

# **COURSE STRUCTURE**

  

## **B.TECH.**

  

### **COMPUTER SCIENCE & ENGINEERING**

  

#### **Specialization**

  

#### **in**

  

#### **Data Analytics**

  
  

#### **Under**

  

### **Choice Based Credit System (CBCS)**

## Credits Distributions

Sr. No.	Category	No. of Credits
1	Humanities and Social Sciences (HS)	25
2	Basic Sciences (BS)	19
3	Engineering Sciences (ES)	24
4	Professional Core (PC)	48
5	Professional Elective (PE)	31
6	Open Elective (OE)	16
7	Project Work (PW)	17
8	Mandatory Non Credit Courses (MNC) (4 Courses)	-
<b>Total</b>		<b>180</b>

## First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0101	Engineering Mathematics I	3	1	0	4	4
2.	BPHS0001	Engineering Physics	3	1	0	4	4
3.	BELH0001	English Language Skills for Communication – I	2	0	0	2	2
4.	BECG1001	Electronics Engineering	3	1	0	4	4
5.	BCSG1001	Python Programming	3	0	0	3	3
6.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	2	2
<b>PRACTICALS</b>							
1.	BPHS0801	Engineering Physics Lab	0	0	2	1	2
2.	BELH0801	English Language Lab – I	0	0	2	1	2
3.	BECG0800	Electronics Lab I	0	0	2	1	2
4.	BMEG0801	Engineering Drawing Lab	0	0	2	1	2
5.	BCSG1800	Python Programming Lab	0	0	2	1	2
<b>TOTAL</b>			<b>16</b>	<b>3</b>	<b>10</b>	<b>24</b>	<b>29</b>

## Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HRS/WK
			L	T	P		
1.	BMAS0102	Engineering Mathematics II	3	1	0	4	4
2.	BELH0002	English Language Skills for Communication – II	2	0	0	2	2
3.	BEEG1001	Basic Electrical Engineering	3	1	0	4	4
4.	BMEG0001	Basic Mechanical Engineering	3	1	0	4	4
5.	BCSG0002	Computer Programming	3	0	0	3	3
6.	BCSC0601	Web Programming through PHP	3	0	0	3	3
<b>PRACTICALS</b>							
1.	BELH0802	English Language Lab – II	0	0	2	1	2
2.	BEEG0800	Electrical Engineering Lab	0	0	2	1	2
3.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	1	2
4.	BCSG0801	Computer Programming Lab	0	0	2	1	2
5.	BCSC0800	Web Programming Lab	0	0	2	1	2
<b>TOTAL</b>			<b>17</b>	<b>3</b>	<b>10</b>	<b>25</b>	<b>30</b>

## Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
THEORY									
1.	BCSC0002	Object Oriented Programming	3	0	0	0	3	3	Programming
2.	BCSC0003	Database Management System	3	0	0	0	3	3	
3.	BCSC0004	Operating Systems	3	0	0	0	3	3	
4.	BCSC1005	Computer Organization	3	0	0	0	3	3	
5.	BCSC0006	Data Structures and Algorithms	3	1	0	0	4	4	Programming
6.	BCSC0007	Introduction to Microprocessors	3	0	0	0	3	3	Computer Organization
7.	BCSC0008	Computer Networks	3	1	0	0	4	4	
8.	BCSC0009	Software Engineering	3	0	0	0	3	3	
9.	BCSC1010	Discrete Mathematics	3	1	0	0	4	4	
10.	BCSC0011	Theory of Automata and Formal Language	3	1	0	0	4	4	
11.	BCSC0012	Design and Analysis of Algorithms	3	0	0	0	3	3	Programming, Data Structures
12.	BCSE0101	Digital Image Processing	3	0	0	0	3	3	Mathematics, Programming
PRACTICALS									
1.	BCSC0801	Object Oriented Programming Lab	0	0	2	0	1	2	Programming Lab
2.	BCSC0802	Database Management System Lab	0	0	2	0	1	2	
3.	BCSC0803	Operating Systems Lab	0	0	2	0	1	2	
4.	BCSC0804	Computer Organization Lab	0	0	2	0	1	2	
5.	BCSC0805	Data Structures and Algorithms Lab	0	0	2	0	1	2	Programming Lab
6.	BCSC0806	Microprocessors Lab	0	0	2	0	1	2	
7.	BCSC0807	Design and Analysis of Algorithms Lab	0	0	2	0	1	2	Programming, Data Structures
8.	BCSE0131	Digital Image Processing Lab	0	0	2	0	1	2	Programming
Total			36	4	16	0	48	56	

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
LIST OF PROGRAMME ELECTIVES									
THEORY									
1.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	0	2	2	
2.	BCSC0601	Web Programming through PHP	3	0	0	0	3	3	
3.	BCSE0551	Introduction to Business Analytics	3	0	0	0	3	3	
4.	BCSE0552	Applied Statistical Analysis	3	0	0	0	3	3	Introduction to Business Analytics
5.	BCSE0553	Data Mining and Predictive Modeling	3	0	0	0	3	3	
6.	BCSE0556	Hadoop & Big Data Analytics	3	0	0	0	3	3	Multidimensional Modeling
7.	BCSE0557	Social, Web & Mobile Analytics	3	0	0	0	3	3	Hadoop & Big Data Analytics
8.	BCSE0558	Enterprise Business Intelligence And Data Warehousing	3	0	0	0	3	3	
9.	BCSE0511	DevOps	3	0	0	0	3	3	
10.	BCSE0502	Introduction to Virtualization and Cloud Computing	3	0	0	0	3	3	
11.	BCSE0252	Full Stack Using Node JS	3	0	0	0	3	3	
12.	BCSE0704	Computational Linguistics and Natural Language Processing	2	0	0	0	2	2	
13.	BCSE0602	IT Network Security	3	0	0	0	3	3	
14.	BCSE0203	Internet of Things	3	0	0	0	3	3	
15.	BCSC0013	Compiler Design	3	1	0	0	4	4	
PRACTICALS									
1.	BCSC0800	Web Programming Lab	0	0	2	0	1	2	
2.	BCSE0581	Applied Statistical Analysis Lab	0	0	2	0	1	2	
3.	BCSE0582	Data Mining and Predictive Modeling Lab	0	0	2	0	1	2	
4.	BCSE0585	Hadoop & Big Data Analytics Lab	0	0	2	0	1	2	
5.	BCSE0586	Social, Web & Mobile Analytics Lab	0	0	2	0	1	2	
6.	BCSE0587	Enterprise Business Intelligence And Data Warehousing Lab	0	0	2	0	1	2	
7.	BCSE0539	DevOps Lab	0	0	2	0	1	2	
8.	BCSE0531	Virtualization Lab	0	0	2	0	1	2	

9.	BCSE0734	Computational Linguistic and Natural Language Processing Lab	0	0	2	0	1	2	
10.	BCSE0282	Full Stack Using Node JS Lab	0	0	2	0	1	2	
11.	BCSE0632	IT Network Security Lab	0	0	2	0	1	2	
12.	BCSE0232	Internet of Things Lab	0	0	2	0	1	2	

## Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
1.	BCSJ0950	Mini Project – I	0	0	0	0	2	0	
2.	BCSJ0951	Mini Project – II	0	0	0	0	2	0	
3.	BCSJ0971	Project – Part I	0	0	0	0	3	0	
4.	BCSJ0972	Project – Part II	0	0	0	0	8	0	
5.	BCSJ0991	Industrial Training	0	0	0	0	2	0	
<b>TOTAL</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>0</b>	

## Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
5.	BCHM0202	Environmental Studies	2	0	0	0	2	2	
6.	BELM0001	Introduction to Bhagavad Gita	2	0	0	0	2	2	

## Humanities and Social Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purposes – I	2	0	0	0	2	2	
4.	BELH0004	English for Professional Purposes – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAH0001	Industrial Management	3	0	0	0	3	3	
PRACTICALS									
1.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
2.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
3.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
4.	BTDH0302	Soft Skills – II	0	0	2	0	1	2	
5.	BTDH0303	Soft Skills – III	0	0	8	0	4	8	
6.	BTDH0304	Soft Skills – IV	0	0	8	0	4	8	
TOTAL			13	0	24	0	25	37	



## Basic Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT S HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS1103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
5.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
PRACTICALS									
1.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
TOTAL			17	5	4	0	24	26	

## Engineering Sciences

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE- REQUISITES
			L	T	P	J			
THEORY									
1.	BEEG0001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BCSG1001	Python Programming	3	0	0	0	3	3	
5.	BCSG0002	Computer Programming	3	0	0	0	3	3	
PRACTICALS									
1.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
2.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
3.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
4.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
5.	BCSG1800	Python Programming Lab	0	0	2	0	1	2	
6.	BCSG0801	Computer Programming Lab	0	0	2	0	1	2	
Total			15	3	12	0	24	25	

## BCSG0001: PYTHON PROGRAMMING

**Objective:** This course introduces the solving of mathematical problems using Python programming using OO concepts and its connectivity with database.

**Credits:05**

**L-T-P-J:4-1-0-0**

Module No.	Content	Teaching Hours
I	<p>Introduction to Python: Introduction and Basics; Setting up path Python Data Variables &amp; Operators: Data Variables and its types, id () and type () functions, Coding Standards;</p> <p><b>Control Structures:</b> if-else, elif, Nested if, Iteration Control structures, Break, Continue &amp; Pass;</p> <p><b>String Manipulation:</b> Accessing Strings, Basic Operations, String slices Function and Methods.</p> <p><b>Lists:</b> Introduction, Accessing list, Operations, Working with lists, Function and Methods.</p> <p><b>Tuple:</b> Introduction, accessing tuples , Operations, Working, Functions and Methods.</p> <p><b>Dictionaries:</b> Introduction, accessing values in dictionaries, Working with dictionaries, Properties , Functions.</p>	22
II	<p><b>Functions:</b> Defining &amp; Calling a function, Passing arguments to functions – Mutable &amp; Immutable Data Types, Different types of arguments, Recursion, Scope of variables;</p> <p><b>Modules and Packages:</b> User-defined modules and Standard Library: random, numpy, scipy, sys, Math Module, String Module, List Module, Date &amp; Time Module, Regular Expressions: match, search, replace;</p> <p><b>Input-Output:</b> Printing on screen, reading data from keyboard, Opening and closing file, Reading and writing files, Functions.</p> <p><b>Exception Handling:</b> Exception, Exception Handling, except clause, try? finally clause, User Defined Exceptions.</p> <p>Basics of Python for Data Analysis, Introduction to series and dataframes&amp; Python using Pandas.</p>	22

### Text Books:

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

### Reference Books:

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

**Outcome:** After completion of course, the student will be able to:

- C01: Understand the basics of Python Programming.
- C02: Apply the concepts of control structures and string manipulations of python programming.
- C03: Understand the use of data structures available in Python List, Tuple and Dictionary.
- C04: Experiment user-defined functions and access built-in functions.
- C05: Experiment user-defined modules and access built-in modules- math, random, string, date, time, date time.
- C06: Develop the programs using the concept of File Handling.
- C07: Develop programs based on Exceptional Handling.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P02/PS04
C02	P04/PS01
C03	P05/PS04
C04	P05,P07/PS01
C05	P02,P08/PS04
C06	P03,P010/PS02
C07	P05,P09/PS01

## BCSC1001: COMPUTER PROGRAMMING

**Objective:** To impart adequate knowledge on the need of problem solving techniques and develop programming skills to implements applications using the concepts of C Language. Also by learning the programming constructs they can easily switch over to any other language in future.

**Credits:05**

**L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Generation of Programming Languages:</b> Low, Assembly, High and 4GL.</p> <p><b>Language Processors:</b> Compiler, Interpreter, Assembler, Linker and Loader.</p> <p><b>Algorithm:</b> Introduction, Features, Different Ways of stating Algorithms.</p> <p><b>Flow Chart:</b> Introduction, Standard, Guidelines, Advantages and Limitations of using Flowcharts.</p> <p><b>Basics of C:</b> Overview, Structure of a C program, Identifier, Keywords, Variables, Data types, Formatted Input and output.</p> <p><b>Operators and Expression:</b> Assignment, Unary, Arithmetic, Relational, Logical, Bitwise, Conditional, Special operators and their precedence &amp; Associativity.</p> <p>IEEE representation of data types like float &amp; double, Lvalue and Rvalue</p> <p><b>Type Conversion:</b> Type Promotion in expression, Conversion by Assignment, Truncation and Casting Arithmetic expression.</p> <p><b>Decision and Case Control Structure:</b> if, if-else, nested if-else, Decisions using switch, switch versus if-else ladder, goto.</p> <p><b>Loop Control Structure:</b> For loop, while loop, do-while loop, nesting of loops, break, and continue.</p> <p><b>Arrays:</b> Introduction, one-dimensional and two-dimensional Array-Declaration, Initialization, Address Calculation.</p> <p><b>Operations on Arrays:</b> Insertion, Deletion, Linear Search &amp; Bubble Sort.</p> <p><b>String:</b> Introduction, One dimensional and two dimensional Array-Declarations, Initialization</p> <p><b>Operations on String:</b> Length, Copy, Reverse, Concatenate, Compare with &amp; without built-in functions.</p>	25
II	<p><b>Functions:</b> Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value, Passing Arrays to Functions.</p> <p><b>Introduction to Storage Classes:</b> Auto, Static, Extern and Register.</p> <p><b>Recursion:</b> Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration.</p> <p><b>The C Preprocessor:</b> Introduction, Macro Expansion and File Inclusion, Conditional Compilation and Miscellaneous Directives.</p> <p><b>Pointers:</b> Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Arrays and Pointers, Pointer and Strings, Pointer Arithmetic, Pointers to Pointers, Array of Pointers, Pointer to an Array, Two Dimensional Array and Pointers, Pointers to Functions, Dynamic Memory Allocation, void Pointer and Null Pointer.</p> <p><b>User Defined Types:</b> enum, typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference between Structures and Union.</p> <p><b>File Handling:</b> Data and Information, File Concepts, File Organization, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. Random Access to Files of Records.</p> <p>Introduction to Command Line Arguments.</p>	25

### Text Books:

- Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science – A Structured Programming Approach Using C", C Language Learning, 2007

### Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritchie, "The C Programming Language", PHI, 2nd Edition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

**Outcome:** After completion of course, the student will be able to:

- C01: Understand the basic concepts of problem solving skills.
- C02: Apply the basic principles of programming in C language.
- C03: Understand the concepts of arrays and strings in C language.
- C04: Apply the concepts of functions to solve real world problems.
- C05: Illustrate the concepts of recursion.
- C06: Understand the concepts of pointers in C language.
- C07: Understand the basic concepts of file handling.
- C08: Develop algorithmic solutions to simple computational problems.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1,PO2,PO4,PO12/PS01,PS03
C02	PO1,PO2,PO3,PO10/PS01,PS03
C03	PO1,PO2,PO3,PO4/PS01,PS03
C04	PO1,PO3, PO12/PS01,PS02
C05	PO1,PO2,PO4 /PS01,PS03
C06	PO1,PO2,PO3,PO4/PS01,PS02
C07	PO1,PO3,PO6 /PS01
C08	PO1,PO2,PO4,PO10,PO12/PS01,PS03

## BCSC0002: OBJECT ORIENTED PROGRAMMING

**OBJECTIVE:** This course introduces the Object-Oriented programming paradigm to students. It also teaches a student how to think objectively and model a Java program for solving real-world problems.

**CREDITS: 3**

**L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Object-Oriented Programming:</b> Features of Object-Oriented Programming, Introduction to Object-Oriented Java Programming.</p> <p><b>g Java Technology &amp; Environment:</b> Understanding the compilation process of the JVM, JVM vs JDK vs JRE, Key Features of Java, Structure of a simple Java program.</p> <p><b>Working with Java Primitive Data Types:</b> Strongly Typed nature of Java, Primitive Data Types in Java, The new 'var' keyword, Scope of a variable.</p> <p><b>Accepting User Input in Java Programs:</b> using the Scanner class, using command line arguments.</p> <p><b>Programming Constructs:</b> Sequence, Selection, Iteration &amp; Transfer Statements, For-Each Loop.</p> <p><b>Working with Java Arrays:</b> Declaring and Initializing One-Dimensional and Two-Dimensional Arrays in Java, Introduction to java. util. Arrays class.</p> <p><b>The String API:</b> String Data Type, commonly used methods from the String API, StringTokenizer, StringBuilder &amp; StringBuffer.</p> <p><b>Creating and Using Methods:</b> Signature of a method, Types of Methods, Overloading methods in a class, Static and Non-Static Methods.</p> <p><b>Describing and Using Objects &amp; Classes:</b> Declare the structure of a Java class, declaring members of a class (fields and methods), declaring and using Java Objects, lifecycle of an Object (creation, assignment, dereferencing and garbage collection), Constructors of a class, Overloading Constructors, Constructor chaining using 'this' and 'super' keyword.</p> <p><b>Using Java Packages:</b> create and import Java packages and static imports, abstracting program logic to packages, creating executable main class, running the executable class inside a package.</p> <p><b>Applying Encapsulation:</b> Using access modifiers with/in a class, principles of encapsulation.</p> <p><b>Programming Abstractly Through Interfaces:</b> create and implement Interfaces for programs, private and default methods in Interfaces, declaring Abstract Classes, Constructors in Abstract Classes. Marker Interface, Functional Interfaces, Lambda Expressions in Java.</p>	20
II	<p><b>Reusing Implementations using Inheritance:</b> Declaring Subclasses and Superclasses, extend Abstract Classes, implementing Interfaces, exploring polymorphic behavior by overriding methods, Object Types vs Reference Types, differentiate overloading, overriding and hiding.</p> <p><b>Exception Handling:</b> Exception Hierarchy, Need of Exception Handling, Checked Exceptions, Unchecked Exceptions and Errors, Try-Catch Blocks, Finally, Throw &amp; Throws Keywords, creating and handling Custom Exceptions.</p> <p><b>Threads in Java:</b> Life Cycle of a Thread, creating threads using Runnable and Thread, 'sleep ()', Thread Priorities.</p> <p><b>Using Wrapper Classes:</b> Wrapper Classes in Java, Boxing-Unboxing-Auto Boxing-Auto Unboxing.</p> <p><b>Generics &amp; Collections:</b> Creating Generic classes, Generic Methods, Diamond Notation, Wildcards, Type Erasure, Collection Hierarchy, Base Interfaces, Lists, Sets and Maps.</p> <p><b>The Stream API:</b> Introduction to the Stream API, using lambda expressions in Streams.</p> <p><b>Regular Expressions:</b> Pattern and Matcher Class.</p> <p><b>JDBC:</b> JDBC Drivers, Connecting to a MySQL Database, DriverManager, Connection Interface, Statement Interface, Result Set Interface, Prepared Statements.</p>	18

### Text Book:

- Herbert Schildt , “The Complete Reference, Java Eleventh Edition”, Oracle Press, 2019.

