Matrix Representation and Homogeneous Coordinates, Composite Transformations, Reflection and Shearing transformations.
4. **Clipping:** Window to viewport transformation, Clipping Operations- Point Clipping, Line Clipping, Polygon Clipping and Text Clipping.
5. **Filling Techniques:** Scan line algorithms, Boundary-fill algorithm, Flood-fill algorithm, Edge fill and fence fill algorithms,
6. **Elementary 3D Graphics:** Plane projections and its types, Vanishing points, Specification of a 3D view.
7. **Visibility:** Image and object precision, Hidden edge/surface removal or visible edge/surface determination techniques; z buffer algorithms, Depth sort algorithm, Scan line algorithm and Floating horizon technique.
8. **Advance Topics:** Introduction of Rendering, Raytracing, Antialiasing, Fractals, Gourard and Phong shading.

**Suggested Readings/Books:**

1. Donald Hearn and M. Pauline Baker, “**Computer Graphics**”, **Second Edition**, PHI/Pearson Education.
  2. Zhigang Xiang, Roy Plastock, Schaum’s outlines, “**Computer Graphics Second Edition**”, Tata McGrawhill edition.
  3. C. Foley, VanDam, Feiner and Hughes, “**Computer Graphics Principles & Practice**”, **Second Edition**, Pearson Education
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### **BTCS 505 Computer Peripherals and Interfaces**

**OBJECTIVES:** To learn the functional and operational details of various peripheral devices.

1. **SYSTEM RESOURCES:** Interrupt, DMA Channel, I/O Port Addresses and resolving and resolving the conflict of resources. I/O buses- ISA, EISA, Local bus, VESA Local bus, PCI bus, PCI Express, Accelerated graphics port bus.
2. **IDE & SCSI Interfaces:** IDE origin, IDE Interface ATA standards ATA1 to ATA7. ATA feature, ATA RAID and SCSI RAID, SCSI Cable and pin Connector pin outs SCSI V/s IDE Advantages and limitation.

3. **Video Hardware** : Video display technologies, DVI Digital signals for CRT Monitor,LCD Panels, Video adapter types, Integrated Video/ Motherboard chipset, Video RAM,Video driver and multiple Monitor, Graphic accelerators. Advanced 3D Technologies,TV Tuner and Video Capture upgrades troubleshooting Video Cards and Drivers.
4. **I/O Interfaces:** I/O Interfaces from USB and IEEE1394, I/O Interface from serial and Parallel to IEEE1394 and USB 961, Parallel to SCSI converter. Testing of serial andparallel port, USB Mouse/ Keyboard Interfaces.
5. **Input/ Output Driver software aspects:** Role of device driver DOS and UNIX/ LINUX device drivers.
6. Design & Integration of Peripheral devices to a computer system as a Case Study
7. **Future Trends:** Detailed Analysis of recent Progress in the Peripheral and Bus systems. Some aspects of cost Performance analysis while designing the system

### **Suggested /Readings / Books**

1. Douglas V. Hall ,“**Microprocessors and Interfacing**”, Tata McGraw Hill 2006.
2. Barry B. Brey & C.R.Sarma” **The intel microprocessors,**” Pearson 2003.
3. P. Pal Chandhari , “**Computer Organization and design**” Prentice Hall of India Pvt. Ltd, 1994.
4. Del Corso, H.Kirrman, JD Nicond “**Microcomputer buses & links**” Academic Press 1986.

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### **BTCS 506 RDBMS LAB**

*Note:* This practical will enable students to retrieve data from relational databases using SQL. Students will also learn about triggers, cursors, stored procedures etc.

1. Introduction to SQL and installation of SQL Server / Oracle.
2. Data Types, Creating Tables, Retrieval of Rows using Select Statement, Conditional Retrieval of Rows, Alter and Drop Statements.
3. Working with Null Values, Matching a Pattern from a Table, Ordering the Result of a Query, Aggregate Functions, Grouping the Result of a Query, Update and Delete Statements.
4. Set Operators, Nested Queries, Joins, Sequences.
5. Views, Indexes, Database Security and Privileges: Grant and Revoke Commands, Commit and Rollback Commands.
6. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.
7. Stored Procedures and Exception Handling.
8. Triggers and Cursor Management in PL/SQL.

**Suggested Tools** – MySQL, DB2, Oracle, SQL Server 2012, Postgre SQL, SQL lite

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### **BTCS 507 Computer Networks – II LAB**

1. To configure the IP address for a computer connected to LAN and to configure network parameters of a web browser for the same computer.
  2. To plan IPv6 address scheme for a local area network comprising of 'n' terminals.
  3. To develop programs for implementing / simulating routing algorithms for Adhoc networks.
  4. To install any one open source packet capture software like wireshark etc.
  5. To configure Wireless Local Loop.
  6. To plan Personal Area Network.
  7. To configure WLAN.
  8. To configure Adhoc networks.
  9. To install and configure wireless access points.
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### **BTCS 508 Design & Analysis of Algorithms Lab**

**Objective:** To get a first-hand experience of implementing well-known algorithms in a high-level language. To be able to compare the practical performance of different algorithms for the same problem.

1. Code and analyze to compute the greatest common divisor (GCD) of two numbers.
2. Code and analyze to find the median element in an array of integers.
3. Code and analyze to find the majority element in an array of integers.
4. Code and analyze to sort an array of integers using Heap sort.
5. Code and analyze to sort an array of integers using Merge sort.
6. Code and analyze to sort an array of integers using Quick sort.
7. Code and analyze to find the edit distance between two character strings using dynamic programming.
8. Code and analyze to find an optimal solution to weighted interval scheduling using dynamic programming.
9. Code and analyze to find an optimal solution to matrix chain multiplication using dynamic programming.
10. Code and analyze to do a depth-first search (DFS) on an undirected graph. Implementing an application of DFS such as (i) to find the topological sort of a directed acyclic graph, OR (ii) to find a path from source to goal in a maze.
11. Code and analyze to do a breadth-first search (BFS) on an undirected graph. Implementing an application of BFS such as (i) to find connected components of an undirected graph, OR (ii) to check whether a given graph is bipartite.
12. Code and analyze to find shortest paths in a graph with positive edge weights using Dijkstra's algorithm.
13. Code and analyze to find shortest paths in a graph with arbitrary edge weights using Bellman-Ford algorithm.
14. Code and analyze to find the minimum spanning tree in a weighted, undirected graph.

