



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
B. Sc. III Computer Science (Entire)**

**Under
Faculty of Science and Technology
(As per NEP 2020)**

With effect from Academic Year 2025-2026

Preamble:

There are bright career prospects for computer science professionals or software Professionals in recent scenario. With the opening of huge software and IT companies in India, the job opportunities for trained professionals have increased considerably. India is known to be leader in software and IT sector.

Computer science graduates pass outs find job opportunities in a variety of environments in academia, research, industry, government, private, business organizations and so on.

They are involved in analyzing problems for solutions, formulating and testing, using advanced communications or multi-media equipment, or working in teams for product development.

The software and IT companies are the major employers of computer science graduates.

General Objectives of the Programme:

1. To nurture academicians with focus and commitment to their subject.
2. To shape good and informed citizens from the students entering into the Programme.
3. To create a skilled workforce to match the requirements of the society.
4. To impart knowledge of Science is the basic objective of this Programme.
5. To develop scientific attitude is the major objective so as to make the students Open minded, critical and curious.
6. To develop skill in practical work, experiments and laboratory materials and Equipment along with the collection and interpretation of scientific data to contribute to science.
7. They offer the best packages to the young graduates which are unmatched with other branches of science.

Programme Outcomes:

1. The students will graduate with proficiency in the subject of their choice.
2. The students will be eligible to continue higher studies in their subject.
3. The students will be eligible to pursue higher studies abroad.
4. The students will be eligible to appear for the examinations for jobs in government organizations.
5. The students will be eligible to apply for jobs with a minimum requirement of B.Sc. Programme.

Program Specific Objectives of the Course:

1. The content of the syllabus have been framed as per UGC norms of CBCS Pattern.
2. The students are expected to understand the fundamentals, principles, mathematical, recent IT concepts and recent developments in the subject area.
3. The practical course is in relevance to the theory courses to improve the understanding of the concepts.
4. It is expected to inspire and boost interest of the students towards Computer Science as the main subject.
5. To develop the power of appreciations, the achievements in Computer and role in nature and society.
6. To enhance student sense of enthusiasm towards IT and to involve them in an intellectually stimulating

Program Specific Outcomes:

After successful completion of B.Sc. Computer Science (Entire) Course student will be able to:

1. Understand the basics of Computer Science.
2. Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
3. Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Computer Science.
4. Identify their area of interest in academic, research and development.
5. Perform job in various fields' like IT, science, engineering, education, banking, business and public service, etc. or be an entrepreneur with precision, analytical mind, innovative thinking, clarity of thought, expression, and systematic approach.

1. TITLE: **Computer Science (Entire)**
2. YEAR OF IMPLEMENTATION: **2025-2026**
3. DURATION: **01 year**
4. PATTERN: **Semester examination**
5. MEDIUM OF INSTRUCTION: **English**
6. STRUCTURE OF COURSE:

As per NEP-2020 (1.0)

Level	Sem.	Subject				VS C	FP	CEP	OJT	Total
		DSC		DSE*						
		T	P	T	P					
5.5	V	DSC I (2)	DSCP (4)	DSE I (2)	DSEP (2)	VS C (4)	FP (2)	CEP (2)	--	22
		DSC II (2)		DSE II (2)						
5.5	VI	DSC I (2)	DSCP (4)	DSE I (2)	DSEP (2)	VS C (2)	FP (2)	--	OJT (4)	22
		DSC II (2)		DSE II (2)						

* DSE - 2 Papers out of four for each semester.

7. COURSE TITLE

1) Fifth Semester

Sr.no	Subject	Subject Code	Name of Course	Credits
1	Discipline Specific Course –T	BCSET 351	Core Java	2
2		BCSET 352	C# Programming I	2
3	Discipline Specific Course -P	BCSEP 357	Lab On Core Java	2
4		BCSEP 358	Lab On C# Programming I	2
5	Discipline Specific Elective-T	BCSET 353	PHP Programming I	4
		BCSET 354	Software Engineering	
6		BCSET 355	Basic Of Shell Scripting	
		BCSET 356	Fundamentals Of Data Science	
7	Discipline Specific Elective-P	BCSEP 359	Lab on Elective BCSET 353, BCSET 354 Or BCSET 355, BCSET 356.	2
8	VSC	BCSEPVSC III	GIT Version Control	2
9		BCSEPVSC IV	Figma	2
10	FP	BCSEFP I	Field Project	2
11	CEP	BCSECEP I	Community Engagement Program	2