### Reference Book:

- Cay S Hosrtnmann , “Core Java Volume I—Fundamentals, Eleventh Edition”, Pearson, 2018.
- Rogers Cadenhead , “Sams Teach Yourself Java in 21 Days (Covers Java 11/12), 8th Edition”, Pearson, 2020.

**Outcomes:** After completion of the course, students will be able to -

- C01: Understand the basics of Object-Oriented Programming paradigm.
- C02: Construct the logical flow of programs by using the sequence, selection, iterations and transfer statements.
- C03: Apply the concepts of Object- Oriented Programming to model programs in Classes, Abstract Classes, Interfaces and Enums, and simplify program function by dissecting it into methods.
- C04: Understand accessibility of members in a program unit and create packages to prevent namespace collisions.
- C05: Predict run-time errors in a program by examining program functioning.
- C06: Show the parallel processing capabilities of a program using a multithreading concept.
- C07: Experiment with the predefined classes and interfaces defined in the Collections Framework.
- C08: Develop a program using JDBC connectivity to demonstrate data persistence.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1,PO3/PS01,PS02
C02	PO1,PO3/PS01,PS02
C03	PO1,PO2/PS01,PS02
C04	PO1 /PS02,PS04
C05	PO1,PO2,PO4/PS04
C06	PO1,PO2, PO3/ PS02
C07	PO1,PO2,PO11/PS02
C08	PO1,PO2,PO3/PS01,PS02



## BCSC0003: DATABASE MANAGEMENT SYSTEM

**Objective:** The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.

**Credits: 03**

**L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> An Overview of Database Management System, Database System Vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with Case Studies.</p> <p><b>Data Modeling Using the Entity-Relationship Model:</b> ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model.</p> <p><b>Relational Data Model and Language:</b> Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra</p> <p><b>Database Design &amp; Normalization I:</b> Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, Non-Redundant Cover, Canonical Cover</p>	20
II	<p><b>Database Design &amp; Normalization II:</b> 4<sup>th</sup> Normal Form, 5<sup>th</sup> Normal Form, Lossless Join Decompositions, MVD and JDs, Inclusion Dependence.</p> <p><b>File Organization:</b> Indexing, Structure of Index files and Types, Dense and Sparse Indexing</p> <p><b>Transaction Processing Concept:</b> Transaction System, Testing of Serializability, Serializability of Schedules, Conflict &amp; View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling.</p> <p><b>Concurrency Control Techniques:</b> Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol.</p> <p><b>Distributed Database:</b> Introduction of Distributed Database, Data Fragmentation and Replication.</p>	20

### Text Books:

- Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

### References Books:

- Date C J, "An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

**Outcome:** After the completion of the course, the student will:

- C01: Understand the concept of database management systems and Relational database.
- C02: Identify the various data model used in database design.
- C03: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- C04: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- C05: Select the information from a database by formulating complex queries in SQL.
- C06: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- C07: Discuss indexing mechanisms for efficient retrieval of information from a database.

- C08: Discuss recovery system and be familiar with introduction to web database, distributed databases.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1 /PS01
C02	PO2, PO3/ PS02
C03	PO2,PO3,PO6,PO11/PS01,PS02,PS04
C04	PO1,PO3/PS01
C05	PO1,PO5/PS01
C06	PO2,PO3,PO9/ PS02
C07	PO1,PO11 /PS01
C08	PO1,PO3,PO12/ PS02

## BCSC0004: OPERATING SYSTEMS

**Objective:** This course aims to introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.

**Credits:03**

**L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> Operating System and its Classification - Batch, Interactive, Multiprogramming, Time sharing, Real Time System, Multiprocessor Systems, Multithreaded Systems, System Protection, System Calls, Reentrant Kernels, Operating System Structure- Layered structure, Monolithic and Microkernel Systems, Operating System Components, Operating System Functions and Services.</p> <p><b>Processes:</b> Process Concept, Process States, Process State Transition Diagram, Process Control Block (PCB), Process Scheduling Concepts, Threads and their management.</p> <p><b>CPU Scheduling:</b> Scheduling Concepts, Performance Criteria, Scheduling Algorithms, Multiprocessor Scheduling.</p> <p><b>Process Synchronization:</b> Principle of Concurrency, Implementation of concurrency through fork/join and parbegin/parend, Inter Process Communication models and Schemes, Producer / Consumer Problem, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Synchronization Hardware.</p> <p><b>Classical Problem in Concurrency:</b> Dining Philosopher Problem, Readers Writers Problem.</p>	20
II	<p><b>Deadlock:</b> System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock, Combined Approach.</p> <p><b>Memory Management:</b> Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Paging, Segmentation, Paged segmentation.</p> <p><b>Virtual memory concepts:</b> Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Locality of reference.</p> <p><b>I/O Management and Disk Scheduling:</b> I/O devices, I/O subsystems, I/O buffering, Disk storage and disk scheduling.</p> <p><b>File System:</b> File concept, File organization and access mechanism, File directories, File allocation methods, Free space management.</p>	20

### Text Books:

- Silberschatz, Galvin and Gagne, "Operating Systems Concepts", 9th Edition, Wiley, 2012.

### Reference Books:

- Sibsankar Halder and Alex a Aravind, " Operating Systems", 6th Edition, Pearson Education, 2009.
- Harvey M Dietel, "An Introduction to Operating System", 2nd Edition, Pearson Education, 2002.
- D M Dhamdhare, "Operating Systems: A Concept Based Approach", 2nd Edition, 2006.
- M. J. Bach, "Design of the Unix Operating System", PHI, 1986.

**Outcome:** After completion of course, the student will be able to:

- C01: Understand the classification of operating system environment.
- C02: Understand the basic of process management.
- C03: Apply the concept of CPU process scheduling for the given scenarios.
- C04: Illustrate the process synchronization and concurrency process in operating system.
- C05: Analyze the occurrence of deadlock in operating system.
- C06: Describe and analyze the memory management and its allocation policies.
- C07: Understand the concepts of disk scheduling.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P01,P02,P07/PS01
C02	P01,P02 /PS01
C03	P01,P04/PS01,POS3
C04	P03,P04,P06/PS03,PS04
C05	P01,P04/PS01,PS03
C06	P01,P02 /PS01,PS03
C07	P01,P02,P07/PS01,PS03

## BCSC1005: COMPUTER ORGANIZATION

**Objective:** This course aims at introducing the concept of computer organization. In particular, it focuses on basic hardware architectural issues that affect the nature and performance of software.

**Credits: 03**

**L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Basic Organization:</b> Basic organization of the computer and Block level description of the functional units, Number representation; 1's and 2's Complement, Integer Representation, Arithmetic Addition &amp; Subtraction with overflow. fixed and floating-point number representation, IEEE standard floating point representation. Introduction to Combinational Circuit- half adder, full adder, binary adder/subtractor, carry look ahead adders. Multiplexer and Demultiplexer, Register, bus and memory transfer.</p> <p><b>Central Processing Unit:</b> Addition and subtraction of signed numbers, Multiplication: Signed operand multiplication, Booths algorithm.</p> <p>Processor organization, general registers organization, stack organization, Three, Two, One &amp; Zero address instruction. Addressing modes, Micro-operations (Arithmetic, Logical &amp; Shift) and its applications.</p>	20
II	<p><b>Multiprogramming and Multiprocessing:</b> Flynn's classification, Introduction to pipelined operation. Instruction types, formats, Instruction cycles.</p> <p><b>Control Unit:</b> Execution of a complete instruction. Hardwired and micro programmed control unit. Unconditional and Conditional branching. Microinstruction with next address field, pre-fetching microinstructions, Concept of horizontal and vertical microprogramming.</p> <p><b>Memory:</b> Basic concept of Memory and its hierarchy, RAM memories, 2D, 2 &amp; 1/2D memory organization. ROM memories. Cache memories: concept and design issues, performance, address mapping and replacement. Virtual memory: concept and implementation.</p> <p><b>Input/Output:</b> Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Buses, bus architecture, types of buses and bus arbitration. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Standard communication interfaces.</p>	20

### Text Books:

- M. Mano , "Computer System Architecture", 3<sup>rd</sup> Edition, PHI, 1996.

### Reference Books:

- D.W. Patterson , "Computer Organization and Design", 4<sup>th</sup> Edition, Elsevier Publication, 2008.
- William Stallings , "Computer Organization", 8<sup>th</sup> Edition, PHI, 2011.
- V. Carl Hamacher, Zaky , "Computer Organization", 4<sup>th</sup> International Edition, TMH, 1996.
- John P Hays, "Computer Organization", 2<sup>nd</sup> Edition, TMH.
- Tannenbaum , "Structured Computer Organization", 5<sup>th</sup> Edition, PHI, 2005.
- P Pal Chaudhry , "Computer Organization & Design", 2<sup>nd</sup> Edition, PHI, 2002.

**Outcome:** After completion of the course, the student will be able to:

- CO1: Understand the basics of digital computer system.
- CO2: Demonstrate the principle of arithmetic operations on unsigned, signed integers and floating point numbers.

- C03: Understand the concepts of Combinational and Sequential circuits and their applications.
- C04: Understand the CPU architecture and organization.
- C05: Explain the basic concepts of pipelining.
- C06: Design the steps for the execution of the complete instruction for hardwired and micro-programmed control unit.
- C07: Explain the function of memory hierarchy.
- C08: Determine the interface of CPU with input/output devices and their modes of transfer.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P01,P03/PS01
C02	P01,P03/PS01
C03	P02,P03,P05/PS02
C04	P02,P03,P04/PS01,PS03
C05	P02,P03,P04/PS02
C06	P01,P02,P03/PS01,PS03
C07	P02,P03,P05/PS02,PS03
C08	P03,P04/PS01

## BCSC0006: DATA STRUCTURES AND ALGORITHMS

**Objective:** The objective of this course is that students will construct and application of various data structures and abstract data types including lists, stacks, queues, trees and graphs.

**Credits: 04**

**L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> Basic Terminology, Elementary Data Organization, Properties of an Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic Notations – Big-Oh; Operations on Data Structure, Abstract Data Types (ADT).</p> <p><b>Linked Lists:</b> Implementation of Singly Linked Lists, Doubly Linked List, Circular Linked List, Operations on a Linked List - Insertion, Deletion, Traversal; Generalized Linked List, Polynomial Representation and Addition.</p> <p><b>Stacks:</b> Primitive Stack Operations - Push &amp; Pop, Array and Linked Implementation of Stack in C, Application of Stack: Prefix and Postfix Expressions, Evaluation of Postfix Expression, conversion of Infix to Postfix expression, Recursion, Principles of Recursion, Tail Recursion, Removal of Recursion, use of stack in Recursion, Tower of Hanoi Problem.</p> <p><b>Queues:</b> Operations on Queue - Add, Delete operations, Implementation of Queue Using Array and Linked List, Circular Queues, Deque and Priority Queue.</p> <p><b>Trees:</b> Basic Terminology, Array Representation and Dynamic Representation; Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Tree Traversal Algorithms - Inorder, Preorder and Postorder; Threaded Binary Trees, Traversing Threaded Binary Trees.</p>	20
II	<p><b>Search Trees:</b> Binary Search Trees (BST), Insertion and Deletion in BST, AVL Trees, Introduction to M-Way Search Trees, B Trees.</p> <p><b>Searching:</b> Sequential Search, Binary Search.</p> <p><b>Sorting:</b> Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Two Way Merge Sort, and Heap Sort.</p> <p><b>Graphs:</b> Terminology, Adjacency Matrices, Adjacency List, Graph Traversal - Depth First Search and Breadth First Search; Spanning Trees, Minimum Cost Spanning Trees – Prim's and Kruskal's Algorithm; Shortest Path Algorithm – Bellman-Ford and Dijkstra's Algorithm.</p> <p><b>Hashing &amp; Indexing:</b> Hash Function, Collision Resolution Strategies. Primary Indices, Secondary Indices, Indexing and Hashing Comparisons.</p>	20

### Text Book:

- Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein , “Data Structures Using C and C++”, 2nd Edition, PHI, 2009.

### Reference Books:

- Horowitz and Sahani , “Fundamentals of Data Structures”, 3rd Edition, W H Freeman & Co, 2004-05
- Jean Paul Trembley and Paul G. Sorenson , “An Introduction to Data Structures with Applications”, 2nd Edition, TMH, 2007.
- R. Kruse, “Data Structures and Program Design in C” ,2nd Edition, Pearson Education, 2004.
- Lipschutz Schaum's Outline Series , “Data Structures”, 12th Reprint, TMH, 2010.
- G A V Pai , “Data Structures and Algorithms”, TMH, 2009.

**Outcome:** After completion of course, student will be able to:

- C01: Understand the basic concepts of the data structure and algorithms.
- C02: Understand the complexity representation in terms of Big Oh, Theta and Omega notations.
- C03: Apply the associated operations in linear data structure like stack, Queue and link list.
- C04: Apply the associated operations in Binary Search Tree, AVL Tree and M- Way Search Tree.
- C05: Understand the basic algorithms such as heap sort, graph traversal, quick sort, AVL trees, and hashing.
- C06: Select the appropriate data structure to solve the problem.
- C07: Apply the shortest path algorithm to solve real life problem.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1/PSO1,PSO2
C02	PO1, PO2/PSO1,PSO2
C03	PO1/PSO1
C04	PO1,PO4/PSO1
C05	PO1,PO4/PSO3
C06	PO2/PSO4
C07	PO2/PSO4



## BCSC0007: INTRODUCTION TO MICROPROCESSORS

**Objective:** Objective of this subject is to introduce the basic concepts of microprocessor and assembly language programming. Identify and explain the operation of the components of typical microprocessor: the role of the ALU, registers, stack and the use of interrupts.

**Credits: 03**

**L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> Microprocessors Evolution and Types, Basics of Pentium Microprocessor, Microprocessor Application,</p> <p><b>8-Bit Microprocessor:</b> 8085 Microprocessor and its Architecture, Addressing Modes, The 8085 Programming Model, Instruction Classification, Instruction Format, Overview of Instruction Set - Data Transfer Operation, Arithmetic Operation, Logic Operations and Branch Operations; Introduction to Assembly Language Program.</p> <p><b>Programming Technique with Additional Instruction:</b> Looping, Counting, Indexing, Additional Data Transfer and 16-Bit Arithmetic Instruction, Counters and Time Delays, Stack and Subroutine.</p>	20
II	<p><b>16 Bit Microprocessor:</b> Architecture of 8086 – Register Organization, Execution Unit, Bus Interface Unit, Signal Description, Physical Memory Organization, Mode of Operation, I/O Addressing Capabilities.</p> <p><b>Peripheral Interfacing:</b> I/O Programming, Programmed I/O, Interrupt Driven I/O, DMA I/O, Memory-Mapped I/Os.</p> <p><b>Peripheral Devices:</b> 8237 DMA Controller, 8255 Programmable Peripheral Interface, 8253/8254 Programmable Timer/Counter, 8259 Programmable Interrupt Controller.</p>	18

### Text Books:

- N Senthil Kumar, M Saravanan, and S Jeevananthan , “Microprocessors and Microcontrollers”, Oxford University Press India, 2010.

### Reference Books:

- Ramesh S. Gaonkar , “Microprocessor Architecture Programming and Applications with 8085”, 4th Edition, Penram International Publishing, 2000.
- Ray A.K. Bhurchandi.K.M , “Advanced Microprocessor and Peripherals”, TMH, 2002.
- D. V. Hall , “Microprocessors and Interfacing: Programming and Hardware”, 2nd Edition, TMH, 1992.
- Y.C. Liu and G.A. Gibson , “Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design”, 2nd Edition, PHI, 2003.

**Outcome:** After the completion of the course, the student will be able to:

- C01: Demonstrate the Microprocessor internal architecture and its operations.
- C02: Develop programs based on 8085 microprocessor instruction set and addressing mode.
- C03: Develop program using looping, counting, indexing, counter and time delays.
- C04: Understand the concept of stack and subroutine for modular approach.
- C05: Compare accepted standards and guidelines to select microprocessor (8085 & 8086) to meet performance requirements.
- C06: Analyze the concept of interfacing the processor to external device with I/O programming & Interrupt Driven I/O.
- C07: Understand the working of interfacing chips (8237, 8253/54, 8255 & 8259).

---

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P01,P02/PS01
C02	P02,P03/PS01,PS02
C03	P02,P03/PS01,PS02
C04	P01,P02,P03/PS01,PS03
C05	P02,P03,P05/PS01,PS03
C06	P01,P02/PS03
C07	P01,P02,P04/PS03

## BCSC 0008: Computer Networks

**Objective:** The objective is to understand fundamental underlying principles of computer networking, details and functionality of layered network architecture.