15. Code and analyze to find all occurrences of a pattern P in a given string S.
16. Code and analyze to multiply two large integers using Karatsuba algorithm.
17. Code and analyze to compute the convex hull of a set of points in the plane.
18. (Mini-project Topic) Program to multiply two polynomials using Fast Fourier Transform (FFT).

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### **BTCS 509 Computer Graphics Lab**

1. To plot a point (pixel) on the screen.
2. To draw a straight line using DDA Algorithm.
3. To draw a straight line using Bresenham's Algorithm.
4. Implementation of mid-point circle generating Algorithm.
5. Implementation of ellipse generating Algorithm.
6. To translate an object with translation parameters in X and Y directions.
7. To scale an object with scaling factors along X and Y directions.
8. To rotate an object with a certain angle about origin.
9. Perform the rotation of an object with certain angle about an arbitrary point.
10. To perform composite transformations of an object.
11. To perform the reflection of an object about major axis.
12. To clip line segments against windows using Cohen Sutherland Algorithm.
13. Perform the polygon clipping against windows using Sutherland Hodgeman technique.
14. Fill a rectangle with a specified color using scan line algorithm.
15. Implementation of flood-fill and boundary-fill algorithms.

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### **BTCS 510 Industrial Training**

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*Sixth Semester*

## BTCS 601 Simulation and Modeling

**Objectives:** This course should provide the students with good understanding of various techniques of Simulation.

*Module 1:* Introduction- When simulation is appropriate and when not, advantages and disadvantages of simulation, application areas in communication, computer and software design, systems and systems environment, components of a system, discrete and continuous systems, model of a system, types of models, discrete-event simulation, steps in a simulation study. Simulation Examples- Simulation of queueing systems, on-demand and inventory systems, simulation for reliability analysis etc

*Module 2:* General Principles- Concepts in discrete event simulation: event scheduling/time advance algorithms, world views. List Processing: properties and operations, data structures and dynamic allocation, techniques;

*Module 3:* Simulation Software- Integrated environments. Examples and review of some existing software popular and useful in the industry, e.g., Arena, AutoMod, Extend, Flexsim, Micro Saint, ProModel, Quest, SIMUL8, WITNESS etc. Simulation using languages and environments like C++/Java/GPSS/SSF etc. Experimentation and Statistical-Analysis Tools: common features and relevant current products.

*Module 4:* Statistical Models in Simulation- Terms and concepts. Statistical Models. Review of discrete and continuous distributions. Review of Poisson (stationary and non-stationary) processes. Empirical Distributions; Elementary Queueing Theory- Basic Structure of Queueing Models. Input Source (Calling Population). Queue, Queue Discipline, Service Mechanisms. Notations and relationships between  $L$ ,  $W$ ,  $Lq$ , and  $Wq$ . Little's Formula. Role of Exponential Distribution and Properties. Birth and Death Processes. M/M/s queues. Finite queue variation in M/M/s/K models with different s values. Finite Calling Population cases. Queueing Models involving Non-Exponential Distributions: M/G/1, M/D/s, M/Ek/s (involving Erlang distribution), Models without a Poisson Input, Models involving hyperexponential distributions, Priority Discipline Queueing Models: Preemptive and Non- Preemptive with results, properties and server number variations, Queueing Networks:Equivalence Property. Infinite Queues in Series and Product Form Solutions. Jackson Networks,

*Module 5:* Application of Queueing Models- Review of Characteristics (calling population system capacity, arrival processes, behavior and disciplines, service times and mechanisms etc) and notations, Application of Long-Run Measures of Performance: Time average in system, average time spent per customer, Little's Formula and server utilization, costs. Steady State behaviour of Infinite (M/G/1, M/M/c/infinity, M/M/c/N/infinity) and finite (M/M/c/K/K) Calling Population Models, Use of Network of Queues.

*Module 6:* Random Number Generation- Properties. Generation of Pseudo-Random Numbers, Techniques for Generation of Pseudo-Random Numbers: Linear Congruential, Combined Linear Congruential, Random Number Streams. Tests for Random Numbers: Frequency Tests and Tests for Autocorrelation. Random Variate Generation- Inverse Transform Techniques for Exponential, Uniform, Weibull, Triangular and for Empirical Continuous Distributions. Acceptance-Rejection Techniques for Poisson (Stationary and Non-Stationary) Distribution and Gamma Distribution. Special Properties like the Direct Transformation for the Normal and Lognormal Distributions, Convolution Method and others.

*Module 7:* Input Modeling- Data collection, Identifying the Distribution with Data: Histograms, Selection of the Appropriate Family of Distributions, Quantile-Quantile Plots. 100 Parameter Estimation: Sample Mean and Sample Variance and various biased and unbiased Estimators. Goodness of Fit Tests applied to Simulation inputs: Chi-Square and Chi-Square with Equal Probabilities, Kolmogorov-Smirnov Tests, p-Values and Best Fits. Verification and Validation of Simulation Models- Verification and Validation of

Simulation Models. Calibration and Validation: Face Validity, Validation of Assumptions, Input-Out Transformation Validation.

*Module 8:* Output Analysis of a Single Model- Output analysis and types of simulation. Stochastic Nature of the Output Data. Measures of Performance and Estimation: Point Estimation and Confidence-Interval Estimation. Output Analysis for Terminating Simulations and Estimation of Probabilities. Output Analysis of Steady State Simulations: Initialization Bias, Error Estimation, Replications, Sample Size and Batch Means for Interval Estimation.

*Module 9:* Comparison and Evaluation of Alternative System Designs- Comparison of Two System Designs.; Sampling with Equal and Unequal Variances. Common Random Numbers. Confidence Intervals with Specified Precision. Comparison of Several System Designs: Bonferroni Approaches to Multiple Comparisons and to Screening and to Selection of the Best. MetamodelingL Sample Linear Regression, Testing for Significance, Multiple Linear Regression. Random Number Assignment for Regression. Optimization via Simulation: Robust Heuristics.