2) Sixth Semester

Sr.no	Subject	Subject Code	Name of Course	Credits
1	Discipline Specific Course –T	BCSET 361	Advanced Java	2
2		BCSET 362	C# Programming Ii	2
3	Discipline Specific Course -P	BCSEP 367	Lab On Advance Java	2
4		BCSEP 368	Lab On C# Programming Ii	2
5	Discipline Specific Elective-T	BCSET 363	PHP Programming Ii	4
		BCSET 364	Software Testing	
6		BCSET 365	TCS	
		BCSET 366	Internet Of Things (IOT)	
7	Discipline Specific Elective-P	BCSEP 369	Lab On Elective BCSET 363, BCSET 364 Or BCSET 365, BCSET 366	2
8	Value Skill Course	BCSEPVSC VI	Fundamentals of MongoDB	2
10	FP	BCSEFP II	Field Project	2
11	OJT	BCSEOJT I	On Job Training	4

8. Exam Evaluation Pattern :

➤ B.Sc. III NEP 1.0

- Semester V (5.5)

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	Mid - Semester	CCE-II			
DSC	T	BCSET 351	05	10	05	30	50	02
	T	BCSET 352	05	10	05	30	50	02
	P	BCSEP 357	--	--	--	50	50	02
	P	BCSEP 358	--	--	--	50	50	02
DSE (2 Theory Papers Out of Four)	T	BCSET 353	05	10	05	30	50	02
	T	BCSET 354	05	10	05	30	50	02
	T	BCSET 355	05	10	05	30	50	02
	T	BCSET 356	05	10	05	30	50	02
	P	BCSEP 359	--	--	--	50	50	02
VSC	P	BCSEPVSC III	--	--	--	50	50	02
	P	BCSEPVSC IV	--	--	--	50	50	02
FP	P	BCSEFP I	--	--	--	50	50	02
CEP	P	BCSEPCEP I	--	--	--	50	50	02
Total							550	22

-Semester VI

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	Mid - Semester	CCE-II			
DSC	T	BCSET 361	05	10	05	30	50	02
	T	BCSET 362	05	10	05	30	50	02
	P	BCSEP 367	--	--	--	50	50	02
	P	BCSEP 368	--	--	--	50	50	02
DSE (2 Theory Papers Out of Four)	T	BCSET 363	05	10	05	30	50	02
	T	BCSET 364	05	10	05	30	50	02
	T	BCSET 365	05	10	05	30	50	02
	T	BCSET 366	05	10	05	30	50	02
	P	BCSEP 369	--	--	--	50	50	02
VSC	P	BCSEPVSC V	--	--	--	50	50	02
FP	P	BCSEFP II	--	--	--	50	50	02
OJT	P	BCSEPOJT I	--	--	--	100	100	04
Total							550	22

DSC: Discipline Specific Course; DSE: Discipline Specific Elective VSC: Vocational Skill Course; OJT: On Job Training; FP: Field Project; CEP: Community Engagement Program, T: Theory; P: Practical

9. OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computers, LCD projector, Laptops, smart Screen board

b) Laboratory Equipment:

1. Computers

2. Printers

3. Scanners

4. LAN Connection

5. LCD Projector

6. Power Supplies

B.Sc. Part – III, Semester V
BCSET 351 Core Java
(Total Credits 2)

Course Objectives: Students will be able to

- 1) learn basic concepts of Java Language
- 2) study the concepts of classes and objects
- 3) know the concepts of Inheritance, packages, and interfaces
- 4) understand Exception handling and multithreading

Units	Content	No. of hours
I	Basics of Java History and features of Java, Java Virtual Machine (JVM), JDK tool Compilation and execution of java program, Java keywords, Data types. Java variables- declaration and assigning values to variables, Scanner Class, Scope of variables. Type casting- Implicit and Explicit casting, Operators of java, Control structures of java, Branching statements- If, if else, if ...else if and switch statement. Iterative statements- for loop, do... while, while loop, for each loop, jumping statements-break and continue statement.	8
II	Object oriented concepts in Java Introduction: Classes, Objects and methods , Field declaration, method declaration, Accessing class members, Access modifiers in java, Static variables and methods Method overloading, Constructor- types of constructors, constructor overloading Use of this keyword, Array, types of array, Collection- List interface, Array List class, Linked List class, Vector class and Stack class.	7
III	Inheritance, packages and interfaces Inheritance- definition, syntax, Types of inheritance, Method overriding Difference between method overloading and overriding, Abstract class and method Use of final keyword, Interface, abstract class, Packages and it's types.	7
IV	Exception Handling and Multithreading Concept of exception, Types of exceptions, Exception handling: try and catch block, Multiple catch block finally block, throws keyword User defined exception: throw keyword, Concept of Thread, Life cycle of thread start (), run (), sleep (), wait (), stop () Multithreading, Creating thread by extending Thread class and implementing Runnable interface.	8