**Credits: 03**

**Semester - IV**

**L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	<b>Introduction Concepts:</b> Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design, Physical Layer Transmission Media, Line coding scheme, switching methods (circuit switching, Packet switching), TDM. <b>Medium Access sub layer:</b> Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols, CSMA, CSMA/CD, Overview of IEEE standards. <b>Data Link Layer:</b> Error detection and correction, Flow control (sliding window protocol)	20
II	<b>Network Layer:</b> Network Layer –IP addressing, subnet, CIDR, VLSM, Internetworking, Address mapping, routing. Connecting devices. <b>Transport Layer:</b> Transport Layer - Design issues, connection management, Flow control, TCP window management, congestion control-slow start algorithm. <b>Application Layer:</b> Data compression, Data Encryption, File Transfer, DNS, HTTP, SMTP, TELNET <b>Introduction to IPv6, transition from IPv4 to IPv6.</b>	20

### Text Books:

- Forouzan B. A. , “Data Communication and Networking”, 4th Edition, McGrawHill, 2004.

### References:

- Kurose, J.F. and Ross K.W. , “Computer Networking: A Top-Down Approach Featuring the Internet”, 3rd Edition, Addison-Wesley, 2005.
- A.S. Tanenbaum , “Computer Networks”, 2nd Edition, Prentice Hall India, 2006.

**Outcome:** After the completion of the course, the student will be able to:

- C01: Understand the concept of OSI and TCP/IP reference model.
- C02: Understand the basics of data transmission at physical layer.
- C03: Understand the channel allocation using ALOHA, CSMA and CSMA/CD.
- C04: Apply error detection and correction technique to eliminate transmission error.
- C05: Analyze the fixed and variable length address (IPv4) subnetting for the given scenarios.
- C06: Understand the design issues of the transport layer.
- C07: Understand the mechanism of protocols at application layer such as FTP, HTTP, Telnet, DNS.
- C08: Understand IPv6 addressing and differentiate it from IPv4.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1,PO3,PO12/PS01
C02	PO1/PS02
C03	PO1,PO4/PS01,PS04
C04	PO1,PO3/PS01
C05	PO1,PO3,PO4,PO6/PS03
C06	PO2,PO4/PS01
C07	PO5,PO12/PS02
C08	PO4,PO7/PS04

## BCSC0009: SOFTWARE ENGINEERING

**Objective:** Be employed in industry, government, or entrepreneurial endeavors to demonstrate professional advancement through significant technical achievements and expanded leadership responsibility.

**L-T-P-J: 3-0-0-0**

**Credits: 03**

Module No.	Content	Teaching Hours
I	<p><b>Introductory Concepts:</b> The evolving role of software – characteristics, components and applications.</p> <p><b>Process Models:</b> Waterfall Model, Prototyping, Incremental, Spiral.</p> <p><b>Agile software Development:</b> Introduction to Agile, Agile software development framework.</p> <p><b>Software Requirement Specification:</b> Requirement Process, SRS Components, Requirement Specifications with Use Cases Diagram.</p> <p><b>Software Project Planning:</b> Project Planning Objectives.</p> <p><b>Software Metrics:</b> Size, Function Point, Staffing, Project Estimation Methods–COCOMO Model.</p> <p><b>Function-Oriented Design:</b> Problem Partitioning, Abstraction, Top Down and Bottom Up Design.</p> <p><b>Module-Level Concepts:</b> Coupling, Cohesion, Design Notation and Specification - Structure Charts; Structured Design Methodology - Data Flow Diagram, Sequence Diagram.</p>	20
II	<p><b>OO Analysis and OO Design:</b> OO Concepts, Introduction to UML Design Patterns: Class Diagram, Activity Diagram, State Chart Diagram.</p> <p><b>Coding:</b> Coding Process, Verification – Code Inspections, Software Metrics.</p> <p><b>Testing Fundamentals:</b> Test Case Design, Black Box Testing Strategies, White Box Testing, Unit Testing, Integration Testing, System Testing.</p> <p><b>Introduction to Automation Testing and Testing Tools:</b> Automated Testing Process, Framework for Automation Testing, Introduction to Automation Testing Tool.</p> <p><b>Software Quality:</b> Models, ISO 9000 Certification for Software Industry, SEI Capability Maturity Model.</p> <p><b>Software Maintenance:</b> Models Cost of Maintenance, Re-engineering, Reverse Engineering.</p>	18

### Text Books:

- R. S. Pressman, “Software Engineering: A Practitioners Approach”, 7th Edition, McGraw Hill, 2010.

### Reference Books:

- K. K. Aggarwal and Yogesh Singh, “Software Engineering”, 3rd Edition, New Age International Publishers, 2008.
- Rajib Mall, “Fundamentals of Software Engineering”, 3rd Edition, PHI Publication, 2009.
- R.E Fairley, “Software Engineering”, McGraw Hill, 2004.
- Sommerville, “Software Engineering”, 9th Edition, Pearson Education, 2010.

**Outcome:** After the completion of the course, the student will be able to:

- C01: Understand the basic concepts of software engineering.
- C02: Apply software processes to solve real world problems.
- C03: Estimate the cost, effort and schedule of software using COCOMO Model.
- C04: Analyze the software design techniques (structure chart, SDM, sequence diagram).
- C05: Understand the basic concepts of OO analysis and design.
- C06: Develop the test cases to validate the software.
- C07: Understand the basic models of software Quality and maintenance.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P01,P07/PS01
C02	P02,P03/PS04
C03	P02,P011/PS03
C04	P03,P010/PS04
C05	P03,P07/PS01
C06	P05,P012/PS02
C07	P04,P09,P012/PS01

## BCSC1010: DISCRETE MATHEMATICS

**Objective:** The objective is to introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in computer science.

Credits: 4

**L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Sets, Relations and Functions:</b> Introduction to Set Theory, Venn diagrams, algebra of Sets, Inclusion-Exclusion Principle, Partitions, Relations, Properties and their types, Function and their types.</p> <p>Recurrence Relations and Generating Functions</p> <p><b>Introduction to Counting Principle:</b> Permutation, Combination, Permutation with Repetition, Combination with Repetition, Pigeonhole Principle.</p> <p><b>Posets &amp; Lattices:</b> Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice.</p> <p><b>Natural Numbers:</b> Introduction, Mathematical Induction, Variants of Induction, Induction with Nonzero Base cases. Proof Methods, Proof by counter – example, Proof by contradiction.</p>	20
II	<p><b>Propositional Logic</b> - Logical Connectives, Truth Tables, Normal Forms (Conjunctive and Disjunctive), Validity;</p> <p><b>Predicate Logic</b> - Quantifiers, Inference Theory</p> <p><b>Algebra:</b> Motivation of Algebraic Structures, Finite Groups, Subgroups and Group Homomorphism; Lagrange's Theorem; Commutative Rings and Elementary Properties;</p> <p><b>Graph Theory:</b> Trees: Definition, Binary tree, Binary tree traversal, Binary search tree. Introduction to Graphs, , Operations on Graphs, Representation of graphs, Types: Planner, Directed, Complete, Bipartite Graph, Isomorphism, Euler Graph, Hamiltonian Graph, Connectivity.</p>	20

### Text Book:

- Kenneth H Rosen , “Discrete Mathematics and Its Applications”, 7th edition, TMH, 2012.

### Reference Books:

- J.P. Tremblay, “Discrete Mathematical Structures with Applications to Computer Science”, TMH, New Delhi, 1997.
- V. Krishnamurthy, “Combinatorics: Theory and Applications”, East-West Press, New Delhi, 1986.
- Ralph P. Grimaldi , “ Discrete and Combinatorial Mathematics- An Applied Introduction”, 5th Edition, Pearson Education, 2004
- C.L. Liu , “Elements of Discrete Mathematics”, 2nd Edition, TMH, 2000.

**Outcome:** After the completion of the course, the student will be able to:

- C01: Understand the notion of mathematical thinking and proofs to solve the problem.
- C02: Apply the basics of discrete probability and number theory to solve the real world problem. C03: Analyze basic discrete structures and algorithms using effectively algebraic techniques.
- C04: Analyze mathematical concepts like sets, reasoning, relational algebra and graph theory to solve optimization problems.
- C05. Analyze the validity of an argument using logical notation.
- C06. Demonstrate the basic structures of proof techniques to write and evaluate the validity of arguments.
- C07. Understand the basic principles of sets, set equalities and operations in sets.
- C08. Apply counting principles to determine probabilities.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	PO1,PO2/PS01,PS03
C02	PO1,PO3/PS04
C03	PO2,PO3/PS03
C04	PO2,PO3/PS03
C05	PO1,PO2/ PS03
C06	PO1,PO3/PS02,PS03
C07	PO1,PO2/PS01
C08	PO1,PO3/PS01,PS04



## BCSC0011: THEORY OF AUTOMATA & FORMAL LANGUAGES

**Objective:** The objective of this course is that students will study and compare different models and views of the abstract notion of computation and its various aspects.

**Credits:04**

**Semester V**

**L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> Alphabets, Strings and Languages; Automata and Grammars, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem; FA with Output - Moore and Mealy machine, Applications and Limitations of FA.</p> <p><b>Regular expression (RE):</b> Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages.</p> <p><b>Push Down Automata (PDA):</b> Introduction, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA.</p>	20
II	<p><b>Context Free Grammar (CFG) and Context Free Languages (CFL):</b> Introduction, Derivation Trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal Forms for CFGs - CNF and GNF; Pumping lemma for CFLs, Equivalence of PDA and CFG.</p> <p><b>Turing machines (TM):</b> Basic Model, Definition and Representation, Variants of Turing Machine and their equivalence, TM for Computing Integer Functions, Universal TM, Church's Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Computational Complexity.</p>	20

### Text Books:

- K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

### Reference Books:

- Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2013.
- Martin J. C., "Introduction to Languages and Theory of Computations", 4th Edition, TMH, 2011.

**Outcome:** After completion of course, the student will be able to:

- C01: Understand the basic concepts of Context Free languages, Expression and Grammars.
- C02: Analyze the conversion of NFA to DFA, Mealy to Moore and Moore to Mealy.
- C03: Analyze the process to convert regular expression to DFA, DFA to regular expression, and minimization of DFA.
- C04: Develop the PDA for the context free language and context free grammar.
- C05: Analyze that the grammar is ambiguous or unambiguous.
- C06: Apply the process to convert CFG to CNF and GNF.
- C07: Understand the concept of Turing machine and its variants.
- C08: Design the Turing machine for the real world application.



**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P01/PS01,PS04
C02	P02,P03/PS03
C03	P02,P03,P09,P012/PS01,PS03,PS04
C04	P01,P03,P05,P09/PS03,PS04
C05	P01,P02,P04/PS03
C06	P02,P03/PS03
C07	P01,P02/PS01,PS03
C08	P03,P012/PS01,PS02,PS03

## BCSC0012: DESIGN & ANALYSIS OF ALGORITHMS

**Objective:** The objective of this course is that students will construct and application of various data structures and concepts including Trees, Recursion & Dynamic programming.

**Credits:03**

**L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	<b>Introduction:</b> Algorithms, analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. <b>Advanced Data Structures:</b> Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps. Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull and Searching.	20
II	Greedy methods with examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim's and Kruskal's algorithms, Single source shortest paths - Dijkstra's and Bellman Ford algorithms. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets Dynamic programming with examples such as Knapsack. All pair shortest paths – Warshal's and Floyd's algorithms, Resource allocation problem	20

### Text Books:

- Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest , Introduction to Algorithms, Third edition, Prentice Hall of India, 2008.

### Reference Books:

- Gilles Brassard Paul Bratley , " Fundamentals of Algorithms", Prentice Hall, 1996.
- Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran , "Fundamentals of Computer Algorithms", Orient Longman Pvt. Ltd, 2008.
- Levitin , "An Introduction to Design and Analysis of Algorithms", Pearson, 2008.

**Outcome:** After completion of course, student will be able to:

- C01: Understanding of complexity representation in terms of Big Oh, Theta and Omega notations.
- C02: Derive and solve recurrences describing the performance of divide-and-conquer algorithms (quick sort and merge sort).
- C03: Compare and analyze different data structures (RB Tree, B Tree, Binomial Heaps, Fibonacci Heaps).
- C04: Understand the major graph algorithms (DFS, BFS, Dijkstra's Bellman Ford) and their analyses.
- C05: Understand the greedy paradigm and able to analyze when an algorithmic design situation calls for it. Synthesize greedy algorithms (Optimal Reliability Allocation, Minimum Spanning Trees, factorial Knapsack) and analyze them.
- C06: Synthesize dynamic-programming algorithms (0/1 knapsack problem, Resource allocation problem, Warshal's and Floyd's algorithms) and analyze them.
- C07: Understand the backtracking paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize backtracking algorithms (N Queen Problem, TSP Problem, sum of subsets problem, Graph Coloring) and analyze them.
- C08: Understand the branch and bound paradigm and able to analysis when an algorithmic design situation calls for it. Synthesize branch and bound algorithms (N Queen Problem, TSP Problem, Hamiltonian Cycles, Graph Coloring) and analyze them.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	PO1,PO3,PO4,PO12/PS01,PS03
C02	PO1, PO3,PO4,PO5/PS01,PS03
C03	PO1,PO3, PO6/PS01,PS03
C04	PO1,PO2,PO3, /PS01,PS03
C05	PO1,PO2 /PS01,PS03
C06	PO1,PO2,PO3, PO6/PS01,PS03
C07	PO1,,PO4,PO12/PS01,PS03
C08	PO1,PO2,PO3,PO4,PO12/PS01,PS02

## BCSC0014: APPLIED DATABASE MANAGEMENT SYSTEM

**Objective:** The objective of the course is to enable students to understand and use a relational database & NoSQL system. Students learn how to design and create a good database.

**Credits:04**

**L-T-P-J:4-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence, Database Language and Interfaces (DDL, DML, DCL), Database Development Life Cycle (DDLC) with case studies.</p> <p><b>Data Modeling Using the Entity-Relationship Model:</b> ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Specialization, Generalization, Aggregation, Reduction of an ER Diagram to Tables, Extended ER Model.</p> <p><b>Relational Data Model and Language:</b> Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra</p> <p><b>Database Design &amp; Normalization:</b> Functional Dependencies, Primary Key, Foreign Key, Candidate Key, Super Key, Normal Forms, First, Second, Third Normal Forms, BCNF, 4<sup>th</sup> Normal Form, 5<sup>th</sup> Normal Form, Lossless Join Decompositions, Non Redundant Cover, Canonical Cover, MVD and JDs, Inclusion Dependence.</p>	26
II	<p><b>Transaction Processing Concept:</b> Transaction System, Testing of Serializability, Serializability of Schedules, Conflict &amp; View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Deadlock Handling.</p> <p><b>Concurrency Control Techniques:</b> Concurrency Control, Locking Techniques for Concurrency Control, 2PL, Time Stamping Protocols for Concurrency Control, Validation Based Protocol.</p> <p><b>Distributed Database:</b> Introduction of Distributed Database, Data Fragmentation and Replication.</p> <p><b>NoSQL System:</b> RDBMS vs NoSQL, BASE properties, Key-value, Columnar, Document and Graph-Based database, Introduction of MongoDB, Cassandra, Neo4j and Riak.</p> <p><b>Database Programming using Python:</b> Database connectivity, Retrieving Data from Database, Parameters Passing, Executemany Methods, Cursor Attributes, Invoke Stored Procedures, Invoke Stored Functions.</p>	26

### Text Books:

- Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010.
- Sadalage, P. & Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

### References Books:

- Date C J, "An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Redmond, E. & Wilson, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement", 1st Edition.

**Course Outcome:** After completion of course, student will be able to:

- CO1: Understand the concept of database management systems and Relational database.
- CO2: Identify the various data model used in database design.
- CO3: Design conceptual models of a database using ER modeling for real life applications and construct queries in Relational Algebra.
- CO4: Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
- CO5: Select the information from a database by formulating complex queries in SQL.

- C06: Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
- C07: Discuss recovery system and be familiar with introduction to web database, distributed databases.
- C08: Explain the differences between RDBMS and No-SQL, BASE properties and No-SQL databases.
- C09: Design and implement the database system with the fundamental concepts of DBMS using Python.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1/PS01
C02	PO2,PO3/PS02
C03	PO2,PO3,PO6,PO11/PS01,PS01,PS02,PS04
C04	PO1,PO3/PS01
C05	PO1,PO5/PS01
C06	PO2,PO3/PS02
C07	PO1,PO3/PS02
C08	PO1,PO2,PO3/PS01,PS04
C09	PO1,PO2,PO3,PO5/PS01,PS02,PS04

## BCSC0808: APPLIED DATABASE MANAGEMENT SYSTEM LAB

**Objective:** The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL and NoSQL databases.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	<ul style="list-style-type: none"> <li>Write the SQL queries for data definition and data manipulation language.</li> <li>To implement various operations on a table.</li> <li>To implement various functions in SQL.</li> <li>To implement restrictions on the table.</li> <li>To implement the concept of the grouping of Data.</li> <li>To implement the concept of Joins in SQL.</li> <li>To implement the concept of sub-queries.</li> <li>To implement the concept of views, sequence.</li> <li>To implement the concept of PL/SQL using a cursor.</li> <li>To implement the concept of Procedure function and Triggers.</li> <li>Introduction to MongoDB and its Installation on Windows or Linux, Description of mongo Shell, create database and show database, Commands for MongoDB and To study operations in MongoDB – Insert, Query, Update, Delete and Projection</li> <li>To implement Database connectivity using Python</li> </ul>	24

### References Books:

- Date C J, "An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar & Bhattacharya, "Database Management System", TMH
- Sadalage, P. & Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2012.