*Module10:* Simulation of Computer Systems- Simulation Tools: Process Orientation and Event Orientation. Model Input: Modulated Poisson Process and Virtual-Memory Referencing. High-Level Simulation. CPU and Memory Simulations. Simulation of Computer Networks- Traffic Modeling, Media Access Control: Token-Passing Protocols and Ethernet, Data Link Layer, TCP, Model Construction.

**Simulation Languages:** Basic Introduction to Special Simulation Languages:-GPSS/ MATLAB/ Network Simulators.

### **Suggested Readings/ Books:**

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, *Discrete-Event System and Simulation*, Prentice Hall of India, New Delhi, 2005
2. Averill M. Law, *Simulation modeling and analysis (SIE)*, Tata McGraw Hill India, 2007
3. David Cloud, Larry Rainey, *Applied Modeling and Simulation*, Tata McGraw Hill, India.
4. Gabriel A. Wainer, *Discrete-event modeling and simulation: a practitioner's approach*, CRC Press, 2009.
5. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, *Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems*, Academic Press, 2000.
6. Walter J. Karplus, George A. Bekey, Boris Yakob Kogan, *Modeling and simulation: theory and practice*, Springer, 2003.
7. Stanislaw Raczynski, *Modeling and simulation: the computer science of illusion*, Wiley, 2006.
8. Mohammad Salameh Obaidat, Georgios I. Papadimitriou, *Applied system simulation: methodologies and application*, Springer, 2003.
9. van Dijk, Nico M.; Boucherie, Richard J. (Eds.) 2011. *Queueing Networks: A Fundamental Approach*. 798 p. 148 illus. Springer.
10. Bhat, U. Narayan, *An Introduction to Queueing Theory: Modeling and Analysis in Applications*, Springer 2008 (Birkhäuser Boston).
11. James J. Nutaro, *Building software for simulation: theory and algorithms, with applications in C++*. Wiley, 2010.

**Objectives:** This course offers a good understanding of advanced database concepts and technologies. It prepares the student to be in a position to use and design databases for a variety of applications.

**Introduction to Database Systems:** Database System Concepts and Architecture, Data Models, Data Independence, SQL: DDL, DML, DCL, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF. (6)

**Query Processing and Optimization:**

Query Processing, Syntax Analyzer, Query Decomposition, Query Optimization, Heuristic Query Optimization, Cost Estimation, Cost Functions for Select, Join, Query Evaluation Plans. (6)

**Transaction Processing and Concurrency Control:**

Transaction Processing Concepts, Concurrency Control Techniques: Two-phase Locking, Timestamp Ordering, Multiversion, Validation, Multiple Granularity Locking. (5)

**Object Oriented and Object Relational Databases:**

Object Oriented Concepts, Object Oriented Data Model, Object Definition Language, Object Query Language, Object Relational Systems, SQL3, ORDBMS Design. (5)

**Distributed Databases:**

Distributed Database Concepts, Advantages and Disadvantages, Types of Distributed Database Systems, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Five Level Schema Architecture, Query Processing, Concurrency Control and Recovery in Distributed Databases. (6)

**Backup and Recovery:**

Types of Database Failures, Types of Database Recovery, Recovery Techniques: Deferred Update, Immediate Update, Shadow Paging, Checkpoints, Buffer Management. (5)

**Introduction to Data Warehousing and Data Mining:**

Introduction to OLAP, OLTP, Data Warehouse, Data Marts, Data Mining, Data Mining Process, Big Data. (5)

**Enterprise Database Products:**

Enterprise Database Products, Familiarity with IBM DB2 Universal Database, Oracle, Microsoft SQL Server, MySQL, their features. (7)

**Suggested Readings/ Books:**

1. Ramez Elmasri, Shamkant Navathe, Fundamentals of Database Systems, Fifth Edition, Pearson Education, 2007.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, Tata McGraw-Hill.
3. C.J. Date, An Introduction to Database Systems, Eighth Edition, Pearson Education.
4. Alexis Leon, Mathews Leon, Database Management Systems, Leon Press.
5. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Tata McGraw-Hill.
6. S. K. Singh, Database Systems Concepts, Design and Applications, Pearson Education.
7. Chris Eaton, Paul Zikopoulos, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data



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## BTCS 603 Software Engineering

*Module1:* Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification.

*Module2:* Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques.

*Module3:* Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.

*Module4:* Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management, ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development.

### **Suggested Readings/ Books:**

1. Roger Pressman, “**Software Engineering: A Practitioners Approach**,(6th Edition), McGraw Hill, 1997.
2. Sommerville, ”**Software Engineering, 7th edition**”, Adison Wesley, 1996.
3. Watts Humphrey, ”**Managing software process**”, Pearson education, 2003.
4. James F. Peters and Witold Pedrycz, “ **Software Engineering – An Engineering Approach**”, Wiley.
5. Mouratidis and Giorgini. “**Integrating Security and Software Engineering–Advances and Future**”, IGP. ISBN – 1-59904-148-0.
6. Pankaj Jalote, “**An integrated approach to Software Engineering**”, Springer/Narosa.

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# *Elective-I*

## BTCS 901 Web Technologies (Elective-I)

**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. (4)

**HTML:** Introduction to HTML, Lists, adding graphics to HTML page, creating tables, linking documents, frames, DHTML and Style sheets. (6)

**Java Script:** Introduction, programming constructs: variables, operators and expressions, conditional checking, functions and dialog boxes, JavaScript DOM, creating forms, introduction to Cookies

**JAVA:** Introduction to java objects and classes, control statements, arrays, inheritance, polymorphism, Exception handling. (6)

**XML:** Why XML, XML syntax rules, XML elements, XML attributes, XML DTD displaying XML with CSS. (6)

**AJAX :** Introduction, HTTP request, XMLHttpRequest, AJAX Server Script, AJAX Database.

**PHP:** Introduction, syntax, statements, operators, sessions, E-mail, PHP and MySQL, PHP and AJAX.

### Suggested Readings/Books:

1. Deitel,Deitel, Nieto, and Sandhu: XML How to Program, Pearson Education.
2. Herbert Schildt: Java 2: The Complete Reference, Fifth Edition, TMH
3. Ivan Bayross: Web Enabled Commercial Application
4. Schafer: Development, BPB
5. HTML,CSS, JavaScript,Perl, Python and PHP, Wiley India Textbooks.