Course Outcomes: Students will be able to

- 1) implement Object oriented concepts using java
- 2) develop Object oriented software application
- 3) perform multithreading applications
- 4) handle exceptions while executing programs

Reference Books:-

1. Horstmann, Cay S. 2022. Core Java Volume I—Fundamentals. 11th ed. Pearson ISBN: 978-0135166307
2. Schildt, Herbert. 2018. Java: The Complete Reference. 11th ed. McGraw-Hill ISBN: 978-1260440232
3. Bloch, Joshua. 2018. Effective Java. 3rd ed. Addison-Wesley ISBN: 978-0134685991
4. Eckel, Bruce. 2006. Thinking in Java. 4th ed. Prentice Hall ISBN: 978-0131872486
5. Sierra, Kathy, and Bert Bates. 2005. Head First Java. 2nd ed. O'Reilly Media ISBN: 978-0596009205
6. Gosling, James, et al. 2000. The Java Programming Language. 4th ed. Addison-Wesley ISBN: 978-0201310060
7. Cornell, Gary, and Cay S. Horstmann. 2005. Core Java 2 Volume II—Advanced Features. 7th ed. Prentice Hall ISBN: 978-0131118263
8. Barnes, David J., and Michael Kölling. 2012. Objects First with Java. 5th ed. Pearson ISBN: 978-0132492669

B.Sc. Part – III, Semester V
BCSET 352 C# Programming I
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study the concept of parameter passing mechanism
- 2) learn concept of command line argument, typecasting
- 3) understand control structure, looping statement
- 4) get knowledge of array, statics, non-static , DLL ,EXE concepts

Units	Content	No. of hours
1	Dot Net Framework Overview, component Architecture of .Net framework, Features of .NET, Evolution of .net framework, Meta data and assembly, CLR, Managed and unmanaged code, MSIL, JIT Compiler, CTS, CLS, Compilation and execution process, NET base classes, namespace	8
2	C# Basics Introducing C#, Inside a C# Program, Compiling and Running the Program, Variables, Datatypes, The Main() Method, Multiple Main() Methods, Defining & using functions & its scope, Passing Arguments to Main(), Parameter passing technique, Console I/O, Classes and Structs, Class Members, Data Members, Function Members, read-only Fields, The Object Class, System Object Methods, The ToString() Method.	7
3	Class, Object, Inheritance, Types of Inheritance Implementation Inheritance, Abstract Classes and Functions, Sealed Classes and Functions, Constructors, Interfaces, Defining and Implementing Interfaces, Polymorphism, Method overloading, Operator overloading.	8
4	Windows base applications Creating a Windows Form Application, Standard Controls and Components, Properties and Events of the controls, Forms, Form Class, Multiple Document Interface (MDI), Custom Controls (user Controls).	7

Course Outcomes: Students will be able to

- 1) use of command line argument, typecasting in C#
- 2) implement the use of control structure, looping statement
- 3) apply the concept of array, statics, non -static , DLL ,EXE concepts
- 4) describe the concept of Inheritance, Interface

Reference Books:-

1. Albahari, Joseph, and Ben Albahari. 2022 C# 11 in a Nutshell. O'Reilly Media ISBN: 9781098121952
2. Troelsen, Andrew, and Philip Japikse. 2022 Pro C# 10 with .NET 6. Apress ISBN: 9781484278680
3. Sharp, John. 2021, Microsoft Visual C# Step by Step. 10th ed. Microsoft Press ISBN: 9780137619832

4. Price, Jason. 2017 C# for Beginners. Independently published.
5. Freeman, Adam, and Matthew MacDonald.. 2012.Pro C# 5.0 and the .NET Framework. Apress
ISBN: 9781430242338