**Outcome:** After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Implement the procedural language (PL/SQL) and Triggers.
- CO3: Apply NoSQL queries in MongoDB.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO2/PS01,PS04
CO2	PO2,PO3,PO5/PS02,PS03
CO3	PO5/PS02

## BCSC0600: INTRODUCTION TO OPEN SOURCE SOFTWARE AND OPEN STANDARDS

**Objective:** The objective of this is to give the concept of Open Source Software and to learn the Open Source Adoption History and Evolution.

**Credits: 02**

**Semester - I**

**L-T-P-J: 2-0-0-0**

Module No.	Content	Teaching Hours
<b>I</b>	<p><b>Introduction to Open Source:</b> Introduction to Open Source Software - History of Open Source Software, Initiation of Open Source project start; Open Source Software examples: The Origins, The GNU projects, The Operating System GNU/Linux, The Graphical User Interface KDE/GNOME, Apache Web Server, <b>Application Software;</b> Strengths and Advantages of Open Source Software - Network effects, Lower cost, Availability, Maintainability. Drivers for Adoption - Lower cost of ownership, Quality, Innovation reuse, Technical competence; Open Source Software Assessment, Examples of Open Source Adoption in the World, Open Source Challenges.</p> <p>Standards, Licenses, Contribution to open source community-Evolution of UNIX, GNU General Public License - Genesis of GNU Myth Buster, Brook's law; Open Source Community; Apache Web Server; Apache Software Foundation (ASF); How to contribute to open source projects.</p>	13
<b>II</b>	<p><b>Introduction to standards,</b> Types of standard, Lifecycle of standard, Importance and benefits of standards. <b>Adoption of Open Source:</b> Introduction; Drivers for Open Source adoption; Adoption Methods and Process; examples of Open Standard Adoptions in the World; Open Source Challenges. <b>Case Study On Open Standard and Software:</b> Introduction. Case Study 1 - Open Standard Case Study 2 - Linux - The Operating System – an Overview, Linux Basics, Various Linux distributions available, Preparing for Installation – Installation Checklist, Hardware Requirements, Partitioning, Installation problems, Working with the System, Shells and Utilities, Linux commands, File Handling using vi editor, Getting familiar with shell scripts</p>	13

### Text Books:

- Introduction to Open Source Software & Open Standards (IBM ICE Publication)

### Reference Books:

- Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives by Kirk St. Amant and Brian Still - IGI Global © 2007.
- Open Source: Technology and Policy by Fadi P. Deek and James A. M. McHugh - Cambridge University Press © 2008.
- Perspectives on Free and Open Source Software by Joseph Feller, Brian Fitzgerald, Scott A. Hissam and Karim R. Lakhani (eds) The MIT Press © 2005.
- Understanding Open Source and Free Software Licensing First Edition, Annotated by Andrew M. St. Laurent

**Outcome:** The student will be able to

- CO1: Explain Open Source Software and the History of Open Source Software.
- CO2: Explain Application Software and Open Source Software Assessment.
- CO3: Understand the basics of open Standards.
- CO4: Understand the reason associated with open source Adoption.
- CO5: Implement the shell commands and shell scripts.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P01/PS03
C02	P01,P02/PS01
C03	P01/PS02
C04	P04/PS03
C05	P03/PS02,PS04



## BCSC 0601 WEB PROGRAMMING THROUGH PHP & HTML

**Objective:** This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.

**Credits: 03**

**Semester II**

**L-T-P-J: 3-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction to Client Server Architecture:</b> Components of Client-Server Application, Client-Server Models and their Benefits, Characteristics of Web Projects, Static V/s Dynamic Websites and Web Portal.</p> <p><b>Web Servers:</b> Introduction to prominent Web Servers, Installation of WAMP/XAMPP and Eclipse IDE</p> <p><b>Client Side Implementation:</b> Introduction to HTML, Formatting tags, Meta, Anchor, List, Table, Headers, Frames and iframes, Image, Form, Fieldset, Legend, and other tags, their usage and implementation, Introduction of Formatting using CSS, Basics of Javascript, Statements, Functions in Javascript, Integrating Javascript with Various Elements of HTML, Validating a form using Javascript.</p> <p><b>DOM:</b> Introduction, Methods and Properties and their usage.</p> <p><b>PHP Basics:</b> Introduction to PHP, Basic Syntax of PHP, Embedding PHP in HTML, Comments, Variables, Constants, Managing Variables, Operators and Operator Precedence and String Manipulation functions.</p> <p><b>Conditional Control Structures:</b> If statement, If- else statement, If- else if statement, Nested If, Switch statement.</p> <p><b>Looping Control Structures:</b> For loop, While loop, Do- While loop, For-each, Break and Continue.</p> <p><b>Functions in PHP:</b> Functions, User-Defined function, Call by value and call by references, Understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP.</p>	20
II	<p><b>Arrays:</b> Arrays and its types in PHP, Accessing Elements of an Array, Modifying Elements of an Array, Functions in array, Array Sorting, Multidimensional Array.</p> <p><b>PHP File Handling:</b> Introduction, File Open, File Creation, Writing to files, Reading from File, Searching a record from a file, Closing a File.</p> <p><b>Class and Object:</b> Introduction, Object, Class, Defining Class in PHP, Object in PHP, Usage of this variable, Constructor, Constructor with Parameters.</p> <p><b>Exception Handling:</b> Introduction to Exception, Exception Handling mechanisms, Creating Custom Exceptions, Multiple Catch Blocks, Exception Propagation, Error Handling in PHP.</p> <p><b>Form Handling and Session Management in PHP:</b> Accessing and displaying Form data from different Form components, Differences among \$_GET, \$_POST and \$_REQUEST variables, Session management, Session operations, Session tracking mechanism, Clearing/Modifying data from session, Destroying a session, Setting and Retrieving Cookies, Uploading a file, displaying its details, restricting various details of a file during upload, checking for errors and reading Error code table.</p> <p><b>Database Management:</b> Introduction to DBMS, SQL Basics, Database connectivity in PHP with MySQL, Executing Queries from frontend,</p> <p><b>XML:</b> Introduction to XML, Parsing XML document using DOM parser, Various operations on XML document using PHP.</p>	20

### Reference Books:

- IBM Student Guide on "Web Programming through PHP & HTML"
- Robin Nixon: "Learning PHP, MySQL and JavaScript" "O'Reilly Media, Inc.", July 2009.
- Dave W Mercer, Allan Kent, Steven D Nowicki, David Mercer, Dan Squier, Wankyu Choi – Beginning PHP, Wiley Publishing, Inc
- Ivan Bayross - "HTML, DHTML, JavaScript, Pearl & CGI", Fourth Revised Edition, BPB Publication
- "Programming PHP", RasmusLerdorf and Kevin Tatore, Shroff Publishers & Distributors Pvt.Ltd

**Outcome:** Upon completion of this course, the students will be able to:

- C01: Understand the basics of client server architecture and its components.
- C02: Explain the basics of web development using PHP and HTML.
- C03: Develop a program using functions, control structures and array.
- C04: Demonstrate the concepts of object and exception handling in PHP.
- C05: Demonstrate web application using PHP,XML and MYSQL.
- C06: Develop a dynamic/ static websites with server side programming.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1, PS01
C02	PO1, PS02
C03	PO3, PS02
C04	PO4, PO2, PS04
C05	PO4, PO5, PS04
C06	PO3, PS04

## BCSG0800: PYTHON PROGRAMMING LAB

**Objective:** This course introduces the solving of problems using Python programming using OO concepts and its connectivity with database.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	<p>Programs based on the concepts of:</p> <ul style="list-style-type: none"> <li>Building Python Modules</li> <li>Obtaining user Data</li> <li>Printing desired output</li> </ul> <p>Programs based on the concepts of:</p> <ul style="list-style-type: none"> <li>Conditional if statements</li> <li>Nested if statements</li> <li>Using else if and elif</li> </ul> <p>Programs based on the concepts of Iteration using different kinds of loops</p> <p>Usage of Data Structures</p> <ul style="list-style-type: none"> <li>Strings</li> <li>Lists</li> <li>Tuples</li> <li>Sets</li> <li>Dictionary</li> </ul> <p>Program based on the concepts of User-defined modules and Standard Library (random, numpy, scipy, sys, Math Module, String Module, List Module).</p> <p>Program based on Input Output.</p> <p>Program based on exception Handling.</p> <p>Program based on Simple Data analysis.</p> <p>Program based on Pandas.</p>	26

**Text Books:**

- Paul Barry: "Head First Python "O'Reilly Media, Inc.", 2010.

**Reference Books:**

- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

**Outcome:** By the end of the course, students will learn to:

- C01: Apply OO concepts using Python programming.
- C02: Apply in-built packages defined in Python.
- C03: Apply front-end as Python Programming to connect with any back-end.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO2/PS01
C02	PO3/PS04
C03	PO5/PS02

## BCSC0800: COMPUTER PROGRAMMING LAB

**Objective:** The objective is to provide a comprehensive study of the C programming language. It stress the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I & II	<ul style="list-style-type: none"> <li>Mapping of flow chart, Algorithm, Language</li> <li>Simple C-program execution</li> <li>Programs based on various operators</li> <li>Programs based on Decision and case Control Structure</li> <li>Programs based on Loop Control Structure</li> <li>Program based on special control statement               <ul style="list-style-type: none"> <li>break</li> <li>continue</li> </ul> </li> <li>Programs based on Array Insertion, Deletion, Linear Search &amp; Bubble Sort</li> <li>Programs based on String               <ul style="list-style-type: none"> <li>Length, Copy, Reverse, Concatenate, Compare with &amp; without built-in functions</li> </ul> </li> <li>Programs based on Functions.</li> <li>Programs based on Storage Class.</li> <li>Programs based on Recursion.</li> <li>Programs based on Preprocessor.</li> <li>Programs based on Pointers</li> <li>Programs based on array</li> <li>Programs based on string</li> <li>Programs based on call by value and call by reference</li> <li>Programs based on Dynamic Memory Allocation</li> <li>Programs based on User Defined Data types               <ul style="list-style-type: none"> <li>Structure and Union</li> <li>Enum and Typedef</li> </ul> </li> <li>Programs based on File handling               <ul style="list-style-type: none"> <li>Opening a file</li> <li>Reading, writing and appending a file</li> <li>Closing file</li> <li>Random Access to Files of Records</li> </ul> </li> <li>Programs based on Command Line Argument.</li> </ul>	52

### Reference Books:

- Herbert Schildt, "C: The Complete Reference", 5th Edition, McGraw Hill Education
- K. N. King, "C Programming a Modern Approach", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritchie, "The C Programming Language", PHI, 2nd Edition, 2011.
- P. Dey and M. Ghosh, "Programming in C", Oxford University Press 2nd Edition, 2013.

**Outcome:** On Completion of this course, students are able to:

- C01: Design programs involving decision structures, loops and functions.
- C02: Understand the concepts of functions, recursion, pointers and file handling.
- C03: Design programs involving structures, union and functions.

---

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	PO1,PO3/PS01,PS02
C02	PO3,PO4/PS01
C03	PO3/PS02,PS04

## BCSC0801: OBJECT ORIENTED PROGRAMMING LAB

**Objective:** The objective of this course is that students will study and learn Object Oriented Modeling and programming.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	<p>Programs in Java and python based on the concepts of:</p> <ul style="list-style-type: none"> <li>Classes, Constructors, Polymorphism and Keyword Static.</li> </ul> <p>Programs based on the concepts of:</p> <ul style="list-style-type: none"> <li>Inheritance, Multithreading Using Thread Class &amp; Interface Runnable, String Handling, Generic Classes.</li> </ul> <p>Programs based on the concepts of:</p> <ul style="list-style-type: none"> <li>Handling Database Connectivity.</li> <li>Implementation of Collection Framework.</li> </ul> <p>Programs based on the concepts of:</p> <ul style="list-style-type: none"> <li>Database Connectivity.</li> <li>Retrieving Data from Database.</li> <li>Parameters Passing, Execute many Method.</li> <li>Cursor Attributes.</li> <li>Invoke Stored Procedures.</li> <li>Invoke Stored Functions.</li> </ul>	24

### Reference Books:

- Naughton, Schildt, "The Complete Reference JAVA2", 9<sup>th</sup> Edition, Oracle Press.
- Bhave & Patekar, "Programming with Java", Pearson Education
- Bret Slatkin: "Effective Python: 59 Specific ways to write better Python", Addison Wesley, 2015.

**Outcome:** After completion of course, the student will be able to:

- C01: Implement object oriented language features.
- C02: Design GUIs and Graphical programming.
- C03: Design object oriented solutions for small systems involving database and event handling concepts.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1,PO2/PSO1
C02	PO3,PO5/PSO2
C03	PO3,PO5/PSO4

## BCSC0802: DATABASE MANAGEMENT SYSTEM LAB

**Objective:** The lab aims to develop an understanding of different applications and constructs of SQL, PL/SQL.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	<ul style="list-style-type: none"> <li>Write the SQL queries for data definition and data manipulation language.</li> <li>To implement various operations on a table.</li> <li>To implement various functions in SQL.</li> <li>To implement restrictions on the table.</li> <li>To implement the concept of the grouping of Data.</li> <li>To implement the concept of Joins in SQL.</li> <li>To implement the concept of sub-queries.</li> <li>To implement the concept of views, sequence.</li> <li>To implement the concept of PL/SQL using a cursor.</li> <li>To implement the concept of Procedure function and Triggers.</li> </ul>	24

### References Books:

- Date C J, "An Introduction to Database Systems", 8th Edition, Addison Wesley.
- Korth, Silbertz and Sudarshan, "Database Concepts", 5th Edition, TMH, 1998.
- Majumdar & Bhattacharya, "Database Management System", TMH

**Outcome:** After the completion of the course, the student will be able to:

- CO1: Apply SQL queries for DML and DDL.
- CO2: Develop the SQL queries for real life scenarios.
- CO3: Implement the procedural language (PL/SQL) and Triggers.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO2/PSO1,PSO4
CO2	PO1,PO2/PSO1,PSO4
CO3	PO2,PO3,PO5/PSO2,PSO3

## BCSC0803: OPERATING SYSTEMS LAB

**Objective:** The lab aims to develop understanding the operation of UNIX operating system.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	<ul style="list-style-type: none"> <li>Implement the following basic commands (with options) used in UNIX/LINUX OS.</li> <li>Write and implement the basic vi editor commands.</li> <li>Shell scripts that use simple commands.</li> <li>Decision based Shell scripts.</li> <li>Shell scripts related to strings.</li> <li>Shell scripts using pipes.</li> <li>Shell scripts with loop statements.</li> <li>Demonstration and solution for race condition.</li> <li>Demonstration and use of System Calls.</li> <li>Implement the basics of IPC in UNIX.</li> </ul>	24

**Reference Books:**

- Sibsankar Halder and Alex a Aravind , “Operating Systems”, 6th Edition, Pearson Education 2009.
- Harvey M Dietel “An Introduction to Operating System”, 2nd Edition, Pearson Education 2002.
- D M Dhamdhare “Operating Systems: A Concept Based Approach”, 2nd Edition 2006.
- M. J. Bach. “Design of the Unix Operating System”, PHI, 1986.

**Outcome:** After completion of course, the student will be able to:

- CO1: Implement the basic operations on UNIX operating systems.
- CO2: Demonstrate the working of systems calls.
- CO3: Demonstrate message passing in Unix operating system.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO3,PO4/PS01
CO2	PO1,PO2/PS01
CO3	PO1,PO4,PO5/PS01,PS02



## BCSC0804: COMPUTER ORGANIZATION LAB

**Objective:** The aim of the lab is to better understand the design of sequential Circuits such as Flip-Flops, Registers, and Counters.

**Credits: 01**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
I & II	<ul style="list-style-type: none"> <li>Bread Board Implementation of Flip-Flops.</li> <li>Experiments with clocked Flip-Flops.</li> <li>Design of Counters.</li> <li>Bread Board implementation of Counters &amp; Shift Registers.</li> <li>Implementation of Arithmetic Algorithms.</li> <li>Bread Board implementation of Adder/Subtraction (Half, Full).</li> <li>Bread Board implementation of Binary Adder.</li> <li>Bread Board implementation of Seven Segment Display.</li> <li>Small Project based on combinational and sequential circuit.</li> </ul>	24

### Reference Books:

- D.W. Patterson , “Computer Organization and Design”, 4<sup>th</sup> Edition, Elsevier Publication, 2008.
- William Stalling , “Computer Organization”, 8<sup>th</sup> Edition, PHI, 2011.
- M. Mano , “Computer System Architecture”, 3<sup>rd</sup> Edition, PHI, 1996.