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## BTCS 902 Mobile Applications Development (Elective-I)

### Unit I:

**Introduction:** Mobile operating system, Operating system structure, Constraints and Restrictions, Hardware configuration with mobile operating system, Features: Multitasking Scheduling, Memory Allocation, File System Interface, Keypad Interface, I/O Interface, Protection and Security, Multimedia features.

### Unit II:

Introduction to Mobile development IDE's, Introduction to Worklight basics, Optimization, pages and fragments , Writing a basic program- in Worklight Studio, Client technologies, Client side debugging, Creating adapters, Invoking adapters from Worklight Client application, Common Controls, Using Java in adapters, Programming exercise with Skins, Understanding Apache Cordova, Offline access, Encrypted cache deprecated, Using JSONStore

### Unit III:

Understanding Apple iOS development, Android development, Shell Development, Creating Java ME application, Exploring the Worklight Server, Working with UI frameworks, Authentication, Push notification, SMS Notifications, Globalization, WebView overlay , Creating Authentication application: development for Apple iOS by using a login module, Device Analytics, Worklight Server Administration

### Unit IV:

**Windows Phone:** Introduction to Windows Phone, Architecture, memory management, communication protocols, application development methods, deployment.

**Case Study:** Design and development of Application using mobile application development platforms e.g. WorkLight, Kendo, Appcon, Xcode, Xpages

### Unit V:

**Android:** Introduction to Android, Architecture, memory management, communication protocols, application development methods, deployment.

**Case Study:** Design and development of Application using mobile application development platforms e.g. WorkLight, Kendo, Appcon, Xcode, Xpages

**Unit VI:**

**iOS:** Introduction to iOS, Architecture, memory management, communication protocols, application development methods, deployment.

**Case Study:** Design and development of Application using mobile application development platforms e.g. WorkLight, Kendo, Appcon, Xcode, Xpages

**Suggested Readings/Books:**

1. Anubhav Pradhan, Anil V Deshpande, “ Mobile Apps Development” Edition: I
  2. Jeff McWherter, Scott Gowell “Professional Mobile Application Development”, John Wiley & Sons, 2012.
  3. Barry Burd, “Android Application Development All in one for Dummies”, Edition: I
  4. Teach Yourself Android Application Development In 24 Hours, Edition: I, Publication: SAMS
  5. Neal Goldstein, Tony Bove, “iPhone Application Development All-In-One For Dummies”, John Wiley & Sons
  6. Henry Lee, Eugene Chuvyrov, “Beginning Windows Phone App Development”, Apress, 2012.
  7. Jochen Schiller, “Mobile Communications”, Addison-Wesley, 2<sup>nd</sup> edition, 2004.
  8. Stojmenovic and Cacute, “Handbook of Wireless Networks and Mobile Computing”, Wiley, 2002, ISBN 0471419028.
  9. Worklight resources
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**BTCS 903 Ethical Hacking (Elective-I)**

**Introduction:** Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking

**Foot printing:** Authoritative, Non -Auth reply by DNS, Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase.

**Scanning:** Detecting live systems on the target network, Discovering services running /listening on target systems, Understanding port scanning techniques, Identifying TCP and UDP services running on the target network, Understanding active and passive fingerprinting.

**System Hacking:** Aspect of remote password guessing, Role of eavesdropping ,Various methods of password cracking, Keystroke Loggers, Understanding Sniffers ,Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.

**Hacking Wireless Networks:** Introduction to 802.11,Role of WEP, Cracking WEP Keys, Sniffing Traffic, Securing Wireless Networks.

**Cryptography:** Understand the use of Cryptography over the Internet through PKI, RSA, MD-5, Secure Hash Algorithm and Secure Socket Layer.

**Suggested Readings/Books:**

1. Network Security and Ethical Hacking, Rajat Khare , Luniver Press
2. Ethical Hacking, Thomas Mathew ,OSB Publisher
3. Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill

## **BTCS 904 Information Security (Elective-I)**

**Objectives:** Upon completion of this course, students will have gained knowledge of information security concepts and understanding of Information Security principles and approaches.

*Module1:* Symmetric Ciphers - Overview: Services, Mechanisms and Attacks, The OSI Security Architecture, A Model of Network Security. 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.

*Module2:* Public Key Encryption, Digital Signatures - Number Theory, Prime Numbers Format's 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.

*Module3:* 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.

*Module4:* Network Security - Authentication Applications: Kerberos, X.509 Directory Authentication Service. Electronic Mail Security: Pretty Good Privacy. 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.

*Module5:* System Security- Intruders, Malicious Software, Viruses and Related Threats, Counter Measures, Firewalls and its Design Principles.

### **Suggested / Readings & 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. ISBN: 0-321-24744-2. (2005)
4. Michael. E. Whitman and Herbert J. Mattord Principles of Information Security, Cengage Learning
5. **Atul Kahate Cryptography & Network Security, TMH, 2<sup>nd</sup> Edition**
6. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in Public World, 2nd Edition, 2011, Pearson Education.

## **BTCS 604 RDBMS-II Lab**

1. Case studies on normalization
2. Study and usage of query optimization techniques
3. Study and usage of backup and recovery features of database management software
4. Server administration of any database management software
5. Study and usage of any object oriented or object relational database management software
6. Study and usage of open source data mining tool: Weka
7. Study of web databases
8. Development of a project by making use of tools studied above

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## **BTCS 605 Free/Open Source Software Lab**

Students will be doing the practicals related to the **Elective-I** opted by them by using open source technologies available in the area of the subject.

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## **BTCS 606 Software Engineering Lab**

1. Study and usage of OpenProj or similar software to draft a project plan
2. Study and usage of OpenProj or similar software to track the progress of a project
3. Preparation of Software Requirement Specification Document, Design Documents and Testing Phase related documents for some problems
4. Preparation of Software Configuration Management and Risk Management related documents
5. Study and usage of any Design phase CASE tool
6. To perform unit testing and integration testing
7. To perform various white box and black box testing techniques
8. Testing of a web site

**Suggested Tools** - Visual Paradigm, Rational Software Architect, Visio, Argo UML, Rational Application Developer etc. platforms.