B.Sc. Part – III, Semester V
BCSEP 357 Lab Course on BCSET 351
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study Basic Java Programs
- 2) learn Class, object and methods in Java
- 3) use the Inheritance, packages , interfaces, abstraction effectively
- 4) understand Exception handling and multithreading

Practicals	Practical List	No. of hours
Practical Set	1. Program to demonstrate variable declaration, initialization, and type casting 2. Program using Scanner class to take user input and perform operations 3. Program using arithmetic and logical operators 4. Program using if-else to check if a number is positive, negative, or zero 5. Program using switch-case 6. Program using do-while loop to print a multiplication table 7. Program demonstrating break and continue in a loop 8. Program to define a class with fields and methods (student data example) 9. Program demonstrating method overloading 10. Program using constructors and constructor overloading 11. Program using this keyword to differentiate between class and parameter variables 12. Program to demonstrate 1D and 2D arrays 13. Program using ArrayList to store and display student names 14. Program using Stack to push and pop elements 15. Program using abstract class and abstract method 16. Program to implement interface and achieve multiple inheritance 17. Program using try-catch and finally block 18. Program to create and throw a user-defined exception 19. Program to create a thread by extending Thread class 20. Program to create a thread using Runnable interface	60

Course Outcomes: Students will be able to :

- 1) implement Basic Java Programs
- 2) apply Class, object and methods in Java
- 3) perform the Inheritance, packages and interfaces.
- 4) illustrate Exception handling and multithreading

Reference Books:-

1. Horstmann, Cay S. 2022. Core Java Volume I—Fundamentals. 11th ed. Pearson. ISBN: 9780135166307
2. Schildt, Herbert. 2018. Java: The Complete Reference. 11th ed. McGraw-Hill. ISBN: 9781260440232
3. Bloch, Joshua. 2018. Effective Java. 3rd ed. Addison-Wesley. ISBN: 9780134685991
4. Eckel, Bruce. 2006. Thinking in Java. 4th ed. Prentice Hall. ISBN: 9780131872486
5. Sierra, Kathy, and Bert Bates. 2005. Head First Java. 2nd ed. O'Reilly Media. ISBN: 9780596009205
6. Gosling, James, et al. 2000. The Java Programming Language. 4th ed. Addison-Wesley. ISBN: 9780321349804
7. Cornell, Gary, and Cay S. Horstmann. 2005. Core Java 2 Volume II—Advanced Features. 7th ed. Prentice Hall. ISBN: 9780131118263
8. Horstmann, Cay S., and Gary Cornell. 2018. Core Java Volume I—Fundamentals. 11th ed. Upper Saddle River, NJ: Prentice Hall. ISBN: 9780135166307

B.Sc. Part – III, Semester V
BCSEP 358 Lab Course on BCSET 352-
(Total Credits 2)

Course Objectives: Students will be able to

- 1) understand the fundamentals of the C# programming language and the .NET framework.
- 2) learn object-oriented programming concepts using C#.
- 3) gain proficiency in building Windows Forms and console-based applications.
- 4) use Visual Studio for writing, debugging, and testing C# programs.

Practicals	Practical List	No. of hours
Practical Set	1. Practical on .Net Framework study and comparison. 2. Explain with an example the concept of Managed Code vs Unmanaged Code. 3. Program on Variables and Data Types. 4. Create a small console-based calculator using functions for each operation. 5. Program on Class and Object. 6. Create a struct and a class, and show how they differ when passed to a function. 7. Program on Parameter passing. 8. Program on Inheritance. 9. Write a C# program where you implement Multiple Inheritance using Interfaces. 10. Program on Constructor, Interface and Polymorphism 11. Create a base class and abstract class, then derive child classes from both and call their functions. 12. Demonstrate the use of sealed classes by restricting inheritance. 13. Program on Windows Applications. 14. Program on MDI application. 15. Create a Windows Form Application that accepts two numbers and displays the sum. 16. Create a login form using standard controls (TextBox, Label, Button). 17. Add a ListBox and ComboBox to a form; populate them dynamically through code. 18. Create a form and write code to handle events like button click, mouse hover, and form closing. 19. Build a Simple Notepad Clone using Windows Forms (menus, open/save file dialogs). 20. Create a Custom User Control (example: a reusable login box) and	60

	use it in a Windows Form.	
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Course Outcomes: Students will be able to.....