**Outcome:** After the completion of the course, the student will be able to:

- CO1: Implement the Combinational and Sequential Circuit.
- CO2: Demonstrate the working of counter and shift register.
- CO3: Demonstrate the working of ALU and seven segment displays.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO2, PO3, PO5/PSO2
CO2	PO3, PO4/PSO2
CO3	PO3, PO5/PSO1, PSO2

## BCSC0805: DATA STRUCTURES & ALGORITHMS LAB

**Objective:** The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module		Lab
I & II	<ul style="list-style-type: none"> <li>Program to implement various operations in a singly linked list.</li> <li>Program to implement insertion, deletion and traversal in a doubly linked List.</li> <li>Program to implement polynomial addition using linked list.</li> <li>Program to demonstrate the various operations on stack.</li> <li>Program to convert an infix expression into postfix expression.</li> <li>Program to evaluate a given postfix expression.</li> <li>Program to implement Tower of Hanoi problem using Recursion.</li> <li>Program to demonstrate the implementation of various operations on linear and circular queue.</li> <li>Program to demonstrate the implementation of insertion and traversals on a binary search tree.</li> <li>Program to implement Dijkstra's Algorithm to find the shortest path between source and destination.</li> <li>Program to search a given element as entered by the user using sequential and binary search to search a given element as entered by the user.</li> <li>Implementation of various sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.</li> </ul>	24

**Note:** All Code must be done in Java as well as Python

**Outcome:** After completion of course, student will be able to:

- CO1: Demonstrate the associated operations in linear data structure like stack, Queue and link list.
- CO2: Demonstrate the associated operations in Binary Search Tree and Dijkstra's Algorithm.
- CO3: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO4/PSO1,PSO3
CO3	PO2/PSO3,PSO4

## BCSC0806: MICROPROCESSORS LAB

**Objective:** The objective is to introduce the Architecture and programming of the microprocessor and learning about interfacing and various applications of microprocessor.

**Credits: 01**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
I & II	<ul style="list-style-type: none"> <li>To study 8085 microprocessor System.</li> <li>To study 8086 microprocessor System.</li> <li>To develop and run basic programs in 8085 ALP.</li> <li>To develop and run programs in 8085 ALP related to the concept of looping, counting and indexing.</li> <li>To perform interfacing of RAM chip to 8085/8086.</li> <li>To perform interfacing of keyboard controller.</li> <li>To perform interfacing of DMA controller.</li> <li>To perform interfacing of UART/USART.</li> </ul>	24

### Reference Books:

- Ramesh S. Gaonkar , “Microprocessor Architecture Programming and Applications with 8085”, 4th Edition, Penram International Publishing, 2000.
- D. V. Hall , “Microprocessors and Interfacing: Programming and Hardware”, 2nd Edition, TMH, 1992.

**Outcome:** After completion of course, student will be able to:

- C01: Demonstrate the arithmetic and logical operations using assembly language programming (8085).
- C02: Demonstrate the memory operations using assembly language programming (8085).
- C03: Demonstrate the interfacing of Keyboard, DMA and UART controller.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1,PO3/PS01,PS02
C02	PO1,PO2/PS01,PS02
C03	PO1,PO3,PO5/ PS02

## BCSC0807: DESIGN & ANALYSIS OF ALGORITHMS LAB

**Objective:** The objective of this course is that students will understand and implement simple data structures, able demonstrate different sorting and searching techniques. and will be familiar with graphs and their applications.

**Credits:01**

**L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I & II	<ul style="list-style-type: none"> <li>Implementation of sorting algorithms: <ul style="list-style-type: none"> <li>Insertion Sort</li> <li>Bubble Sort</li> <li>Selection Sort</li> <li>Divide and conquer approach:</li> </ul> </li> <li>Quick Sort</li> <li>Merge Sort <ul style="list-style-type: none"> <li>Heap Sort</li> <li>Counting Sort</li> </ul> </li> <li>Implementation of Searching Techniques: <ul style="list-style-type: none"> <li>Linear Search</li> <li>Binary Search</li> </ul> </li> <li>Implementation of Matrix Multiplication</li> <li>Implementation of Convex Hull</li> <li>Implementation of Breadth First Search</li> <li>Implementation of Depth First Search</li> <li>Implementation of Greedy approaches: <ul style="list-style-type: none"> <li>Optimal Reliability Allocation.</li> <li>Knapsack. Minimum</li> <li>Minimum Spanning trees:</li> </ul> </li> <li>Prim's and Kruskal's algorithms. <ul style="list-style-type: none"> <li>Single source shortest paths –</li> </ul> </li> <li>Dijkstra's and Bellman Ford algorithms.</li> <li>Implementation of Dynamic Programming: <ul style="list-style-type: none"> <li>Longest Increasing Subsequence.</li> <li>Finding best path in maze.</li> <li>Matrix Chain Multiplication</li> <li>0/1 Knapsack Problem</li> <li>Resource Allocation Problem</li> </ul> </li> </ul>	32

**Note:** All Code must be done in Java as well as Python

**Outcome:** After completion of course, student will be able to:

- C01: Implementation the sorting algorithms like Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort and Heap Sort.
- C02: Demonstrate and use the appropriate data structures for a given problem
- C03: Implement the algorithms based on Greedy approach and Dynamic Programming.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	PO1,PO2,PO4/PS01,PS02,PS04
C02	PO1,PO3,PO4/PS01,PS02,PS03
C03	PO2,PO3,PO5/PS01,PS02,PS04

## BCSC0900: WEB PROGRAMMING THROUGH PHP & HTML LAB

**Objective:** This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.

**Credits: 01**

**Semester IV**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
<b>I&amp;II</b>	Static web applications using HTML/CSS Web applications using HTML & Javascript Programs using Decision Control Structures Programs using Loop Control Structures Programs using user defined functions Programs of Array handling and manipulation Programs of File handling and manipulation Programs using OO concepts in PHP Web applications with Form handling at server Web applications for managing sessions Web applications with connectivity with MySQL Web applications manipulating XML file	24

### Reference Books:

- IBM Student Guide on "Web Programming through PHP & HTML"
- Robin Nixon: "Learning PHP, MySQL and Javascript" "O'Reilly Media, Inc.", July 2009.

**Outcome:** After completion of course, student will be able to:

- CO1: Design websites with interactive web page(s) using HTML, CSS and JavaScript
- CO2: Design a responsive web site using HTML and CSS.
- CO3: Develop simple web application using server-side PHP programming with backend as MySQL.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO2/PS01
CO2	PO1,PO2/PS01
CO3	PO1,PO5/PS01,PS02

## Program Elective (Only for Specialization Programme)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACT'S HR/WK	PRE- REQUISITES
			L	T	P	J			
Bouquet: Data Analytics									
THEORY									
1.	BCSC0600	Introduction to Open Source Software & Open Standards	2	0	0	0	2	2	
2.	BCSC0601	Web Programming through PHP	3	0	0	0	3	3	
3.	BCSE0551	Introduction to Business Analytics	3	0	0	0	3	3	
4.	BCSE0552	Applied Statistical Analysis	3	0	0	0	3	3	Introduction to Business Analytics
5.	BCSE0553	Data Mining and Predictive Modeling	3	0	0	0	3	3	
6.	BCSE0556	Hadoop & Big Data Analytics	3	0	0	0	3	3	Multidimensional Modeling
7.	BCSE0557	Social, Web & Mobile Analytics	3	0	0	0	3	3	Hadoop & Big Data Analytics
8.	BCSE0558	Enterprise Business Intelligence And Data Warehousing	3	0	0	0	3	3	
9.	BCSE0511	DevOps	3	0	0	0	3	3	
10.	BCSE1502	Introduction to Virtualization and Cloud Computing	3	0	0	0	3	3	
11.	BCSE0252	Full Stack Using Node JS	3	0	0	0	3	3	
12.	BCSE0704	Computational Linguistics and Natural Language Processing	2	0	0	0	2	2	
13.	BCSE0602	IT Network Security	3	0	0	0	3	3	
14.	BCSE0203	Internet of Things	3	0	0	0	3	3	
15.	BCSC0013	Compiler Design	3	1	0	0	4	4	
PRACTICALS									
1.	BCSC0800	Web Programming Lab	0	0	2	0	1	2	
2.	BCSE0581	Applied Statistical Analysis Lab	0	0	2	0	1	2	
3.	BCSE0582	Data Mining and Predictive Modeling Lab	0	0	2	0	1	2	
4.	BCSE0585	Hadoop & Big Data Analytics Lab	0	0	2	0	1	2	
5.	BCSE0586	Social, Web & Mobile Analytics Lab	0	0	2	0	1	2	
6.	BCSE0587	Enterprise Business Intelligence And Data Warehousing Lab	0	0	2	0	1	2	
7.	BCSE0539	DevOps Lab	0	0	2	0	1	2	
8.	BCSE0531	Virtualization Lab	0	0	2	0	1	2	

9.	BCSE0734	Computational Linguistic and Natural Language Processing Lab	0	0	2	0	1	2	
10.	BCSE0282	Full Stack Using Node JS Lab	0	0	2	0	1	2	
11.	BCSE0632	IT Network Security Lab	0	0	2	0	1	2	
12.	BCSE0232	Internet of Things Lab	0	0	2	0	1	2	



## BCSC 0601 WEB PROGRAMMING THROUGH PHP & HTML

**Objective:** This course introduces the building of dynamic web solutions using PHP programming and OO concepts and its connectivity with database.

**Credits: 03**

**Semester II**

**L-T-P-J: 3-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction to Client Server Architecture:</b> Components of Client-Server Application, Client-Server Models and their Benefits, Characteristics of Web Projects, Static V/s Dynamic Websites and Web Portal.</p> <p><b>Web Servers:</b> Introduction to prominent Web Servers, Installation of WAMP/XAMPP and Eclipse IDE</p> <p><b>Client Side Implementation:</b> Introduction to HTML, Formatting tags, Meta, Anchor, List, Table, Headers, Frames and iframes, Image, Form, Fieldset, Legend, and other tags, their usage and implementation, Introduction of Formatting using CSS, Basics of Javascript, Statements, Functions in Javascript, Integrating Javascript with Various Elements of HTML, Validating a form using Javascript.</p> <p><b>DOM:</b> Introduction, Methods and Properties and their usage.</p> <p><b>PHP Basics:</b> Introduction to PHP, Basic Syntax of PHP, Embedding PHP in HTML, Comments, Variables, Constants, Managing Variables, Operators and Operator Precedence and String Manipulation functions.</p> <p><b>Conditional Control Structures:</b> If statement, If- else statement, If- else if statement, Nested If, Switch statement.</p> <p><b>Looping Control Structures:</b> For loop, While loop, Do- While loop, For-each, Break and Continue.</p> <p><b>Functions in PHP:</b> Functions, User-Defined function, Call by value and call by references, Understanding variable scope, Global Variables, Static Variables, Include and Require, Built-in functions in PHP.</p>	20
II	<p><b>Arrays:</b> Arrays and its types in PHP, Accessing Elements of an Array, Modifying Elements of an Array, Functions in array, Array Sorting, Multidimensional Array.</p> <p><b>PHP File Handling:</b> Introduction, File Open, File Creation, Writing to files, Reading from File, Searching a record from a file, Closing a File.</p> <p><b>Class and Object:</b> Introduction, Object, Class, Defining Class in PHP, Object in PHP, Usage of this variable, Constructor, Constructor with Parameters.</p> <p><b>Exception Handling:</b> Introduction to Exception, Exception Handling mechanisms, Creating Custom Exceptions, Multiple Catch Blocks, Exception Propagation, Error Handling in PHP.</p> <p><b>Form Handling and Session Management in PHP:</b> Accessing and displaying Form data from different Form components, Differences among \$_GET, \$_POST and \$_REQUEST variables, Session management, Session operations, Session tracking mechanism, Clearing/Modifying data from session, Destroying a session, Setting and Retrieving Cookies, Uploading a file, displaying its details, restricting various details of a file during upload, checking for errors and reading Error code table.</p> <p><b>Database Management:</b> Introduction to DBMS, SQL Basics, Database connectivity in PHP with MySQL, Executing Queries from frontend,</p> <p><b>XML:</b> Introduction to XML, Parsing XML document using DOM parser, Various operations on XML document using PHP.</p>	20

### Reference Books:

- IBM Student Guide on "Web Programming through PHP & HTML"
- Robin Nixon: "Learning PHP, MySQL and JavaScript" "O'Reilly Media, Inc.", July 2009.
- Dave W Mercer, Allan Kent, Steven D Nowicki, David Mercer, Dan Squier, Wankyu Choi – Beginning PHP, Wiley Publishing, Inc
- Ivan Bayross - "HTML, DHTML, JavaScript, Pearl & CGI", Fourth Revised Edition, BPB Publication
- "Programming PHP", RasmusLerdorf and Kevin Tatore, Shroff Publishers & Distributors Pvt.Ltd

**Outcome:** Upon completion of this course, the students will be able to:

- C01: Understand the basics of client server architecture and its components.
- C02: Explain the basics of web development using PHP and HTML.
- C03: Develop a program using functions, control structures and array.
- C04: Demonstrate the concepts of object and exception handling in PHP.
- C05: Demonstrate web application using PHP,XML and MYSQL.
- C06: Develop a dynamic/ static websites with server side programming.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1, PS01
C02	PO1, PS02
C03	PO3, PS02
C04	PO4, PO2, PS04
C05	PO4, PO5, PS04
C06	PO3, PS04

## **BCSE0551: INTRODUCTION TO BUSINESS ANALYTICS**

**Objective:** This course provides introductory knowledge of Business Analytics.

**Credits: 03**

*Semester III*

*L-T-P-J: 3-0-0-0*

Module No.	Content	Teaching Hours
I	<p><b>Business Analytics and Optimization:</b> Introduction to Business Analytics and Optimization, Challenges - Volume, Variety (Diversity), and speed of Data Creation (and needed decisions), Approaches to help maximize profitability and returns, Business Analytics Capabilities, Enterprise Analytics Capabilities, Business Analytics Technologies, Predictive Analytics, Prescriptive Analytics, A fact-based decision making culture, A strong data infrastructure, The Right Analytical Tools, Analytics Workforce, Knowledge Requirements, Business Analyst, Data Scientist, Where to put the analytics team, IBM Business Analytics Maturity Model, Optimization, Key BAO Concepts, The need for BAO now, Essential Capabilities In BAO, BAO Capabilities: Business Performance Management, Predictive Analysis and Mining, Value of BAO to Business Organization, Impact of BAO on diverse industries, Advantages to implementing BAO solutions, BAO Capabilities: Real-time Analytics: Data In Motion, BAO support for decision-making, High level architecture of BAO, Importance of reference architecture, BAO reference architecture, BAO reference architecture to BAO architects, IBM Technology Portfolio for BAO.</p> <p><b>Data Warehouse:</b> Decision Support ,Three Tier Decision Support Systems, Exploring and Analyzing Data, What is a data warehouse? Data warehouse architecture choices, Enterprise data warehouse, Independent data mart architecture, Dependent data mart architecture, Data Warehouse, Data warehouse usage, Multidimensional Data, Conceptual Modeling of Data Warehouses, The "Classic" Star Schema, The "Snowflake" Schema, The "Fact Constellation" Schema, Data Warehouse Design Process, Single-Layer Architecture, Two-Layer Architecture, Three-Tier Data Warehouse Architecture, Data Warehouse Development, Multi-Tiered Architecture, Information pyramid, BI reporting tool architectures, Types of BI users, Multidimensional analysis techniques, Data Analysis and OLAP, OLAP Server Architectures, Data Cube, Discovery-Driven Data Cubes, OLTP vs. OLAP, Business Query, Dashboards and Scorecards Development, Metadata Model, Automated Tasks and Events, Mobile BI, Disconnected BI, Collaborative BI, Real-time Monitoring, Software Development Kit (SDK), Setting up data for BI, Making BI easy to consume.</p> <p><b>Business Intelligence:</b> Definitions of Business Intelligence, Sample BI Architecture, Things are getting more complex, BI Components and Architecture, Scope and fit of BI solutions with in existing infrastructure, High Level BI Process, Functional Areas of BI Tool, A single or a few applications, Benefits of BI, Maximize Value from BI Systems, Strategy and Business Intelligence, Business Transformation Projects, Business Role of BI (TWDI), ASUG Business Intelligence Maturity Model, Why Act? BI Effectiveness Scorecard, BI Value Scorecard, Five key areas of strategy, Planning a BI Project, Pre- Engagement Activities, Engagement Activities and process, BI Design and Development, Business Environment, Project Tasks: Task 1- Knowledge Capture Goals - Discuss Business Objectives &amp; Prior Learning, Interview key stakeholders, Project Planning, Task 2 - Consolidate Findings - Create logical design, Task 3 - Map the Customer Situation - Current Environment, Business/Functional Requirements Sample Diagram, Logical BI Diagram, Task 4 - Methodology &amp; Approach, Task 5- Standards &amp; Governance, Task 6- Sections, Milestones and Tasks, Task 7 - Proof of Concept (POC), Task 8 - Table Creation, Task 9 - OLAP Creation, Task 10 - Final Deliverables, Risk management and mitigation, Cost justification and measuring success.</p>	20

II	<p><b>Data Mining:</b> What is Data Mining, Evolution of Data Mining, and Why Data Mining? Knowledge Based System, Data Mining Process, Phases of Data Mining Process, KDD Process Model, CRISP - DM, CRISP-DM - Elaborate view, Data Mining – On what kinds of Data? DM Tasks and Components of DM methods, Data mining operations, Data mining techniques, Industry examples of application of DM, Challenges of Data Mining, and Why Machine should “Learn”? Machine Learning, Growth of Machine Learning, Machine Learning types, Unsupervised learning, Reinforcement Learning.</p> <p><b>Dashboard &amp; Report Designing:</b> Definition, Dashboard Types, Evolution of Dashboards, Layers of Information, Dashboard Design, Dashboard Design Principles, Other Dashboard Examples, Display Media for Dashboards, Chart Overview, Singular Components, Metrics, Metrics drive behavior in a number of ways, Kaplan-Norton Balanced Scorecard, The Rayport-Jaworski Performance Dashboard and Strategy Framework, Introducing the R-J Performance Dashboard, Blueprint to the R-J PerformanceDashboard,BuildingReports,ListReport,CrosstabReport,ChartReport, Map Report, Data group, sort and Filters, add calculations to report, Conditions and Aggregations in Report, Drilling in report,Run report–on demand or schedule ,Charts, ChartType–Bar Chart ,Line ,Pie ,Area ,Scatter and all other charts and types of charts.</p> <p><b>Big Data Analytics:</b> Introduction to Big Data, Need for Big Data, Characteristics of Big Data, Structure of Big Data and need for standards, Big Data Analytics Adoption, Benefits &amp; Barrier of Big Data Analytics, Trends for Big Data Analytics, Commoditization of Hardware Enabling New Analytics ,Analytics and Techniques, Big Data Platform and Application Frameworks, Manifesto, Big Data UseCases.</p>	20
----	---	----

#### Text Books:

- Introduction to Business Analytics (IBM ICE Publication)
- Fundamentals of Business Analytics by R N Prasad, Seema Acharya, Wiley India, 2012.

