Course	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
Category			L	Т	Р	CA	MSE	ESE	Total	
	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
	BTCOC302	Discrete Mathematics	3	1	-	20	20	60	100	4
	BTCOC303	Data Structures	3	1	-	20	20	60	100	4
	BTCOC304	Computer Architecture & Organization	3	1	-	20	20	60	100	4
	BTCOC305	Elective –I (a) Object - oriented Programming in C++ (b) Object Oriented Programming in Java	3	1	-	20	20	60	100	4
	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	-	-	4	60	-	40	100	2
	BTCOS307	Seminar – I	-		4	60	-	40	100	2
	BTES211P	Field Training / Internship / Industrial Training Evaluation	-	_	-	-	-	-	-	Audit
TOTAL			15	5	8	220	100	380	700	24

Semester –III (Second Year) Proposed Scheme w.e.f. July – 2021

BTES 301: Engineering Mathematics-III

[UNIT 1]

Introduction, Vectors in \mathbb{R}^n , Vector Addition and Scalar Multiplication, Dot (Inner) Product, Located Vectors, Hyperplanes, Lines, Curves in \mathbb{R}^n , Vectors in \mathbb{R}^3 (Spatial Vectors), ijk Notation, Complex Numbers, Vectors in \mathbb{C}^{n} .

[UNIT 2]

Introduction, Matrix Addition and Scalar Multiplication, Summation Symbol, Matrix Multiplication, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible (Nonsingular) Matrices, Special Types of Square Matrices, Complex Matrices, Block Matrices.

[UNIT 3]

Introduction, Basic Definitions, Solutions, Equivalent Systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Row Canonical Form, Row Equivalence, Gaussian Elimination, Matrix Formulation, Matrix Equation of System of Linear Equations, Systems of Linear Equations and Linear Combinations of Vectors, Homogeneous Systems of Linear Equations, Elementary Matrices, LU Decomposition. Applications: Linear Programming, Fourier series: Linear Algebra for Functions, Computer Graphics, Linear Algebra for Cryptography.

[UNIT 4]

Determinants: Introduction, Determinants of Orders 1 and 2, Determinants of Order 3, Permutations, Determinants of Arbitrary Order, Properties of Determinants, Minors and Cofactors, Evaluation of Determinants, Classical Adjoint, Applications to Linear Equations, Cramer's Rule, Submatrices, Minors, Principal Minors, Block Matrices and Determinants, Determinants and Volume, Determinant of a Linear Operator, Multilinearity and Determinants.

[UNIT 5]

Diagonalization Introduction, Polynomials of Matrices, Characteristic Polynomial, Cayley–Hamilton Theorem, Diagonalization, Eigenvalues and Eigenvectors, Computing Eigenvalues and Eigenvectors, Diagonalizing Matrices, Diagonalizing Real Symmetric Matrices and Quadratic Forms, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices. Applications: Graphs and Networks, Matrices in Engineering, Markov Matrices, Population, and Economics.

Text Book:

1. Linear Algebra, Seymour Lipschutz, Schaums outlines, 4th Edition, McGraw-Hill Publication.

Reference Books

- 1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley-Cambridge Press.
- 2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
- 3. M. Artin, Algebra, Prentice-Hall of India, 2005.

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BTCOC302: Discrete Mathematics

[UNIT 1] Fundamental Structures and Basic Logic

Sets, Venn diagram, Cartesian product, Power sets, Cardinality and countability, Propositional logic, Logical connectives, Truth tables, Normal forms, Validity, Predicate logic, Limitations of predicate logic, Universal and existential quantification, First order logic, Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

[UNIT 2] Functions and Relations

Subjective, Injective, Bijective and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations.

Combinatorics: Counting, Recurrence relations, generating functions.

[UNIT 3] Graph

Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path problems, Euler and Hamiltonian paths, Representation of graph, Isomorphic graphs, Planar graphs, Connectivity, Matching Colouring.

[UNIT 4] Trees

Trees: Rooted trees, Path length in rooted tree, Binary search trees, Spanning trees and cut set, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

[UNIT 5] Algebraic Structures and Morphism

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Text Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:

- 1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
- 2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
- 3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
- 4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010.Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
- 5. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

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BTCOC303: Data Structures

[UNIT 1] Introduction

Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs. Arrays and Hash Tables Concept of sequential organization, linear and non-linear data structure, storage representation, array processing sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

[UNIT 2] Stacks and Queues

Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.