- 1) describe the syntax, structure, and basic data types in C#.
- 2) apply object-oriented principles such as encapsulation, inheritance, and polymorphism in C#.
- 3) write modular and reusable code using classes, interfaces, and delegates.
- 4) develop and debug applications using Visual Studio IDE and manage projects.

Reference Books:-

1. Albahari, Joseph, and Ben Albahari. 2022. C# 11 in a Nutshell. O'Reilly Media. ISBN: 9781098121952
2. Troelsen, Andrew, and Philip Japikse. 2022. Pro C# 10 with .NET 6. Apress. ISBN: 9781484278680
3. Sharp, John. 2021. Microsoft Visual C# Step by Step. 10th ed. Microsoft Press. ISBN: 9780137619832
4. Price, Jason. 2017. C# for Beginners. Independently published. ISBN: Not available (self-published, likely without official ISBN)
5. Freeman, Adam, and Matthew MacDonald. 2012. Pro C# 5.0 and the .NET Framework. Apress. ISBN: 9781430242338
6. Watson, Wallace. 2015. Beginning C# Programming. CreateSpace. ISBN: 9781514207604

B.Sc. Part – III, Semester V
BCSET 353 PHP Programming I
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study Basic PHP Programs
- 2) learn basic concepts of PHP programming Language
- 3) know programming logic in PHP.
- 4) understand skills for writing programs of control structure and looping structure using 'PHP'.

Units	Content	No. of hours
1	Basics of PHP Introduction to PHP and Applications of PHP, Benefits of using PHP, PHP syntax, First PHP Program , Embed PHP in HTML / HTML in PHP, Data Types, variables, PHP Constants, type Casting, operators, PHP strings	6
2	Control Structure & Arrays Indexed Arrays, Associative arrays, Multidimensional arrays, Sorting Arrays, Control Structure and Looping, If Statement, If else if Statement, If.....Else statement, Nested if statement, Switch statement, For loop, while loop , Do.....while loop, For each loop	9
3	PHP OOPS & Functions Declaring class and objects, constructor and destructor, Inheritance & Polymorphism Abstract method and class, Interface, Function Definition, Syntax, Conditional Functions Functions with parameters, Function with Relive in Values, Assigning Default values to function parameters, Functions with static variables, Passing Array to A Function and returning list, Nested Functions, Recursive function, Anonymous Functions, Dynamic Function Calls, Call Back function Passing array to function	9
4	PHP Forms Working with Forms and User Input: HTML forms and form elements , Retrieving user input with \$_GET and \$_POST, Form validation and sanitization, Handling file uploads Designing Form through CSS Elements	6

Course Outcomes: Students will be able to

1. identify basic PHP syntax, Create basic PHP scripts
2. apply variables, string, and constant to a PHP script
3. implement Control and looping structures in PHP.
4. design Array and Functions in PHP.

Reference Books:-

1. PHP & MySQL: Novice to Ninja, Tom Butler, Kevin Yank, SitePoint, 2021 (6th Edition)ISBN: 9780994346988
2. PHP Objects, Patterns, and Practice, Matt Zandstra, Apress, 2021 (6th Edition)ISBN: 9781484267905
3. Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5, Robin Nixon, O'Reilly Media, 2021 (6th Edition)

ISBN: 9781492093824
4. Modern PHP: New Features and Good Practices, Josh Lockhart, O'Reilly Media, 2015

ISBN: 9781491905012
5. PHP Cookbook: Solutions & Examples for PHP Programmers, David Sklar, Adam Trachtenberg, O'Reilly Media, 2014 (3rd Edition)

ISBN: 9781449363758
6. Programming PHP, Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, O'Reilly Media, 2020 (4th Edition)

ISBN: 9781492054139
7. The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications, Alan Forbes, CreateSpace Independent Publishing, 2014

ISBN: 9781522792147
8. Head First PHP & MySQL, Lynn Beighley, Michael Morrison, O'Reilly Media, 2008

ISBN: 9780596006303

B.Sc. Part – III, Semester V
BCSET 354- Software Engineering
(Total Credits 2)

Course Objectives: Students will be able to

- 1) introduce the principles of software engineering and the software development Life cycle (SDLC).
- 2) understanding of software processes, requirements engineering, and design methodologies.
- 3) know foundational knowledge of coding, testing, and software maintenance.
- 4) understand unified modeling language

Units	Content	No. of hours
1	Basic concepts of Software Engineering Definition and Importance of Software Engineering, Characteristics of Software, Software Engineering Ethics and Professionalism, Software Development Lifecycle (SDLC) Phases: Planning, Analysis, Design, Implementation, Testing, Deployment, Maintenance	8