#### Reference Books:

- Leskovec , Jure, Anand Rajaraman, and Jeffrey David Ullman. Mining of massive datasets. Cambridge University Press, 2014.

#### Outcome:

- C01: Understand the use of reference architecture inbusiness analytics.
- C02: Explain the decision support science and data warehouse.
- C03: Understand the concepts of Business Intelligence.
- C04: Explain the KDD in data mining.
- C05: Understand the process of analysis using Dashboards and Reports.
- C06: Explain Big Data, Filtering BigData and Adoption Architecture.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	P03/PS02
C02	P04/PS03
C03	P05/PS02
C04	P02/PS01
C05	P01/PS04
C06	P03/PS02

## **BCSE0552: APPLIED STATISTICAL ANALYSIS**

**Objective:** This course provides the knowledge about the statistical methods and implementation using software(e.g,R).

**Credits: 03**

**Semester IV**

**L-T-P-J: 3-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction to Statistical Analysis:</b> What is statistics? Types of Statistics, Population vs Sample, basic terminology, Measurement &amp; Scaling: characteristics <b>Variables:</b> Nominal and Ordinal, Interval &amp; ratio scales, Quantitative variables, Qualitative or categorical variables.</p> <p><b>Data:</b> Sources of Data, cross-section data, Time-series data.</p> <p><b>Measures of central tendency:</b> Mean, Outlier, Median, Mode, Left &amp; Right Skewness, Measure of spread, Range, Variance and Standard deviation.</p> <p><b>Population parameters &amp; Sample Statistics:</b> Measures of position-quartiles and interquartile range, Quartiles, Percentiles and percentile rank, Box &amp; Whisker Plot.</p> <p><b>Describing Data &amp; Probability:</b> Raw Data, Graphical presentation of qualitative data, Graphical quantitative data, Frequency distributions, relative frequency and percentage distributions, Graphing grouped data, Cumulative frequency distributions, Probability concepts, Simple and compound events, Two properties of probability, Classical probability, Complementary events, Discrete Random Variables.</p> <p><b>Probability Distributions:</b> The Binomial experiment, Poisson Probability distribution, Continuous random variables, Normal Distribution.</p>	20
II	<p><b>Testing Hypothesis:</b> Population distribution, Sampling and Non sampling Errors, point estimate, Interval estimation, The <i>t</i> Distribution, Testing Hypothesis, Chi-Square Distribution, The F-Distribution</p> <p><b>Examining Relationship:</b> Covariance, Pearson correlation coefficient, Computing a correlation, Hypothesis test for a correlation, Correlation coefficient, correlation analysis, Scatter plots, Relationships between continuous variables, Correlation, Extreme data values, Correlation Matrix, ANOVA, Regression.</p> <p><b>Advanced Techniques:</b> Non Parametric tests, Chi-squared goodness-of-fit test, Chi-square test of independence, the sign test, Mann-Whitney test, Kruskal-Wallis test, Structural equation modelling, Cluster analysis, Factor analysis, Centroid method, Principal Components method, Maximum Likelihood Method</p>	20

### **Reference Books:**

- IBM Student Guide on “Applied Statistical Analysis”
- G. Jay Kerns: “Introduction to Probability and Statistics Using R”, 2014.

**Outcome:** After completion of course, student will be able to:

- CO1: Understand the different variables measurement and scaling.
- CO2: Analyze the different central tendency operations.
- CO3: Demonstrate the different ways to represent the data.
- CO4: Analyze the hypothesis testing using different estimation and distribution methods.
- CO5: Analyze the correlation and regression for the real world problem data.
- CO6: Analyze the data using the advanced techniques like , Chi-squared goodness-of-fit test, Chi-square test of independence, the sign test and Mann-Whitney test.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1/PS03
C02	PO1/PS03
C03	PO2/PS04
C04	PO1/PS04
C05	PO3/PS01
C06	PO1/PS04



## **BCSE0581: APPLIED STATISTICAL ANALYSIS LAB**

**Objective:** This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyze data using common statistical methods, and generate reproducible statistical reports. Student will also learn data munging

**Credits: 01**

**Semester VI**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
I&II	<ul style="list-style-type: none"> <li>• Introduction and Basics</li> <li>• Data frames, functions, loops, if/else</li> <li>• Importing Data in R</li> <li>• Handling Numerical and categorical variables</li> <li>• Data manipulation in R</li> <li>• Data Preprocessing in R</li> <li>• Probability Distribution in R</li> <li>• Statistical tests and models</li> <li>• Correlation &amp; Regression</li> <li>• Nonparametric tests</li> </ul>	

### **Reference Books:**

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc., 2011.
- Norman Matloff. The art of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Golemund. R for data science, 2016.
- Phil Spector. Data manipulation with R. Springer Science & Business Media, 2008.

**Outcome:** After completion of course, student will be able to:

- CO1: Implement data import, data manipulation and data preprocessing using R.
- CO2: Demonstrate the statistical summaries of continuous and categorical data.
- CO3: Demonstrate the common hypothesis tests using simple regression models in R.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO2,PO5/PSO3
CO2	PO4,PO3/PSO4
CO3	PO4/PSO3



## **BCSE 0553: DATA MINING AND PREDICTIVE MODELLING**

**Objective:** The course objectives is to give the basic concepts of e data mining methods based on prediction and do the prediction modeling for finding the accuracy.

**Credits: 04**

**Semester V**

**L-T-P-J: 4-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction:</b> What Is Data Mining? Data Mining and Related Terms, Knowledge based System, KDD Process Model, CRISP - DM, Terminology and Notation,</p> <p><b>The Steps in Data Mining:</b> Data Preparation, Data Understanding, Data Cleaning, Missing data, Coding Systems, Discretization , Univariate Data Analysis</p> <p><b>Core Ideas in Data Mining:</b> Classification, Prediction, Association Rules and Recommendation Systems, Predictive Analytics, Data Reduction and Dimension Reduction, Data Exploration and Visualization, machine Learning: Growth and Applications, Supervised and Unsupervised Learning, Reinforcement Learning</p> <p><b>Unsupervised Learning Models: Association Rules:</b> Introduction, Discovering Association Rules in Transaction, Databases, Generating Candidate Rules, Selecting Strong Rules</p> <p><b>Data Visualization:</b> Uses of Data Visualization, Basic Charts: bar charts, line graphs, and scatterplots, Boxplots and Histograms, Heat maps, Multidimensional Visualization, Specialized Visualizations, Summary of major visualizations and operations</p> <p><b>Supervised Learning Models and Techniques: The Naive Bayes Classifier</b> Conditional Probability, Applying the Full (Exact) Bayesian Classifier, Advantages and Shortcomings ,<b>Multiple Linear Regression:</b> Estimating the Regression Equation and Prediction, Variable Selection,</p> <p><b>Classification and Regression Trees:</b> Introduction, Measures of Impurity, Evaluating, Avoiding Overfitting , Classification Rules from Trees, Classification Trees for More Than Two Classes, Regression Trees,</p> <p><b>Evaluating Predictive Performance:</b> Introduction, Evaluating Predictive Performance, Judging Classifier Performance: Confusion Matrix, K-S Chart, Judging Ranking Performance: Lift and Gain Charts, ROC, AUC, Model Evaluation of Regression: BIC, AIC, Cross Validation,</p>	20
II	<p><b>Logistic Regression:</b> Model with a Single Predictor, Estimating the Logistic Model from Data, Interpreting Results in Terms of Odds, Evaluating Classification Performance, Variable Selection, Data Preprocessing, Model-Fitting and Estimation, Model Interpretation, Model Performance, <b>Cox Regression</b></p> <p><b>Cluster Analysis:</b> Introduction, Measuring Distance Between Two Records, Measuring Distance Between Two Clusters, Hierarchical (Agglomerative) Clustering, k-Means Algorithm</p> <p><b>Dimension Reduction:</b> Introduction, Curse of Dimensionality, Practical Considerations, Data Summaries, Correlation Analysis, Reducing the Number of Categories in Categorical Variables, Converting Categorical to Numerical Variable, PCA, Dimension Reduction Using Regression Models and Classification and Regression Trees, Data Partitioning, Model Selection, Link Analysis, Clustering</p> <p><b>Time Series:</b> Handling Time Series, Regression-Based Forecasting, Smoothing Methods</p> <p><b>Artificial Neural Networks:</b> Concept and Structure of a Neural Network, Fitting A Network to Data, Required User Input, Exploring The Relationship Between Predictors and Response, Advantages and Weaknesses of Neural Networks</p> <p><b>Discriminant Analysis:</b> Introduction, Distance of an Observation from a Class, Fisher's Linear Classification Functions, Classification performance of DA, Prior Probabilities, Unequal Misclassification Costs, Classifying more Than Two Classes, Advantages and Weaknesses</p>	20

### Text Books:

- IBM Student Guide on “Data Mining and Predictive Modelling”.
- Data Mining for Business Analytics: Concepts, Techniques, and Applications in R by Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl, Jr., Wiley, 2018

### Reference Books:

- Data Mining and Business Analytics with R by Johannes Ledolter 2013
- Data Mining: Concepts and Techniques By Jiawei Han, Micheline Kamber, Jian Pei 2011
- Introduction to Data Mining By Pang-Ning Tan 2018
- A User's Guide to Business Analytics By Ayanendranath Basu, Srabashi Basu · 2016

**Outcome:** After completion of course, student will be able to:

- CO1: Understand the basic concepts of KDD in data mining.
- CO2: Apply visualization methods for evaluating predictive models and the presentation of analytical results.
- CO3: Explain the supervised and unsupervised learning methods and their applications.
- CO4: Categorize and elucidate appropriate data mining approaches for problems relating to predictive modeling.
- CO5: Applying the methods to actual quantitative data and interpreting the results of the analysis.
- CO6: Explain the concepts dimension reduction for better result interpretation.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	P01/PS03
C02	P02,P03/PS04
C03	P01/PS03
C04	P04/PS04
C05	P02,P04/PS03
C06	P02/PS03

## **BCSE0582: DATA MINING & PREDICTIVE MODELING LAB**

**Objective:** *This course provides introductory knowledge to Rattle Tool for Data Mining.*

**Credits: 01**

**Semester V**

**L-T-P-J: 0-0-2-0**

<b>M000odule No.</b>	<b>Content</b>	<b>Teaching Hours</b>
<b>I&amp;II</b>	<ul style="list-style-type: none"> <li>• Introduction to Rattle, Rattle Interface Tabs: Data, Explore, Test, Transform, Cluster Analysis, Association Analysis, Model and Evaluate Tab.</li> <li>• Reading Data Files: free field text files, statistics data files, databases using ODBC, Excel file, Viewing and Manipulate Data Files and R Objects.</li> <li>• Understanding missing data in R Studio, examining the distributions of categorical and continuous fields, imputing missing values in Rattle.</li> <li>• Outliers and Anomalous data</li> <li>• Data Manipulation</li> <li>• Looking for Relationships in Data</li> <li>• Selecting, Sampling and Partitioning Records</li> <li>• Modeling Techniques in RStudio</li> <li>• Comparing and Combining Models</li> </ul>	4

### **Text Books:**

- Data Mining and Predictive Modeling(IBM ICE Publication)
- Data Mining and Business Analytics with RBy Johannes Ledolter

### **Reference Books:**

- R for Demmies by Andrie and Joris, Wiley Publication

**Outcome:** After completion of course, student will be able to:

- C01: Understand the use of Rattle Tool used for Data Mining.
- C02: Design different modelsfor Analytics and Prediction.
- C03: Implement to detect & deal with outliers, missing values.
- C04: Evaluate the performance of different analytical models.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	PO1/PS02
C02	PO3/PS02
C03	PO4,PO5/PS04
C04	PO4/PS03

## **BCSE0556: HADOOP AND BIG DATA ANALYTICS**

**Objective:** Exposure to any object oriented programming language (such as Java) and basic operational knowledge of any RDBMS (such as MySQL)

Credits: 03

L-T-P-J: 3-0-0-0

Module No.	Content	Teaching Hours
I	<p><b>Big Data technology Landscape:</b> Big data growth story, big data sources, Types of Digital Data (Structured, Semi-Structured, Unstructured), Concept, importance and characteristics of data, Challenges with big data, Big data stack, Big Data 1.0, 2.0 and 3.0, Traditional BI vs. Big Data Environment, Big data Process, NoSQL Databases, NoSQL Vs. RDBMS, New SQL, Introduction to Data Science/Scientist</p> <p><b>HADOOP 1.0:</b> Introducing Hadoop 1.0, Limitations of RDBMS, Hadoop Components, High Level Architecture of Hadoop, History of Hadoop, Special Features of Hadoop, Introduction to HDFS 1.0, Architecture, Daemons, Working with HDFS Command, Introduction to Map-Reduce 1.0, Architecture, Daemons</p> <p><b>HADOOP 2.0:</b> Introducing Hadoop 2.0, Limitations of 1.0, Introduction to HDFS 2.0, Architecture, Daemons, Introduction to Map-Reduce 2.0, YARN, Architecture, Daemons, Word Count Example using Java, Introduction to Hadoop 3.0, Difference among Hadoop1.0, Hadoop2.0, Hadoop3.0</p> <p><b>Apache Spark:</b> Introduction, Introduction to Scala &amp; functional programming, Spark Concepts: Main Primitives, RDD Fault Tolerance, Spark Operations, Job Execution, Spark Built-in libraries</p> <p><b>Spark Streaming:</b> Real-time big data processing with Spark Streaming, the working of Spark Streaming and applications of Spark Streaming, Sliding Window Analytics</p>	13
II	<p><b>Introduction to Cassandra DB:</b> Features of Cassandra, CQL Data Types, CQLSH: CRUD, Counter, TTL, List, Set, Map, Tracing, Import Export csv files</p> <p><b>Introduction to HBase:</b> What is HBase? HBase Architecture, HBase Components, Data model, HBase Storage Hierarchy, Cross-Datacenter Replication, Auto Sharding and Distribution, Bloom Filter and Fold, Store, and Shift</p> <p><b>HADOOP Ecosystem and Flume:</b> Introduction to Hadoop Ecosystem, Sqoop, Zookeeper, Kafka</p> <p><b>Introduction to HIVE:</b> Hive Architecture, Hive Data types, Hive Collection Types, Hive File Formats, Hive Query Language, Hive Partitions, Bucketing, Views, RCFile Implementation, Hive User Defined Function, SerDe, UDF</p> <p><b>Introduction to Pig:</b> History and Anatomy of Pig, Pig on Hadoop, Use Case for Pig, Pig Primitive Data Types, Pig Latin Overview, Execution Modes of Pig, Field, Tuple, Bag, User Defined Function, Parameters in Pig, Piggy Bank, Word count example using Pig, Pig vs Hive, When to use Pig.</p>	14

### **Text Book:**

- IBM Technologies ICE "Big Data Analytics Student Guide"
- Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", 1st Edition, 2015, Wiley, India.
- Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", 2nd Edition, 2014, Cambridge University Press.

### **Reference Books:**

- Chuck Lam, "Hadoop in Action", 2nd Edition, Manning Publications, 2014.

**Outcome:** After completion of course, student will be able to:

- CO1: Understand the concept and challenges of big data

**B.Tech.Computer Science & Engineering (Specialization in Data Analytics)**

C02: Apply the existing technology to collect, manage, store, query, and analyze the big data.

- C03: Implement job scheduling and resource management of the cluster using Hadoop and Yarn.
- C04: Apply data summarization, query, and analysis over the big data with the help of pig and hive.
- C05: Design the regression model, cluster and decision tree over the real big data.
- C06: Implement different real life applications by using large-scale analytics tools.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1/PS03
C02	PO3/PS04
C03	PO2,PO3,PO11/PS02,PS04
C04	PO5,PO2/PS04
C05	PO2,PO3/PS02
C06	PO3/PS01

## **BCSE0585: HADOOP & BIG DATA ANALYTICS LAB**

**Objective:** This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyse data using common statistical methods, and generate reproducible statistical reports. Student will also learn data mangling.

Credits: 01

L-T-P-J: 0-0-2-0

Module No.	Content	Lab Hours
I&II	<p><b>Module 1: Introduction to R</b></p> <ul style="list-style-type: none"> <li>• Introduction and installation of R and RStudio</li> <li>• Data types, vectors, multidimensional array.</li> <li>• R utilities function</li> <li>• Correlation and Linear Regression</li> <li>• Logistics Regression</li> </ul> <p><b>Module 2: Hands-On MongoDB, Cassandra</b></p> <ul style="list-style-type: none"> <li>• Installation of VM-Ware and Cloudera</li> <li>• Hands-On Mongo DB: CRUD, Where, Aggregation</li> <li>• Hands-On Mongo DB: Projection, Aggregation</li> <li>• Hands-On Cassandra DB: CRUD, Projection</li> <li>• HDFS and its commands</li> <li>• Word-Count program using Map Reduce</li> <li>• Hands-On HIVE and Pig</li> </ul>	24

### **Reference Books:**

- Paul Teetor. R Cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc.,2011.
- Norman Matloff. Theart of R programming: A tour of statistical software design. No Starch Press, 2011.
- Winston Chang. R graphics cookbook. O'Reilly Media, Inc., 2012.
- Hadley Wickham and Garrett Grolemond. R for data science. 2016.
- Phil Spector. Data manipulation with R. Springer Science& Business Media,2008.