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## **BTCS 607 Simulation and Modeling Lab**

1. **Programming in MATLAB:** Introduction, Branching statements, loops, functions, additional data types, plots, arrays, inputs/outputs etc.
2. Introduction regarding usage of any Network Simulator.
3. Practical Implementation of Queuing Models using C/C++.

*Seventh/Eighth*  
*Semester*

## BTCS 701 Artificial Intelligence

*Module1:* Introduction- What is intelligence? Foundations of artificial intelligence (AI). History of AI; Problem Solving- Formulating problems, problem types, states and operators, state space, search strategies.

*Module2:* Informed Search Strategies- Best first search, A\* algorithm, heuristic functions, Iterative deepening A\*(IDA), small memory A\*(SMA); Game playing - Perfect decision game, imperfect decision game, evaluation function, alpha-beta pruning

*Module3:* Reasoning-Representation, Inference, Propositional Logic, predicate logic (first order logic), logical reasoning, forward chaining, backward chaining; AI languages and tools - Lisp, Prolog, CLIPS

*Module4:* Planning- Basic representation of plans, partial order planning, planning in the blocks world, hierarchical planning, conditional planning, representation of resource constraints, measures, temporal constraints

*Module5:* Uncertainty - Basic probability, Bayes rule, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic; Decision making- Utility theory, utility functions, Decisiontheoretic expert systems.

*Module 6:* Inductive learning - decision trees, rule based learning, current-best-hypothesis search, least-commitment search , neural networks, reinforcement learning, genetic algorithms; Other learning methods - neural networks, reinforcement learning, genetic algorithms.

*Module7:* Communication - Communication among agents, natural language processing, formal grammar, parsing, grammar

### Suggested / Readings & Books

1. Stuart Russell and Peter Norvig. *Artificial Intelligence – A Modern Approach*, Pearson Education Press, 2001.
2. Kevin Knight, Elaine Rich, B. Nair, *Artificial Intelligence*, McGraw Hill, 2008.
3. George F. Luger, *Artificial Intelligence*, Pearson Education, 2001.
4. Nils J. Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kauffman, 2002.

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## BTCS 702 Theory of Computation

**Objectives:** To give the students knowledge of number of areas in theoretical computer science and their interconnections.

*Module 1:* Basics of Strings and Alphabets

*Module2:* Finite Automata – DFA, transition graphs, regular languages, non-deterministic FA, equivalence of DFA and NFA

*Module3:* Regular grammars, regular expressions, equivalence between regular languages, properties of regular languages, pumping lemma.

*Module4:* Context Free Languages – Leftmost and rightmost derivation, parsing and ambiguity, ambiguity in grammar and languages, normal forms

*Module5:* Pushdown Automata – NDPDA, DPDA, context free languages and PDA, comparison of deterministic and non-deterministic versions, closure properties, pumping lemma for CFL

*Module6:* Turing Machines, variations, halting problem, PCP

*Module7:* Chomsky Hierarchy, LR(k) Grammars, properties of LR(k) grammars, Decidability and Recursively Enumerable Languages

### **Suggested Readings/Books**

1. K.L.P. Mishra and N. Chandrasekaran, “**Theory of Computer Science, Third Edition**”, PHI Learning Private Limited, 2011.
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, 2010.
5. Stephen Wolfram, “**Theory and Applications of Cellular Automata**”, World Scientific, 1986.
6. G.E. Revesz, “**Introduction to Formal Languages**”, Dover Publications, 1991.
7. M. A. Harrison, “**Introduction to Formal Language Theory**”, Addison-Wesley, 1978.
8. R.K. Shukla,” **Theory of Computation**”, Cengage Learning.
9. An Introduction to Formal Languages and Automata, by Peter Linz, Third Edition, Narosa Publishers (1998)

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**BTCS 703 Project**

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# *Elective-II*

## BTCS 905 Software Testing and Quality Assurance (Elective-II)

**Objectives:** This course offers a good understanding of the concepts, methods and techniques of software testing and quality assurance and prepares students to be in a position to develop error free and quality software.

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

**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)

**Risk Management and Change Management:** Software Risks, Risk Identification, Risk Projection, Risk Refinement, The RMMM Plan, Software Configuration Management, Baselines, Software Configuration Items, SCM Process: Version Control, Change Control, Configuration Audit, Configuration Management for Web Engineering. (7)

**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)

**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)

**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)

**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 Off-the-Shelf Software, Testing in Multiplatform Environment, Testing for Real Time Systems, Testing Security.

(8)

**Case studies:** Design test cases for: ERP, Traffic controller, University Management system etc.

### Suggested Readings/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, 2010.
5. Yogesh Singh, Software Testing, Cambridge University Press.
6. K.K. Aggarwal, Yogesh Singh, Software Engineering, Second Edition, New Age International.
7. Pankaj Jalote, An Integrated Approach to Software Engineering, Second Edition, Narosa.
8. S. Limaye, Software Testing, McGraw-Hill.

9. A. C. Gillies, Software Quality: Theory & Practice, Cengage Learning.
10. Graham, Foundations of Software Testing: ISTQB Certification, Cengage Learning.
11. R. Shende, Software Automation Testing Tools for Beginners, Shroff Publishers.
12. A. P. Mathur, Foundations of Software Testing, Pearson Education.

**Suggested tools:** XUnit/ rational functional tester.

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### **BTCS 906 Object Oriented Analysis and Design (Elective–II)**

*Module1:* Introduction to object oriented systems, Classes, Objects, Abstraction, Inheritance, Polymorphism, Encapsulation, Message Sending, Association, Aggregation, Iterative development and the Unified Process (UP), UP phases: Inception, Elaboration, Construction and Transition, Object-oriented metrics

*Module2:* Introduction to UML, Use Cases and functional requirements, Identifying and writing Use Cases, Decomposition of use cases, Modeling System Workflows using Activity Diagrams, Modeling a System's Logical Structure using Classes and Class Diagrams, Modeling Interactions using Sequence Diagrams and Communication Diagrams, Timing Diagrams, Interaction Overview Diagrams, Component Diagram, Package diagram, State Machine Diagrams, Deployment Diagrams.