2	Software Process Models Waterfall Model, Incremental and Iterative Models, Agile Development Spiral and V-Model, Prototype Model, RAD Model (Discuss with case study for each model)	7
3	Requirements Engineering & Software Design Functional and Non-Functional Requirements, Requirements Gathering and Analysis Use Case Modeling, Writing Software Requirements Specification (SRS) Principles of Software Design (Modularity, Cohesion, Coupling), Architectural Design Patterns (e.g., MVC, Layered Architecture)	7
4	UML Introduction, Need of UML, Use Case Driven Object Oriented Analysis, Data Flow Diagrams (DFD) and Entity-Relationship Diagrams (ERD), User Interface (UI) and User Experience (UX) Design Basics, Use Case Diagram ,Activity Diagram, Sequence Diagram ,Collaboration Diagram Class Diagram ,State Chart Diagram	8

Course Outcomes: Students will be able to.....

- 1) implement Software Engineering Fundamentals.
- 2) apply Software Development Processes.
- 3) gather, document, and analyze user requirements for software systems.
- 4) use unified modeling language

Reference Books:-

1. Sommerville, Ian. 2015. Software Engineering. 10th ed. Harlow, UK: Pearson.
2. Pressman, Roger S., and Bruce R. Maxim. 2020. Software Engineering: A Practitioner's Approach. 9th ed. New York: McGraw-Hill Education.
3. Martin, Robert C. 2008. Clean Code: A Handbook of Agile Software Craftsmanship. Upper Saddle River, NJ: Prentice Hall.
4. Sommerville, Ian. 2019. Software Engineering. 10th ed. Harlow, UK: Pearson.
5. Pressman, Roger S., and Bruce R. Maxim. 2020. Software Engineering: A Practitioner's Approach. 9th ed. New York: McGraw-Hill Education.
6. Larman, Craig. 2004. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development. 3rd ed. Upper Saddle River, NJ: Prentice Hall.
7. Fowler, Martin. 2002. Patterns of Enterprise Application Architecture. Boston: Addison-Wesley.
8. Bass, Len, Paul Clements, and Rick Kazman. 2012. Software Architecture in Practice. 3rd ed. Boston: Addison-Wesley.

B.Sc. Part – III, Semester V
BCSET 355 Basic of Shell Scripting
(Total Credits 2)

Course Objectives: Students will be able to

- 1) understand the fundamentals of shell scripting and its role in automating tasks in Linux environments.
- 2) study use variables, data types, and operators to store and manipulate data in scripts.
- 3) debug shell scripts and identify errors for effective troubleshooting.
- 4) navigate the command-line interface and execute basic shell commands

Unit	Content	No. of hours
1	Shell Scripting Basic's What is a Shell?, Types of Shells (Bash, Korn, C Shell, etc.), Features and Role of Shell Scripting in Automation, Basic Linux/Unix Commands (ls, pwd, cd, mkdir, rm, etc.), File and Directory Operations, Concept of Permissions (chmod, chown, chgrp)	8
2	Shell Scripting Fundamentals Variables and Data Types, Defining Variables and Scope, Reading User Input (read), Positional Parameters and Special Variables (\$1, \$2, \$?, \$#, etc.), Operators in Shell Scripting, Arithmetic Operators (+, -, *, /, %),	8

	Relational and Logical Operators (==, !=, -lt, -gt, -le, -ge, &&,), String Operators and File Test Operators, Control Structures :, If else, else if ladder, nested if, Looping statements, Switch	
3	Functions in Shell Scripting Defining and Calling Functions, Function Arguments and Return Values, Recursive Functions, Handling Files and Directories.	7
4	Applications and Tools Integration Shell Scripting commands : awk, sed and grep, Shell Scripting commands : unique , sort , head , tail, Automating Tasks with Shell Scripts.	7

Course Outcomes: Students will be able to.....

- 1) debug and troubleshoot shell scripts to resolve errors and optimize performance.
- 2) automate system administration tasks like backups, monitoring, and file handling.
- 3) manage input/output redirection and manipulate files using shell commands.
- 4) execute shell scripts to automate tasks in Linux/Unix environments.