**Outcome:** After completion of course, student will be able to:

Use R-Studio, read R documentation, and write R scripts.

- Import, export and manipulate data.
- Analyse the data using data analytics latest tools based on HDFS like Pig, Hive
- Implement the aggregation projection on data set using Cassandra, MongoDB.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO5/PSO2
CO2	PO2, PO4/ PSO2
CO3	PO2, PO5/PSO3
CO4	PO3, PO5/PSO4

## **BCSE0557: SOCIAL WEB AND MOBILE ANALYTICS**



**Objective:** The course objectives are to give the knowledge of Web & Social media, the need of using Social Media Web Analytics, Dashboard, Relationships, Sentiments, Evolving topics and Reports.

**Credits: 03**

**Semester VII**

**L-T-P-J: 3-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction to Web &amp; Social Analytics:</b> What is Social media? Need of using analytics, Social analytics vs web analytics, Types of web analytics, Current analytics platforms, Open source vs licensed platforms, Google analytics, IBM social media analytics, Choosing right specifications and optimal solution.</p> <p><b>Relevant Data &amp; its Collection:</b> Data collection strategy, Participating with people centric approach, Social graph, Choosing focused data sources and social networks, Facebook social APIs, Live recruiting and remote user research, Types of surveys.</p> <p><b>Welcome to: KPIs/ Metrics:</b> KPI's, Metrics vs KPI's, Creating KPI's, Basic KPI's, Standard vs critical web metrics, KPI's goals and targets, Specific KPIs, Visualizing the social analytics framework, Build scorecards &amp; dashboards to track KPIs, measuring macro &amp; micro conversions, Measuring success for non-ecommerce and B2B websites.</p> <p><b>Manage Web &amp; Social Media with Analytics:</b> Explore &amp; Evaluate – dashboard, Types of charts, Sharing insights with dashboards, Sentiments, Evolving topics, Segmentation, Discovery, Social media content creation process, Competitive intelligence analysis, Website traffic analysis, Social signals.</p> <p><b>Future of Social Media Analytics and Monitoring:</b> Tasks of social media analytics and monitoring, Mashups, integrating customer profile data, colliding data sets for big bang ideas, Social interactions and web visits, Benefits of social media integration.</p>	20
II	<p><b>Introduction to Mobile Analytics:</b> Global Internet usage, Analyzing the mobile consumer behaviors, Web analytics Vs mobile analytics, Social media analysis can't tell..., Need of mobile analytics, Mobile communication, WAP- wireless application protocol, GGSN, Layered architecture of mobile computing, Mobile cloud computing architecture.</p> <p><b>Mobile Customer Experience Management:</b> Customers end-to-end journey, Customer engagement with mobile apps, Mobile app analytics strategies, Metrics for behavior analysis, Real-time In-app analytics, Voice XML (VXML), Mobile IM and messaging apps, Multichannel campaign optimization, LBS applications for the consumer market.</p> <p><b>Mobile analytics for content Publishers &amp; Operators:</b> Mobile Handset Analysis, Screen resolutions in terms of page views, visits and visitors, Mobile operator analysis, Sessions, Content categorization, Mobile operator - RDSN lookup, Full referral URL report, Search term performance, Specific visitor behavior.</p> <p><b>Mobile Analytics in Email Marketing:</b> The need of mobile email marketing, Features of email marketing tools, Categories of email marketing reports, Email bounce tracking, Unsubscribe reporting, Individual-level email tracking, Cold calling.</p> <p><b>Data Functionalities:</b> Data functionalities, Mobile web page tagging, Aggregate containers, Pageviews per annum, Usability analytics, Form field analytics, Attention map, Data archiving, Historical trends, IBM end to end mobile analytical solution with tealeaf integration, Target page HTTPS communication.</p>	20

**Reference Books:**

- IBM Student Guide on "SOCIAL WEB AND MOBILE ANALYTICS"

**Outcome:** By the end of the class, students will learn to:

- CO1: Understand the concepts of Web & Social media, the need of using Social Media Analytics and Web Analytics.
- CO2: Analyze the different analytics platforms and choose the right specifications & optimal solution.

**B.Tech.Computer Science & Engineering (Specialization in Data Analytics)**

- C03: Understand the different techniques of collecting and understanding social media data.
- C04: Understand the concepts of Dashboard, Relationships, Sentiments, Evolving topics, Reports and Mashing up Data from Disparate Sources.
- C05: Understand the importance and need of mobile analytics
- C06: Understand data functionalities of mobile analytics

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1, PO4/ PS01
C02	PO2, PO5/PS03
C03	PO1,PO5/PS01
C04	PO3,PO5/PS01,PS02
C05	PO1,PO2/PS01
C06	PO1/PS01,PS03



## **BCSE0586: SOCIAL WEB AND MOBILE ANALYTICS LAB**

**Objective:** This course introduces students to R, a widely used statistical programming language. Students will learn to manipulate data objects, produce graphics, analyze data using common statistical methods, and perform sentiment analysis.

**Credits: 01**

**Semester VII**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>Extracting Google Analytics data in R using RGoogleAnalytics               <ol style="list-style-type: none"> <li>1. Installing packages RGoogleAnalytics and their dependent packages.</li> <li>2. Obtain the credentials with the Google Analytics API.</li> <li>3. Authenticate the Google Analytics data with the R script and access the Google Analytics data.</li> <li>4. Obtain the Profile ID/View ID of the Google Analytics profile for which the data extraction has to be done.</li> <li>5. Generate the query and hit it to the Google Analytics API</li> </ol> </li> <li>Twitter mining for the popular coffee brand "Starbucks".               <ol style="list-style-type: none"> <li>1. Installing packages twitteR and their dependent packages</li> <li>2. Obtain the credentials for Twitter with the twitter account</li> <li>3. Setting the certification at Twitter</li> <li>4. Searching Twitter and performing sentiment analysis for the tweet named Starbucks.</li> <li>5. Doing some plots of the obtained results</li> </ol> </li> </ul>	

### **Reference Books:**

- IBM Guide on Social Web and Mobile Analytics

**Outcome:** By the end of the class, students learn to:

- CO1: Apply the RStudio to read R documentation, and write R scripts.
- CO2: Implement the code to extract Google analytics data in R.
- CO3: Implement the code to do Twitter mining and perform Sentiment Analysis for the twitter data in R.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO5/PSO2
CO2	PO3,PO5/ PSO4
CO3	PO2,PO3,PO4/PSO4

## **BCSE 0558: ENTERPRISE BUSINESS INTELLIGENCE AND DATA WAREHOUSING**

**Objective:** The course objectives give the basics of the data warehousing, Multi-dimensional modeling including R-OLAP and M-OLAP.

**Credits: 03**

**Semester VI**

**L-T-P-J: 3-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction:</b> What Is a Data Warehouse? Role and Purpose of the Data Warehouse, The Multipurpose Nature of the Data Warehouse, Characteristics of a Maintainable Data</p> <p><b>Planning and Requirements:</b> Introduction: Planning Data Warehouse and Key Issues: Planning and Project Management in constructing Data warehouse: Data Warehouse Project; Data Warehouse Development Life Cycle, Kimball Lifecycle Diagram, Requirements Gathering Approaches: Team organization, Roles, and Responsibilities</p> <p><b>Data Warehouse Architecture:</b> Introductions, Components of Data ware house Architecture: Technical Architectures; Data warehouse architectures 1: Data warehouse architecture 2: Data warehouse architecture 3: Tool selection: Federated Data Warehouse Architecture</p> <p><b>Extract, Transform and Load:</b> Introduction: ETL Overview or Introduction to ETL: ETL requirements and steps: Data Extraction; Extraction Methods, Logical Extraction Methods, Physical Extraction Methods: Data Transformation; Basic Tasks in Transformation, Major Data Transformation Types: Data loading; Data Loading Techniques: ETL Tools</p> <p>Introduction to Data Lakes: Data Lake characteristics and its importance, Real time need of Data Lake</p> <p><b>Data Warehouse Schemas:</b> Star Schema, Inside Dimensional Table, Inside Fact Table, Fact Less Fact Table, Granularity, Star Schema Keys: Snowflake Schema: Fact Constellation Schema</p> <p><b>Data Warehouse &amp; OLAP:</b> Introduction: What is OLAP? Characteristics of OLAP, Steps in the OLAP Creation Process, Advantageous of OLAP: What is Multidimensional Data: OLAP Architectures; MOLAP, ROLAP, HOLAP: Data Warehouse and OLAP: Hypercube &amp; Multi-cubes, OLAP Operations.</p>	20
II	<p><b>Introduction to Business Intelligence:</b> What is Business Intelligence? Definition of Business Intelligence, what is Analytics? Types of Analytics: Descriptive, Prescriptive, Predictive. Sample BI Architecture BI Components and Architecture Complex System Vs Volume Operations Enterprise Analytical Capabilities. Alignment between IT and Business</p> <p><b>Decision Support System:</b> Decision Support System, Three Tier Decision Support system, Exploring and analyzing data, OLAP and Advanced Analytics</p> <p><b>Data Profiling:</b> Need of Data Profiling and value addition of Data Profiling</p> <p><b>Meta Data:</b> Introduction to Meta Data and various types</p> <p><b>BI Best Practices:</b> Important various best practices for BI projects, key start skills for BI project</p> <p><b>Dashboards:</b> Introduction to dashboards, Types of dashboards, usability and industry use cases of dashboards, Evolution of Dashboard, Information discovery and Delivery, BI Architecture, Centralized vs Decentralized architecture, Expanding BI Potential, Data Backup and Restoring.</p> <p><b>BI Roles and Responsibilities:</b> Project management related BI roles, BI Strategies based on levelled roles, Measuring BI Success and value, BI effectiveness Scorecard, Planning of BI Project, BI Design and Development, Project Tasks. Risk Management and mitigation.</p>	20

### **Reference Books:**

- IBM Student Guide on "Data Warehouse and Multi-Dimensional Modeling".
- IBM Student Guide on "Business Intelligence"
- Swain Schleps," Business Intelligence for Dummies
- DB2 Universal Database Developers Guide by Roger E. Sanders
- Building the DataWarehouse by W.H. Inmon.

**Outcome:** After completion of course, student will be able to:

**B.Tech.Computer Science & Engineering (Specialization in Data Analytics)**

- C01: Understand the functionality of the different data mining and data-warehousing component.
- C02: Explain different data models.
- C03: Understand the concepts of different data Warehouse technology models.
- C04: Explain the different data Warehouse optimization models.
- C05: Understand the different operation and managements in data Warehouse.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1/PS02
C02	PO1,PO2/PS03
C03	PO5,PS01
C04	PO1,PO3,PS04
C05	PO11,PO9,PS01

## **BCSE 0587: Enterprise Business Intelligence and Data Warehousing Lab**

**Objective:** This course introduces students to Business Intelligence & Data Warehouse, Students will learn to create multiple reports and analyze data using various methods and generate Business reports. Student will also learn data representation in dimensional Modeling.

**Credits: 01**

**Semester VI**

**L-T-P-J: 0-0-2-0**

M000odule No.	Content	Teaching Hours
I & II	<ul style="list-style-type: none"> <li>Understand the detailed steps involved in Normalization process by converting the main relation into multiple relations in DB2. A Datawarehouse project for a chain of home entertainment retail stores.</li> <li>Understand the Multi-Dimensional modeling aspects in a Datawarehouse Environment. Understand OLAP queries, Materialized query tables, Summary tables and staging tables.</li> <li>Overview of BI Tool-Cognos Report Studio.</li> <li>Authoring Reports</li> <li>List, Crosstab and Charts Reports</li> <li>Grouping and Summarizing Data</li> <li>Filtering on Reports</li> <li>Sorting and calculation on Reports, Adding Prompt in Reports</li> <li>Creation of Miscellaneous Reports</li> <li>Scenario/ Objective Based Reports</li> </ul>	4

**Text Books:**

- Data Warehousing and Multi-Dimensional Modeling(IBM ICE Publication)

**Reference Books:**

- Buliding the Datawarehouse by W.H. Inmon.

**Outcome:**After completion of course, student will be able to:

- CO1: Understand of IBM Infosphere Data Architect and Toad Tool used for Data Warehousing.
- CO2: Design and execute ETL processes.
- CO3: Select best schema with respect to data warehouse design.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO5, PS02
CO2	PO3,PO2, PS03,PS02
CO3	PO2,PS04

## **BCSE0511: DEVOPS**

**Objective:** *This course introduces the knowledge of DevOps Ecosystem in the Software Development.*

**Credits: 03**

**L-T-P-J: 3-0-2-0**

Module No.	Content	Hours
I	<p><b>Introduction to DevOps:</b> Definition, Working and benefits of DevOps, DevOps history; <b>DevOps Phases:</b> Continuous Development, Continuous Integration, Continuous Testing, Continuous Deployment, Continuous Monitoring;</p> <p><b>Agile Methodology:</b> Introduction to Agile Methodology, Traditional Waterfall Model V/s Agile Model, Agile V/s DevOps;</p> <p><b>Business needs for DevOps:</b> DevOps Teams V/s Other Teams;</p> <p><b>DevOps adoption:</b> Four DevOps adoption paths, Impact on Developers, Impact on Operations, Monolithic and Microservices Development.</p> <p><b>DevOps Principles:</b> Development of DevOps team Culture, DevOps principles and DevOps roles, DevOps practices:</p>	20
II	<p><b>Configuration Management:</b> Git workflow, Continuous Integration, Automated testing, Continuous Deployment, Continuous monitoring;</p> <p><b>DevOps Lifecycle.</b></p> <p><b>Common Tools for DevOps:</b> Introduction to Docker, Introduction to Kubernetes, Introduction to Ansible, Introduction to Jenkins.</p> <p><b>Testing, Automated Deployment and Monitoring:</b> Introduction to Testing, Verification and Validation, Black Box Testing V/s White Box Testing, DevOps monitoring using open source tools, Continuous Testing using DevOps.</p> <p><b>DevOps with emerging technologies:</b> BigData, IoT</p>	19

### **Text Books:**

- DevOps- Student Guide, IBM

### **Reference Books:**

- DevOps for Dummies, IBM Limited Edition – Sanjeev Sharma, John Wiley and Sons, Inc., 2014
- What is DevOps? – By Mike Loukides, O'Reilly Media, Inc., 2012

**Outcome:** *By the end of the class, students will learn to:*

- *Explain the benefits of DevOps Methodology with respect to traditional Software Development Methodology.*
- *Identify difference between DevOps and Agile Software Development methodology.*
- *Explain the concepts of DevOps while being Agile.*
- *Explain the Continuous Development, Continuous Integration, Continuous Testing and Continuous Delivery of Software.*
- *Work with the tools for DevOps*

*Relate DevOps with the emerging technologies like BigData and IoT.*



## **BCSE 1502: Introduction to Virtualization and Cloud Computing**

**Objective:** The course enables students to understand the virtualization technology, Applications along with cloud computing concepts and services.

**Credits: 03**

**Semester - IV**

**L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction to Virtualization</b> Overview of Virtualization: Need of Virtualization, traditional IT Infrastructure, shortcoming of physical infrastructure, Benefit of Virtualization, Comparison of traditional IT infrastructure with virtualized infrastructure,</p> <p><b>Virtualization</b> Implementing Virtualization, Typical hardware / software server stack and its logical equivalence, Pre/post virtualization server stack, Types of virtualization, Area and technology based classification, History of virtualization, Time sharing system, IBM mainframe and PowerVM virtualization, Extending Virtualization to x86 and its hardware support, Impact of Virtualization: Cost and Manageability impact.</p> <p><b>Server and Storage Virtualization</b> Types of Server Virtualization, Simulation, Hardware Assisted Virtualization, Hypervisors, Ring levels on x86 processors, Types of Hypervisors, IBM PowerVM Hypervisors, Common consideration in server Virtualization, Desktop Virtualization: Benefits Constraints and Types. Three major layers in Xen server, RAID Levels, DAS, NAS, SAN, Storage Virtualization overview: benefit and types, Features of logical layers, Host level storage Virtualization, Host based mirroring, Storage level Virtualization, Network based storage Virtualization.</p> <p><b>Network and Application Virtualization</b> Network Virtualization overview: VPN, VLAN, Challenges in using application in traditional install, use and update model, Solution for challenges, Benefits of Application Virtualization.</p>	20
II	<p><b>Introduction to Cloud Computing</b> Overview: Introduction to cloud computing, Service driven model, Advantage of cloud computing: Marketing point of view, Types of services, OS and Virtualization, VM, advantage of Virtualization, Virtualization and cloud and its overlapping, Business value, Business impact of cloud, Technological value of cloud, End user benefits, Change for provider and administrator, Pros and cons of cloud model, Anatomy of cloud, Solution component, Service catalog, User self-service portal, Service request management, Provisioning, Optimized infrastructure, Chargeback, Benefit of cloud, Delivery and Deployment Model, Different Cloud Architecture: Public, Private and Hybrid and its pros and cons, Delivery models. Cloud transformation roadmap, History of cloud, Client-server, cluster, Grid models, Cloud vs Grid and their relationship, Cluster and Cloud, Utility computing and Evolution of Cloud Computing, Cloud Computing Milestones.</p> <p><b>Cloud Deployment selection criteria</b> Pros and cons of each Deployment architecture of Cloud: Public, Private, Hybrid, Cloud deployment decision factors( Business IT Control, Business critical application, Data and transaction security, Compliance and audit, Balance of CAPEX and OPEX, Workload characteristics, Workload lifespan preferences, Industry segment- SME and Large enterprises, Data Freedom, Software characteristics, Time to deploy), Public Cloud: Factor Matrix, Advantage, Disadvantage, Public Cloud: Factor Matrix, Advantage and disadvantage, Hybrid Cloud: Factor matrix, Advantage, Disadvantage, Overview of Cloud delivery models, Infrastructure, IT Layers, IaaS Overview,</p>	20



**B.Tech.Computer Science & Engineering (Specialization in Data Analytics)**

	<p>Features, Cloud bursting, Multi tenancy, Resource pooling, PaaS: Overview, Component, Example, SaaS: Advantage, Example.</p> <p><b>Implementation of Virtualization and Factors deciding Cloud workloads</b></p> <p>Case study overview, customer IT landscape, Function of data center, Trigger for virtualization, Preparation for virtualization, Server selection, Server sizing, Server criticality, Provisioning, Proximity and Locality, Transition tool for virtualization, Cost savings, Cloud workload overview, Workload characterization, Factors, Suitable workload for cloud, Private cloud solution, Types of workload, Advantage, Mission critical workload, Mixed workload, Production only workload for hybrid cloud, Industry specific workload , Non suitable workload: Public, Private cloud, Possible workload by cloud.</p>	
--	---	--

**Text Books:**

- R1. Introduction to Virtualization and Cloud Computing(IBM ICE Publication)
- R2. Cloud Computing Black Book (by : Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah)
- R3. Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski , Cloud Computing: Principles and paradigms, 2011.