*Module3:* Introduction to Patterns, GoF Patterns, Creational Patterns, Structural Patterns, Behavioral Patterns, Software Architectural patterns, The Observer Pattern, The Template Method Pattern , Factory Patterns: Factory Method and Abstract Factory , The Singleton Pattern , The Iterator Pattern , The Composite Pattern , The Facade Pattern , The State and Strategy patterns , Command Pattern , The Adapter Pattern , The Proxy Pattern , The Decorator Pattern, The Visitor Pattern , AntiPatterns, Patterns for Assigning Responsibilities: GRASP Patterns

*Module4:* Domain modeling, assigning responsibility using sequence diagrams, mapping design to code, CASE tools, Unit, Cluster, and System-level testing of Object-oriented programs, Aspect- oriented and Service-oriented software.

#### **Suggested Readings/Books**

1. Grady Booch, James Rumbaugh, Ivar Jacobson ,“The Unified Modeling Language User Guide”, Pearson Education.
  2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, “UML 2 Toolkit”, WILEY-Dreamtech India Pvt. Ltd.
  3. Meilir Page-Jones,“Fundamentals of Object Oriented Design in UML”, Pearson Education.
  4. Pascal Roques, “Modeling Software Systems Using UML2”, WILEY- Dreamtech India Pvt. Ltd
  5. Atul Kahate, “Object Oriented Analysis & Design”, The McGraw-Hill Companies.
  6. John W. Satzinger, Robert B Jackson and Stephen D Burd, “Object-Oriented Analysis and Design with the Unified Process”, Cengage Learning
  7. Gamma, et. al., Design Patterns - Elements of Reusable Object-Oriented Software, , Addison-Wesley. (1994)
  8. Craig Larman, Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development, Pearson Education. (1998)
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### **BTCS 907 Software Project Management**

**Objective-** Software development is a complex process involving such activities as domain analysis, requirements specification, communication with the customers and end-users, designing and producing different artifacts, adopting new paradigms and technologies, evaluating and testing software products, installing and maintaining the application at the end-user's site, providing customer support, organizing end-user's training, envisioning potential upgrades and negotiating about them with the customers, and

many more. The proposed subject will take students through the various processes involved in project management.

*Module1:* Project Evaluation and Planning - Activities in Software Project Management, Overview Of Project Planning, Stepwise planning, contract management, Software processes and process models. Cost Benefit Analysis, Cash Flow Forecasting, Cost-Benefit Evaluation Techniques, Risk Evaluation. Project costing, COCOMO 2, Staffing pattern, Effect of schedule compression, Putnam's equation, Capers Jones estimating rules of thumb, Project Sequencing and Scheduling Activities, Scheduling resources, Critical path analysis, Network Planning, Risk Management, Nature and Types of Risks, Managing Risks, Hazard Identification, Hazard Analysis, Risk Planning and Control, PERT and Monte Carlo Simulation techniques.

*Module2:* Monitoring And Control- Collecting Data, Visualizing Progress, Cost Monitoring, review techniques, project termination review, Earned Value analysis, Change Control, Software Configuration Management (SCM), Managing Contracts, Types Of Contracts, Stages In Contract Placement, Typical Terms of A Contract, Contract Management and Acceptance.

*Module3:* Quality Management and People Management- Introduction, Understanding Behavior, Organizational Behaviour, Selecting The Right Person For The Job, Motivation, The Oldman – Hackman Job Characteristics Model , Working in Groups, Organization and team structures, Decision Making, Leadership, Organizational Structures, Stress, Health And Safety. ISO and CMMI models, Testing, and Software reliability, test automation, Overview of project management tools.

### **Suggested Readings/Books**

1. Bob Hughes, Mike Cotterell, "Software Project Management", Tata McGraw Hill. (2009)
2. Royce, "Software Project Management", Pearson Education. (2005).
3. Robert K. Wysocki, "Effective Software Project Management", Wiley.(2006)
4. Ian Sommerville, Software Engineering, Seventh Edition, Pearson Education.
5. R.S. Pressman, Software Engineering: A Practitioner's Approach, Sixth Edition, Tata McGraw-Hill.
6. Kassem, Software Engineering, Cengage Learning.

### **Suggested Tools** – Rational Team Concert, MS Project

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## **BTCS 908 Business Intelligence**

**Introduction to Business Intelligence:** Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities. (8)

**Basics of Data Integration (Extraction Transformation Loading):** Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, introduction to ETL, Introduction to data quality, data profiling concepts and applications. (8)

**Introduction to Multi-Dimensional Data Modeling:** Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, introduction to business metrics and KPIs, creating cubes using SSAS. (8)

**Basics of Enterprise Reporting:** Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, and overall architecture. (6)

**Data Mining Functionalities:** Association rules mining, Mining Association rules from single level, multilevel transaction databases, Classification and prediction, Decision tree induction, Bayesian classification, k-nearest neighbor classification, Cluster analysis, Types of data in clustering, categorization of clustering methods. (15)

### Suggested Readings/Books

- 1.R N Prasad, Seema Acharya: Fundamentals of Business Analytics, Wiley India, First Edition, 2011
- 2.J.Han and M. Kamber: Data Mining: Concepts and Techniques By Morgan Kaufman publishers, Harcourt India pvt. Ltd. Latest Edition
- 3.David Loshin: Business Intelligence: The Savvy Manager's Guide., Latest Edition By Knowledge Enterprise.
- 4.Larissa Terpeluk Moss, Shaku Atre: Business Intelligence roadmap by Addison Weseley
- 5.Cindi Howson: Successful Business Intelligence: Secrets to making Killer BI Applications by Tata McGraw Hill
- 6.Mike Biere: Business intelligence for the enterprise by Addison Weseley, August 2010

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### BTCS-909 Agile Software Development

**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 (6)

**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)

**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)

**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)

**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.(4)

### Suggested Readings/Books:

1. Agile Software Development with Scrum By Ken Schawber, Mike Beedle Publisher: Pearson

2. Agile Software Development, Principles, Patterns and Practices By Robert C. Martin Publisher: Prentice Hall
  3. Agile Testing: A Practical Guide for Testers and Agile Teams By Lisa Crispin, Janet Gregory Publisher: Addison Wesley
  4. Agile Software Development: The Cooperative Game By Alistair Cockburn Publisher: Addison Wesley
  5. User Stories Applied: For Agile Software By Mike Cohn
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# *Elective-III*

## BTCS 910 Multimedia and Application (Elective-III)

**Objectives:** This Course introduces the multimedia systems and their applications to students. This course covers the different compression standards used in multimedia, some current technology and related issues.