[UNIT 3] Linked list

Concept of linked organization, singly and doubly linked list and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.

[UNIT 4] Trees and Graphs

Basic terminology, binary trees and its representation, insertion and deletion of nodes in binary tree, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.

[UNIT 5] Searching and Sorting

Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations– insertion, deletion and searching. Insertion sort, selection sort, radix sort, File handling.

Text Book:

1. Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition, 2013

Reference Books:

- 1. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
- 2. Y. Langsm, M. Augenstin, A. Tanenbaum, Data Structure using C and C++, Prentice Hall India Learning Private Limited,2nd edition,1998.
- 3. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition, 2008.
- 4. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.
- 5. Venkatesan& Rose, Data Structures, Wiley Publication, 1st Edition, 2015.
- 6. Goodrich & Tamassia, Data Structure & Algorithm in C++, Wiley Publication, 2nd Edition, 2011.
- 7. R. G. Dromey, How to Solve it by Computer, 2nd Impression, PearsonEducation.
- 8. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition,1999.

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BTCOC 304: Computer Architecture and Organization

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

[Unit 2] Instruction Sets

[UNIT 1] Introduction

Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

[Unit 3] Computer Arithmetic

The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

[Unit 4] Memory Organization

Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

[Unit 5] Control Unit and Input / Output Organization

Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Microprogrammed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming. Input/output Organization: External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface. Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Book:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

- 1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
- 2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
- 3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
- 4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
- 5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
- 6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
- 7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Elective –I

Concept of computer organization and architecture, Fundamental unit, Computer function and

[7 Hours]

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(A) BTCOC 305: Object Oriented Programming in C++

[Unit 1] Introduction to Object Oriented Programming and Objects and Classes [7 Hours]

Need of object oriented programming, The object oriented approach, Characteristics of object oriented languages, class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

[Unit 2] Operator Overloading, Inheritance and Polymorphism

Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, **multiple** inheritance Examples.

[Unit 3] Polymorphism

Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, this pointer.

[Unit 4] Streams and Files

Streams, Stream output and input, Stream manipulators, Files and streams, Creating, Reading, Updating sequential and random files.

[Unit 5] Templates, Exception Handling and STL

Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications. Standard Template Library (STL) Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Publication, 6th Edition, 2013.

Reference Books:

- 1. Robert Lafore, Object Oriented Programming in C++, Sams Publishing, 4th Edition, 2001.
- 2. Dr. B. B. Meshram, Object Oriented Paradigms with C++ Beginners Guide for C and C++, SPD Publication, 1st Edition, 2016.
- 3. Rajesh R. Shukla, Object-Oriented Programming in C++, Wiley India Publication, 1stEditio,2008
- 4. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.
- 5. P.J. Deitel, H. M. Deitel, C++ How to Program, PHI Publication, 9th Edition, 2012.
- 6. John Hubbard, Programming with C++, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.
- 7. Nicolai M. Josuttis, Object-Oriented Programming in C++, Wiley Publication, 1st Edition, 2002.

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Elective –I (B) BTCOC 305: Object Oriented Programming in JAVA

[Unit 1] Introduction to Java Applications

Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Introduction to Classes and Objects: Introduction, Classes, Objects, Methods and Instance Variables, Declaring a Class with a Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, *set* Methods and *get* Methods, Primitive Types vs. Reference type double Types, Initializing Objects with Constructors, floating point numbers.

[Unit 2] Control Statements

Control structures *if* single-selection statement, *if....else* double-selection statement, *while* repetition statement, *do....while* repetition statement, *switch* multi-selection statement, *break* and *continue* statements, logical operators. Methods :Introduction, Program modules in Java, *static* methods, *static* Fields and *Class Math*, declaring methods with multiple parameters, scope of declaration, method overloading and Java API packages.

[Unit3]Arrays

Arrays, declaring and creating arrays in java, examples using arrays, passing arrays to methods, multidimensional arrays, variable-length argument lists, using command-line arguments.