**Outcome:** After completion of course, the student will be able to:

- CO1: Understand the basics of virtualization technology and hypervisors.
- CO2: Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
- CO3: Recognize real-world problem using cloud computing through group collaboration.
- CO4: Understand on-demand utility computing phenomenon of cloud computing.
- CO5: Understand the issues involved in cloud computing.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	P01,P03,P05,P07/PS02
C02	P01,P03,P05,P07/PS04
C03	P01,P03,P07/PS01
C04	P01,P07/PS01
C05	P01,P03/PS01
C06	P01,P03,P05,P07/PS04



## BCSE0252: FULL STACK USING NODE JS

**Objective:** The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.

**Credits: 03**

**L-T-P:J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>MongoDB:</b> Introduction to MongoDB, MongoDB Environment, MongoDB Create Database, MongoDB Drop Database, MongoDB Create Collection, MongoDB Drop Collection, MongoDB Read Operations, MongoDB Write Operations, MongoDB Data Modelling, MongoDB Administration.</p> <p><b>Angular JS:</b> Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives &amp; Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API.</p> <p><b>Express Framework:</b> Introduction to Express Framework, Introduction to Nodejs, what is Nodejs, Getting Started with Express, Express Routing,</p>	20
II	<p><b>Express Framework:</b> Implementing MVC in Express, Middleware, Using Template Engines, Error Handling, API Handling, Debugging, Developing Template Engines, Using Process Managers, Security &amp; Deployment.</p> <p><b>Node.js:</b> Introduction to Node JS, Setup Dev Environment, Node Core, Node Modules, Creating Web server, File System, Debugging Node JS Application, Automation and Deployment, Events &amp; Database connectivity.</p> <p><b>React.js:</b> Welcome to Starting with React, React Components, React State and Props, React Event Handling, Routing in React React flux, &amp;. Styling React</p>	20

### Text Books:

- Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications by Brad Dayley, Brendan Dayley, Caleb Dayley
- Express.js: Guide Book on Web framework for Node.js by Rick L.
- Introduction to React by Cory Gackenhimer,

**Outcome:** After completion of course, student will be able to:

- CO1: Apply programming concepts using Node.js.
- CO2: Develop web application using MongoDB and Angularjs.
- CO3: Develop web application based on MongoDB.
- CO4: Understand project management and code.
- CO5: Develop RESTful and MVC based web application.
- CO6: Understand the basic concepts of React.js.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1/PSO1
CO2	PO3/PSO2
CO3	PO3/PSO3
CO4	PO2/PSO3
CO5	PO3/PSO2
CO6	PO2/PSO1

## **BCSE0282: FULL STACK USING NODE JS LAB**

**Objective:** The objective is to provide a comprehensive study of the Backend. It stresses the strengths of Web (Full Stack), which provide students with the means of writing efficient, maintainable, and portable Website.

**Credits: 01**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
I/II	<ul style="list-style-type: none"> <li>Installing and Managing MogoDB.</li> <li>Create &amp; Manage Database.</li> <li>Create &amp; Manage collections</li> <li>Implementation of Modeling.</li> <li>Create your first AngularJS application in Visual Studio.</li> <li>Build a shopping cart using AngularJS</li> <li>Implementation AngularJS Expressions</li> <li>Implementation AngularJS Modules</li> <li>Implementation AngularJS Events</li> <li>Implementation AngularJS Filters &amp; Services</li> <li>Node JS- Setup Dev Environment.</li> <li>Express Routing</li> <li>Implementing MVC in Express.</li> <li>Implementing Template Engines.</li> <li>Implementing Node Modules,</li> <li>Implementing React Components,</li> <li>Implementing React Event.</li> </ul>	12*2=24

### **Reference Books:**

- Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications by Brad Dayley, Brendan Dayley, Caleb Dayley
- Express.js: Guide Book on Web framework for Node.js by Rick L.
- Introduction to React by Cory Gackenhimer,

**Outcome:** After studying the subject, the students will be able to:

- C01: Implement web application using MongoDB and Angular.Js.
- C02: Develop web application using NodeJs.
- C03: Develop RESTful and MVC based web application.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO5/PS02
C02	PO3/PS02
C03	PO5/PS04

## **BCSE 0602 IT NETWORK SECURITY**

**Objective:** The objective of this course is to make the student understand the various essential security concepts required for achieving Network Security.

**Credits: 03**

**Semester IV**

**L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction:</b> Network Fundamentals and its Types. Network Security Threats, Vulnerabilities and Attacks</p> <p><b>Network Security Controls, Protocols &amp; Devices:</b> Access Control Terminology, Types of Authentication, Encryption, Digital Signatures, IDS, VPN, Network Security Protocols, Kerberos, HTTPS, IPSec</p> <p><b>Network Security Policy Design and Implementation:</b> Hierarchy of a Security Policy, Design of a Security Policy, Policy Implementation Checklist, Data Backup Policy</p> <p><b>Physical Security:</b> Physical security controls, checklists.</p> <p><b>Host Security:</b> Host Security Baseline, Auditing Windows registry, Patch Management, Email Security, File System Security, Virtualization Terminologies</p> <p><b>Secure IDS Configuration and Management:</b> Firewalls and concerns, Network Address Translation, Vulnerability based Detection and Blocking IDPS Functions,</p>	20
II	<p><b>Secure VPN configuration and Management:</b> Functions of a VPN Concentrator, VPN core functionality, VPN Topologies, VPN concerns</p> <p><b>Wireless Network Defender:</b> Wireless Terminologies, Wireless Standard, Wireless Network Security.</p> <p><b>Network Traffic Monitoring and Analysis:</b> Advantages of Network Traffic Monitoring and Analysis, Network Traffic Signatures, Monitoring and Analyzing FTP, TELNET and HTTP Traffic</p> <p><b>Network Risk and Vulnerability Management:</b> Risk Management Phase, Enterprise Risk Management Framework, Network Vulnerability Assessment Tools</p> <p><b>Data Backup and Recovery:</b> Introduction to Data Backup, STORAGE AREA NETWORK(SAN), Backup Types, Recovery Tools</p> <p><b>Network Incident Response and Management:</b> Incident Handling and Response, First Responder, Fear Uncertainty and Doubt (FUD), Forensic Investigation</p>	20

### **Text Books:**

- Network Security: The Complete Reference, Roberta Bragg, Mark-Rhodes Ousley, Keith Strassberg. Mc-Grawhill Publication.
- Cyber-Security Essentials, Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short. Sybex Publishers.
- Fundamentals of Cyber Security, Mayank Bhushan, Rajkumar Singh Rathore, Aatif Jamshed. BPB Publications

### **Reference Books:**

- IBM-Innovation Centre for Education, "IT Network Security Vol - 1" Student Guide
- IBM-Innovation Centre for Education, "IT Network Security Vol - 2" Student Guide

**Outcome:** After completion of the course, the student will be able to:

- CO1: Understand the fundamentals of network security.
- CO2: Demonstrate the principle of network security controls, protocols and devices
- CO3: Understand the basic concepts of physical and host security, and secure IDS configuration & Management.

- 
- C04: Explain the network security by using VPN and wireless technologies.
- C05: Explain the concepts of network traffic monitoring and analysis.
- C06: Conceptualize the risk management framework and vulnerability management.
- C07: Explain the concepts of data backup, recovery tools and incident response management.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/PSOs</b>
C01	PO1,PO2/PS01
C02	PO3,PO4,PO6/PS02,PS04
C03	PO1,PO2/PS01
C04	PO1,PO2,PO6/PS01,PS03
C05	PO2,PO4,PO5/PS03
C06	PO1,PO2,PO6/PS01
C07	PO1,PO2,PO7/PS01

## **BCSE0203: INTERNET OF THINGS**

**Objective:** To Implement Data and Knowledge Management and use of Devices in IoT Technology.

**Credits: 03**

**L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	<b>Introduction to IoT and Sensor:</b> Introduction to IoT- Sensing, Actuation, Logical design of IoT, Functional blocks/pillars/components of IoT, Communication models, IoT& M2M: Machine to Machine, Difference between IoT and M2M, <b>Introduction to Sensors:</b> About sensor, Properties of Sensors Basic physical principles of sensing, Categorization of Sensor, PIR Sensor, Temperature Sensor, Ultrasonic Sensor, IR Sensor, MQ2/MQ3 <b>Implementing IoT:</b> Introduction to Arduino Programming. Integration of Sensors and Actuators with Arduino. Implementation of IoT with Arduino, Node MCU. Mini project Statement using Node MCU.	20
II	<b>IoT Over Network:</b> IOT Networking Protocols: TCP/IP, 6LowPan, Routing Protocols, Thread. <b>Communication Protocol:</b> CoAP, SMCP, SMTP, HTTP, HTTPS, MQTT, MQTT-S SDN for IoT, Data Handling and Analytics. Cloud Computing, Fog Computing, Introduction to different IoT Tools. Implementation of IoT with Raspberry Pi.	20

### **Books for reference:**

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madiseti (Universities Press)

### **Outcome:**

- CO1: Understand the concepts of Internet of Things.
- CO2: Understand difference between Sensors and Actuators and their working principles.
- CO3: Design IoT applications using different sensors and actuators.
- CO4: Understand different protocols used in IoT over network.
- CO5: Understand different communication protocols.
- CO6: Explain the concept of cloud computing and fog computing.
- CO7: Implement IoT application using Raspberry Pi.

### **Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO1,PO3/PS01
CO2	PO2 /PS04
CO3	PO5/PS02
CO4	PO11/PS02
CO5	PO1,PO3/PS04
CO6	PO2/PS01
CO7	PO5/PS03

## **BCSE0232: INTERNET OF THINGS LAB**

**Objective:** Coordinate and help to increase and optimize the utilization of results and value creation in the area of IoT.

**Credits: 01**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Lab Hours
I/II/III	<ul style="list-style-type: none"> <li>WAP to interface and blink the LED using Arduino UNO.</li> <li>WAP to interface for different sensors (Like DHT11, temperature, IR, Ultrasonic etc) to Arduino UNO.</li> <li>WAP to interface temperature sensor to ESP8266. Turn on the LED if temperature value met threshold value.</li> <li>WAP to interface in between Bluetooth module and Arduino UNO.</li> <li>Write a python program for Gateway to store sensor data on local MySQL database.</li> <li>WAP to transmit the data wirelessly for longer distance using multi-hop technique.</li> <li>Configure the gateway as local MQTT broker (Mosquito), configure one ESP8266 as sender (Publisher), and receive the data on the Smartphone (MQTT Dashboard).</li> </ul>	12*2=24

### **Text Books:**

- Upskill Learning, "ESP8266: Programming NodeMCU Using Arduino IDE - Get Started With ESP8266 (Internet Of Things, IOT, Projects In Internet Of Things, Internet Of Things for Beginners, NodeMCU Programming, ESP8266", 2018.

**Outcome:** After completion of course, student will be able to:

- CO1: Design IoT applications using different sensors and actuators.
- CO2: Design IoT applications in different domain and be able to analyze their performance.
- CO3: Implement basic IoT applications on embedded platform.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
CO1	PO3,PO5/PSO1
CO2	PO4/PSO1
CO3	PO1/PSO4

## **BCSC0013: COMPILER DESIGN**

**Objective:** The course objective is to introduce the major concept areas of language translation and compiler design and to enrich the knowledge in various phases of compiler and its use, code optimization techniques, machine code generation, and use of symbol table.

**Credits:04**

**L-T-P-J: 3-1-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction to Compiler:</b> Phases and passes, bootstrapping, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical analyzer generator, LEX-compiler, YACC, Context free grammars, derivation and parse trees, capabilities of CFG.</p> <p><b>Basic Parsing Techniques:</b> Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables.</p> <p><b>Advance Parser:</b> Constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.</p>	20
II	<p><b>Syntax-directed Translation:</b> Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees &amp; syntax trees, three address code, quadruple &amp; triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array Reference, Cases: in arithmetic expressions, procedures call, declarations and case statements.</p> <p><b>Symbol Tables:</b> Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, Storage allocation in block structured language.</p> <p><b>Error Detection &amp; Recovery:</b> Lexical Phase errors, Syntactic phase errors, semantic errors.</p> <p><b>Code optimization:</b> Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, Value numbers and algebraic laws, Global Data-Flow analysis.</p> <p><b>Code Generation:</b> Design Issues, Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator.</p>	20

### **Text Book:**

- Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2008.

### **Reference Books:**

- V Raghvan, "Principles of Compiler Design", 2nd Edition, TMH, 2010.
- Kenneth Loudon, "Compiler Construction", 1st Edition, Cengage Learning, 1997.
- Charles Fischer and Ricard LeBlanc, "Crafting a Compiler with C", Pearson Education, 2005

**Outcome:** After the completion of the course, the student will be able to:

- CO1: Understand basics of Compilers and its phases.
- CO2: Design top-down and bottom-up parsers and will be able to solve problems related to predictive parser, Shift reduce parsing, compute FIRST and FOLLOW sets, LR (0), LR (1) and LALR sets of items and parse table for a given grammar.



**B.Tech.Computer Science & Engineering (Specialization in Data Analytics)**

- C03: Demonstrate the ability to write syntax directed translations of simple statements and understand the working of procedure calls.
- C04: Demonstrate the ability to write intermediate code for a given high level programming language (preferably C or FORTRAN) and be able to represent the intermediate code as Quadruples, Triples and Indirect Triples
- C05: Identify the basic blocks for three address code, draw flow graphs and represent directed acyclic graphs for the identified basic blocks.
- C06: Write the target optimized code (assembly code) for the given three-address code.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/PSOs
C01	PO1,PO2,PO3,PO4/PS01,PS02,PS03
C02	PO1,PO2,PO3,PO4,PO5/PS01,PS02,PS03
C03	PO1,PO2,PO3,PO4/PS01,PS02,PS03
C04	PO1,PO2,PO3,PO5/PS01,PS02,PS03
C05	PO1,PO2,PO3,PO4,PO5/PS01,PS02,PS03
C06	PO1,PO2,PO3,PO4,PS05/PS01,PS02,PS03



## **BCSE0587: ENTERPRISE BUSINESS INTELLIGENCE AND DATA WAREHOUSING LAB**

**Objective:** *This course introduces students to Business Intelligence & Data Warehouse, Students will learn to create multiple reports and analyze data using various methods and generate Business reports. Student will also learn data representation in dimensional Modeling*

**Credits: 01**

**Semester V**

**L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
<b>I</b>	<ol style="list-style-type: none"> <li>Understand the detailed steps involved in Normalization process by converting the main relation into multiple relations in DB2. A Datawarehouse project for a chain of home entertainment retail stores.</li> <li>Understand the Multi-Dimensional modeling aspects in a Datawarehouse Environment. Understand OLAP queries, Materialized query tables, Summary tables and staging tables.</li> <li>Overview of BI Tool-Cognos Report Studio.</li> <li>Authoring Reports</li> <li>List, Crosstab and Charts Reports</li> <li>Grouping and Summarizing Data</li> <li>Filtering on Reports</li> <li>Sorting and calculation on Reports, Adding Prompt in Reports</li> <li>Creation of Miscellaneous Reports</li> <li>Scenario/ Objective Based Reports</li> </ol>	4

### **Text Books:**

- Data Warehousing and Multi-Dimensional Modeling (IBM ICE Publication)
- "Business Intelligence A Managerial Perspective on Analytics," Turban Sharda Delen King. Third Edition
- IBM Student Exercise Guide on Business Intelligence, BA05SG01 V2.0
- Business Intelligence and Analytics Systems for Decision Support 10th Edition Sharda

### **Reference Books:**

- Building the Datawarehouse by W.H. Inmon

### **Outcome:**

On completion of this course, student will be able to

- gain the understanding of IBM Infosphere Data Architect
- Toad Tool used for Data Warehousing to deal with data,
- display data and design various model for Analytics and Prediction.
- Use IBM Cognos Report Studio
- Import data in Framework, manipulation on Logical Modeling
- Generate List, Crosstab, chart Reports
- Summarizing, calculations on reports
- Understanding of Dashboard
- Perform common filters on reports