**Introduction:** Multimedia and its types, Introduction to Hypermedia, Hyper Text, Multimedia Systems and their Characteristics, Challenges, Desirable Features, Components and Applications, Trends in Multimedia. (4)

**Multimedia Technology:** Multimedia Systems Technology , Multimedia Hardware devices, Multimedia software development tools, Multimedia Authoring Tools, Multimedia Standards for Document Architecture, SGML, ODA, Multimedia Standards for Document interchange, MHEG, Multimedia Software for different media. (6)

**Storage Media:** Magnetic and Optical Media, RAID and its levels, Compact Disc and its standards, DVD and its standards, Multimedia Servers. (4)

**Audio:** Basics of Digital Audio, Application of Digital Audio, Digitization of Sound, Sample Rates and Bit Size, Nyquist's Sampling Theorem Typical Audio Formats Delivering Audio over a Network , Introduction to MIDI (Musical Instrument Digital Interface), Components of a MIDI System Hardware Aspects of MIDI, MIDI Messages. Audio Compression, Simple Audio Compression Methods, Psychoacoustics, MPEG Audio Compression. (8)

**Basics of Compression:** Classifying Compression Algorithms, Lossless Compression Algorithms, Entropy Encoding, Run-length Encoding, Pattern Substitution, Basics of Information theory, Huffman Coding, Adaptive Huffman Coding, Arithmetic Coding, Lempel-Ziv-Welch (LZW) Algorithm, Source Coding Techniques: Transform Coding, Frequency Domain Methods, Differential Encoding. (6)

**Image and Graphics Compression:** Colour in Images, Types of Colour Models, Graphic/Image File Formats: TIFF, RIFF, BMP, PNG, PDF, Graphic/Image Data, and JPEG Compression, GIF Compression. (6)

**Video Compression:** Basics of Video , Video Signals, Analog Video, Digital Video, TV standards, H. 261 Compression, Intra Frame Coding, Inter-frame (P-frame) Coding, MPEG Compression, MPEG Video, The MPEG Video Bitstream , Decoding MPEG Video in Software. (6)

**Multimedia Communication:** Building Communication network, Application Subsystem, Transport Subsystem, QOS, Resource Management, Distributed Multimedia Systems. (5)

### Suggested Readings/Books

1. Ralf Steinmetz and Klara Nahrstedt, “**Multimedia Computing Communications and Applications**” Pearson Educations.
  2. Parag Havaldar, Gerard Medioni, “**Multimedia Systems Design**”, PHI, Latest Edition
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## BTCS-911 Soft Computing (Elective-III)

*Module1:* Introduction - What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing.

*Module2:* Introduction to Genetic Algorithms- Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

*Module 3:* Neural Networks- Concept, biological neural system,. Evolution of neural network, McCulloch-Pitts neuron model, activation functions, feedforward networks, feedback networks, learning rules – Hebbian, Delta, Perceptron learning and Windrow-Hoff, winner-take-all.

*Module 4:* Supervised learning- Perceptron learning, single layer/multilayer perceptron, linear separability, hidden layers, back propagation algorithm, Radial Basis Function network; Unsupervised learning - Kohonen, SOM, Counter-propagation, ART, Reinforcement learning, adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.

*Module 5:* Fuzzy systems - Basic definition and terminology, set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rulebase Structure Identification and Neuro-Fuzzy Control , Applications of neuro-fuzzy modeling.

*Module 6:* Swarm Intelligence- What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

### Suggested Readings/Books

1. S.N. Shivanandam, *Principle of soft computing*, Wiley. ISBN13: 9788126527410 (2011)
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
5. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
6. David E. Goldberg, *Genetic Algorithms in Search, Optimization & Machine Learning*, Addison Wesley, 1997.

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## BTCS 912 – Cloud Computing (Elective-III)

**Overview of cloud computing :** What is a cloud, Definition of cloud , Definition of cloud , characteristics of cloud , Why use clouds, How clouds are changing , How clouds are changing , Driving factors towards cloud, Comparing grid with cloud and other computing systems, workload patterns for the cloud, “Big Data”, IT as a service.

**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.

**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.

**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.

**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, What is SSL?

IBM Smart Cloud, Amazon Web Services, Google Cloud platform, Windows Azure platform, A comparison of Cloud Computing Platforms, Common building Blocks.

### **Suggested Readings/Books**

1. Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski, Cloud Computing: Principles and paradigms, 2011
2. Michael Miller, Cloud Computing, 2008.
3. Judith Hurwitz, Robin Bllor, Marcia Kaufman, Fern Halper, Cloud Computing for dummies, 2009.
4. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud Computing: A practical Approach, McGraw Hill, 2010.
5. Barrie Sosinsky, Cloud Computing Bible, Wiley, 2011.
6. Borko Furht, Armando Escalante (Editors), Handbook of Cloud Computing, Springer, 2010.

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## **BTCS 913 Compiler Design (Elective-III)**

**Objectives:** This course will provide the in-depth knowledge of different concepts involved while designing a compiler.

*Module1:* Overview of compilation- The structure of a compiler and applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, hand-written lexical analyzers, LEX, examples of LEX programs.

*Module2:* Introduction to syntax analysis -Role of a parser, use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars for programming languages (removal left recursion, etc.), non- context-free constructs in programming languages, parse trees and ambiguity, examples of programming language grammars.

*Module3:* Top-down parsing- FIRST & FOLLOW sets, LL(1) conditions, predictive parsing, recursive descent parsing, error recovery. LR-parsing - Handle pruning, shift-reduce parsing, viable prefixes, valid

items, LR(0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing. YACC, error recovery with YACC and examples of YACC specifications.

*Module 4:* Syntax-directed definitions (attribute grammars)-Synthesized and inherited attributes, examples of SDDs, evaluation orders for attributes of an SDD, dependency graphs. S-attributed and L-attributed SDDs and their implementation using LR-parsers and recursive descent parsers respectively.

*Module5:* Semantic analysis- Symbol tables and their data structures. Representation of “scope”. Semantic analysis of expressions, assignment, and control-flow statements, declarations of variables and functions, function calls, etc., using S- and L-attributed SDDs (treatment of arrays and structures included). Semantic error recovery.