[Unit 4] Inheritance and Polymorphism in Java

Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, objectclass. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples and Interfaces.

[Unit 5] Exception-handling and Java script

Exception-handling overview, handling *Arithmetic Exceptions* and *Input Mismatch Exceptions*, when to use exception handling, java exception hierarchy, *finally* block. Introduction to Java Applets. Java script: Introduction to client side scripting, Syntax basics, Operators, Comparisons, Statements, Loops, Events, Objects, and User defined functions, Validations using object functions, Validations using regular expressions, JS document object model, popovers, windows

Text Book:

1. Paul Deitel and Harvey Detail, Java: How to Program, Pearson's Publication, 9thEdition.

Reference Books:

- 1. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication, 1st Edition, 2016. Doug Lowe, *Java All-in-One For Dummies*, Wiley Publication, 4th Edition, 2014.
- 2. Herbert Schildt, Java The Complete Reference, McGraw-Hill Publication, 9thEdition.
- 3. Patrick Niemeyer, Daniel Leuck, *Learning Java*, O'Reilly Media, 4th Edition, 2013.
- "JavaScript: The Good Parts", Douglas Crockford, O'Reilly, ISBN: 9782744055973.
 "Microsoft® .NET: Architecting Applications for the Enterprise", Microsoft Press; 1st edition, ISBN:978-0735626096

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BTCOL306: Data Structure Laboratory

List of Experiments:

- 1. Write a program to implement stack using arrays.
- 2. Write a program to evaluate a given postfix expression using stacks.
- 3. Write a program to convert a given infix expression to postfix form using stacks.
- 4. Write a program to implement circular queue using arrays.
- 5. Write a program to implement double ended queue (dequeue) using arrays.
- 6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
- 7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
- 8. Write a program to implement a queue using two stacks such that dequeue operation runs in constant time and dequeue operation runs in linear time.
- 9. Write programs to implement the following data structures: (a) Single linked list (b)Double linked list.
- 10. Write a program to implement a stack using a linked list such that the push and pop operations of stack still take O(1)time.
- 11. Write a program to create a binary search tree (BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b) Maximum key (c) Search for a given key (d) Find predecessor of a node (e) Find successor of a node (f) delete a node with given key.
- 12. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.
- 13. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
- 14. Implement the following sorting algorithms: (a) Insertion sort (b) Merge sort (c) Quick sort (d) Heap sort.
- 15. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS.

Elective –I

BTCOL306: Object Oriented Programming Lab

(a) Object Oriented Programming in C++

List of Experiments:

- 1. Programs on Operators, Arithmetic Promotion, Method Calling.
- 2. Programs on dealing with Arrays.
- 3. Programs on Classes: String and Math.
- 4. Programs on Inheritance and Polymorphism.
- 5. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
- 6. Programs on Interfaces block initializers, final Modifier, as well as static and dynamic binding.
- 7. Programs on file handling and stream manipulation.
- 8. Programs on Dynamic Polymorphism.
- 9. Programs on Dynamic Memory Management.
- 10. Programs on Exception Handling.
- 11. Programs on generic programming using templates.
- 12. Programs on STL-containers and iterators

(b) Object Oriented Programming in JAVA

List of Experiments:

- 1. Programs on Operators, Arithmetic Promotion, Method Calling.
- 2. Programs on Classes: String and Math.
- 3. Write a program to demonstrate following Function concepts
 - i) Function overloading
 - ii) Constructors of all types
 - iii) Default parameters, returning by reference
- 4. Programs on dealing with Arrays.
- 5. Programs on Classes: String and Math.
- 6. Programs on Inheritance and Polymorphism.
- 7. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
- 8. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
- 9. Programs on Exception Handling.
- 10. Write a Java program that illustrates the following
 - a) Creation of simple package.
 - b) Accessing a package.
 - c) Implementing interfaces.
- 11. Programs on Java script client side scripting.
- 12. Programs on Java script Operators, Comparisons, Statements, Loops, Events, Objects.
- 13. Programs on Java script User defined functions.
- 14. Programs on Java script Validations using object functions.
- 15. Programs on Java script Validations using regular expressions.
- 16. Programs on Java script JS document object model, Popovers, Windows.