Reference Books:-

1. Shotts, William E. 2019. The Linux Command Line. 2nd ed. No Starch Press.
2. Newham, Cameron, and Bill Rosenblatt. 2005. Learning the Bash Shell. 3rd ed. O'Reilly.
3. Robbins, Arnold, and Nelson H. F. Beebe. 2005. Classic Shell Scripting. O'Reilly.
4. Taylor, Mark G. 2018. Shell Scripting: How to Automate Command Line Tasks. Independently published.
5. Bloom, Jason Cannon. 2016. Linux Command Line and Shell Scripting Bible. 3rd ed. Wiley.
6. Ball, Richard. 2020. Linux Shell Scripting Essentials. Packt.
7. Blum, Richard. 2021. Linux Command Line and Shell Scripting Techniques. Wiley

B.Sc. Part – III, Semester V
BCSET 356 Fundamentals of Data Science
(Total Credits 2)

Course Objectives: Students will be able to

1. provide a foundational understanding of data science concepts, processes, and applications across various domains.
2. use students' ability to apply statistical and analytical methods to extract insights from data.
3. equip students with practical skills in programming tools like Python or R for data manipulation and analysis.
4. introduce the fundamentals of machine learning for building and evaluating predictive models.

Units	Content	No. of hours
1	Data Science Concepts What is Data Science, importance of data science, Big data and small data, Industry Perspective Types of Data: Structured vs. Unstructured Data, Quantitative vs. Categorical Data, Data science lifecycle, Role	9

	Data Scientist in data science.	
2	Machine Learning Algorithms Machine Learning Algorithms: Linear Regression, K-nearest Neighbors (k-NN), K-mean, Naive Bayes, Scraping the Web: APIs and Other Tools.	8
3	Data Visualization Introduction to data visualization, Importance of Visualization in Data Science, Basic Visualization Techniques: Bar Charts, Line Charts, Pie Charts, Histograms and Boxplots, Scatter Plots and Bubble Charts, Encoding in Data Science, Types of Encoding techniques: Label encoding, Binary encoding.	7
4	Social Network Analysis What are Social Networks, Examples: Online social media, collaboration networks, Biological networks, Nodes, edges, and types of networks: Directed vs. Undirected, Directed vs. Undirected, Girvan Newman algorithm and edge betweenness.	6

Course Outcomes: Students will be able to

1. evaluate the basic concepts, principles, and scope of data science and its role in decision-making.
2. apply fundamental statistical techniques and probability theories for data analysis.
3. demonstrate proficiency in data preprocessing, data wrangling, and exploratory data analysis.
4. use programming tools such as Python or R for implementing data science workflows.

Reference Books:-

- 1) Grus, Joel. 2019. Data Science from Scratch: First Principles with Python. 2nd ed. Sebastopol, CA: O'Reilly Media.
- 2) McKinney, Wes. 2022. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter. 3rd ed. Sebastopol, CA: O'Reilly Media.
- 3) James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. 2021. An Introduction to Statistical Learning: With Applications in R. 2nd ed. New York: Springer.
- 4) Downey, Allen B. 2014. Think Stats: Exploratory Data Analysis in Python. 2nd ed. Sebastopol, CA: O'Reilly Media.
- 5) Provost, Foster, and Tom Fawcett. 2013. Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking. Sebastopol, CA: O'Reilly Media.
- 6) Cady, Field. 2017. The Data Science Handbook. Indianapolis, IN: Wiley.
- 7) VanderPlas, Jake. 2016. Python Data Science Handbook: Essential Tools for Working with Data. Sebastopol, CA: O'Reilly Media.
- 8) Baumer, Benjamin S., Daniel T. Kaplan, and Nicholas J. Horton. 2017. Modern Data Science with R. Boca Raton, FL: CRC Press.

B.Sc. Part – III, Semester V
BCSEP 359 Lab Course on BCSET 353
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study concept of PHP with HTML
- 2) learn type casting, constant in PHP
- 3) understand the concept of If, Switch, For, While in PHP
- 4) know the concept of functions and arrays.

Practical	Practical List	No. of hours
Practical set	1. Write and execute a "Hello, World!" PHP script. 2. Write program on Polymorphism. 3. Program on operators 4. Program on Type casting , Program on Constants	30

	5. Program on if and if...else statement , Program on if...elseif...else statement 6. Program on Switch...case statement 7. Program on loops 8. Write program on inheritance. 9. Program on Array 10. Program on Function	
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Course Outcomes: Students will be able to ...