*Module6:* Intermediate code generation - Different intermediate representations –quadruples, triples, trees, flow graphs, SSA forms, and their uses. Translation of expressions (including array references with subscripts) and assignment statements. Translation of control-flow statements – it- then-else, while-do, and switch. Short-circuit code and control-flow translation of Boolean expressions. Back patching. Examples to illustrate intermediate code generation for all constructs.

*Module 7:* Run-time environments:- Stack allocation of space and activation records. Access to non-local data on the stack in the case of procedures with and without nesting of procedures.

*Module 8:* Introduction to machine code generation and optimization- Simple machine code generation, examples of machine-independent code optimizations.

### **Suggested Readings/Books**

1. Aho, Ullman:Principles of Compiler Design. Narosa Publication.
2. Dhamdhare:Compiler Construction- Principles and Practice ,Macmillan, India
3. K.D. Cooper, and Linda Torczon, Engineering a Compiler, Morgan Kaufmann, 2004.
4. Holub:Compiler Design in C, PHI.
5. K.C. Loudon, Compiler Construction: Principles and Practice, Cengage Learning, 1997.
6. D. Brown, J. Levine, and T. Mason, LEX and YACC, O’Reilly Media, 1992.

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## **BTCS-914 Big Data (Elective-III)**

### **BigData Overview**

**Analysis of data at Rest- Hadoop analytics:** Limitations of existing distributing systems, Hadoop Approach, Hadoop Architecture, Distributed file system: HDFS and GPFS, Internals of Hadoop MR engine, Need for High level language- JAQL and PIG

**Introduction to Text Analytics:** Using Regular expressions, Using AQL, Sentiment analysis

**No SQL:** JSON store, MongoDB, RDF, HBASE

**Analytics:** Clustering, Classification, Segmentation, Linear regression, ML

**Search:** Indexing and Indexing Techniques, Create inverted index using JAQL, Lab using Data Explorer

**Bundling Hadoop job:** Application, Use BI tooling to create application, Publish applications.

### **Analysis of data in motion – Real time analytics**

**Introduction to streams computing,** Challenges/limitations of conventional Systems, Solving a real time analytics problem using conventional system, Challenges to be solved - scalability, thread pooling, etc., Understanding the challenges in handling streaming data from the real world and how to address those

using stream computing, Benefits of stream computing in Big Data world, Realtime Analytics Platform(RTAP).

### **Suggested Readings/Books**

1. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, by Chris Eaton, Paul Zikopoulos
  2. Big Data Analytics: Turning Big Data into Big Money By Frank J. Ohlhorst
  3. Ethics of Big Data By Kord Davis
  4. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends, By Michael Minelli, Michele Chambers, Ambiga Dhiraj
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### **BTCS 915 Digital Image Processing (Elective-III)**

**Introduction to Image Processing:** Digital Image representation, Sampling & Quantization, Steps in image Processing, Image acquisition, color image representation (8)

**Image Transformation & Filtering:** Intensity transform functions, histogram processing, Spatial filtering, Fourier transforms and its properties, frequency domain filters, color models, Pseudo coloring, color transforms, Basics of Wavelet Transforms (12)

**Image Restoration:** Image degradation and restoration process, Noise Models, Noise Filters, degradation function, Inverse Filtering, Homomorphic Filtering (5)

**Image Compression:** Coding redundancy, Interpixel redundancy, Psychovisual redundancy, Huffman Coding, Arithmetic coding, Lossy compression techniques, JPEG Compression. (8)

**Image Segmentation & Representation:** Point, Line and Edge Detection, Thresholding, Edge and Boundary linking, Hough transforms, Region Based Segmentation, Boundary representation, Boundary Descriptors, Regional (12)

### **Suggested Readings/Books**

1. Gonzalez and Woods: Digital Image Processing ISDN 0-201-600- 781, Addison Wesley 1992.
  2. Boyle and Thomas: Computer Vision - A First Course 2nd Edition, ISBN 0-632-028-67X, Blackwell Science 1995.
  3. Pakhera Malay K: Digital Image Processing and Pattern Recognition, PHI.
  4. Trucco & Verri: Introductory Techniques for 3-D Computer Vision, Prentice Hall, Latest Edition
  5. Low: Introductory Computer Vision and Image Processing, McGraw-Hill 1991, ISBN 0-07-707403-3.
  6. Jain, Kasturi and Schunk: Machine Vision, McGraw-Hill. 1995 ISBN 0070320187.
  7. Sonka, Hlavac, Boyle: Digital Image –Processing and Computer Vision First ed. ISBN 978813150557, Cengage Learning, 2011
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### **BTCS 916 Enterprise Resource Planning (Elective-III)**

**ERP AND TECHNOLOGY :**Introduction – Related Technologies – Business Intelligence – E-Commerce and EBusiness – Business Process Reengineering – Data Warehousing – Data Mining – OLAP – Product life Cycle management – SCM – CRM (10)

**ERP IMPLEMENTATION:** Implementation Challenges – Strategies – Life Cycle – Pre-implementation Tasks – Requirements Definition – Methodologies – Package selection – Project Teams –Process

Definitions – Vendors and Consultants – Data Migration – Project management – Post Implementation Activities. (10)

**ERP IN ACTION & BUSINESS MODULES:** Operation and Maintenance – Performance – Maximizing the ERP System – Business Modules – Finance – Manufacturing – Human Resources – Plant maintenance –

Materials Management – Quality management – Marketing – Sales, Distribution and service. (8)

**ERP MARKET:** Marketplace – Dynamics – SAP AG – Oracle – PeopleSoft – JD Edwards – QAD Inc – SSA Global – Lawson Software – Epicor – Intuitive. (9)

**ERP Application:** Enterprise Application Integration – ERP and E-Business – ERP II – Total quality management – Future Directions – Trends in ERP. (6)

### **Suggested Readings/Books**

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
  2. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.
  3. Jim Mazzullo, “SAP R/3 for Everyone”, Pearson, 2007.
  4. Jose Antonio Fernandez, “The SAP R /3 Handbook”, Tata McGraw Hill, 1998.
  5. Biao Fu, “SAP BW: A Step-by-Step Guide”, First Edition, Pearson Education, 2003.
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