- 1) use the PHP with HTML
- 2) implement type casting, constant in PHP
- 3) design the concept of If, Switch, For, While
- 4) develop functions and arrays.

Reference Books:-

1. PHP & MySQL: Novice to Ninja, Tom Butler, Kevin Yank, SitePoint 2021 (6th Edition)
2. PHP Objects, Patterns, and Practice Matt Zandstra ,Apress, 2021 (6th Edition)
3. Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5, Robin Nixon, O'Reilly Media, 2021 (6th Edition)
4. Modern PHP: New Features and Good Practices, Josh Lockhart, O'Reilly Media, 2015
5. PHP Cookbook: Solutions & Examples for PHP Programmers ,David Sklar, Adam Trachtenberg, O'Reilly Media, 2014 (3rd Edition)
6. Programming PHP, Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, O'Reilly Media, 2020 (4th Edition)
7. The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications, Alan Forbes, CreateSpace Independent Publishing, 2014
8. Head First PHP & MySQL, Lynn Beighley, Michael Morrison, O'Reilly Media, 2008

B.Sc. Part – III, Semester V
BCSEP 359 Lab Course on BCSET 354
(Total Credits 2)

Course Objectives: Students will be able to

- 1) introduce the principles of software engineering and the software development Life cycle (SDLC).
- 2) understanding of software processes, requirements engineering, and design methodologies.
- 3) provide foundational knowledge of coding, testing, and software maintenance.
- 4) know unified modeling language

Practical	Practical List	No. of hours
	1. Implementing Agile Methodology in a Large-Scale Enterprise: A Case Study of Transition Challenges and Successes. 2. Iterative Development in Action: Building a Scalable E-Commerce Platform.	

Practical Set	3.Requirements Engineering for Smart City Applications: A Case Study in Traffic Management Systems. 4. Handling Changing Requirements in Agile Projects: A Real-World Case Study. 5. Designing a Scalable and Reliable Software Architecture for Cloud-Based Applications. 6. Risk Management in Software Development: A Case Study from the Gaming Industry. 7. Applying Waterfall Model in Mission-Critical Systems: Lessons from an Aerospace Software Project. 8.Requirements Engineering for Smart City Applications: A Case Study in Traffic Management Systems. 9. Design UML diagrams for a Library Management System that allows users to register, search for books, borrow/return books, and manage book inventory. 10. Design UML diagrams for an ATM System that includes authentication, cash withdrawal, balance inquiry, mini-statement, and deposit functionalities.	30
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Course Outcomes: Students will be able to

- 1) apply Software Engineering Fundamentals.
- 2) implement Software Development Processes.
- 3) develop document, and analyze user requirements for software systems.
- 4) design the unified modeling language

Reference Books:-

1. Sommerville, Ian. 2015. Software Engineering. 10th ed. Harlow, UK: Pearson.
2. Pressman, Roger S., and Bruce R. Maxim. 2020. Software Engineering: A Practitioner's Approach. 9th ed. New York: McGraw-Hill Education.
3. Martin, Robert C. 2008. Clean Code: A Handbook of Agile Software Craftsmanship. Upper Saddle River, NJ: Prentice Hall.
4. Sommerville, Ian. 2019. Software Engineering. 10th ed. Harlow, UK: Pearson.
5. Pressman, Roger S., and Bruce R. Maxim. 2020. Software Engineering: A Practitioner's Approach. 9th ed. New York: McGraw-Hill Education.
6. Larman, Craig. 2004. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development. 3rd ed. Upper Saddle River, NJ: Prentice Hall.
7. Fowler, Martin. 2002. Patterns of Enterprise Application Architecture. Boston: Addison-Wesley.
8. Bass, Len, Paul Clements, and Rick Kazman. 2012. Software Architecture in Practice. 3rd ed. Boston: Addison-Wesley

B.Sc. Part – III, Semester V
BCSEP 359 Lab Course on BCSET 355
(Total Credits 2)

Course Objectives: Students will be able to

- 1) understand the fundamentals of shell scripting and its role in automating tasks in Linux environments.
- 2) study use variables, data types, and operators to store and manipulate data in scripts.
- 3) know the shell scripts and identify errors for effective troubleshooting.
- 4) navigate the command-line interface and execute basic shell commands

Practical	Practical List	No. of hours
	1. Print Hello World to the Terminal 2. Assign and Print Variable Value in Script 3. Perform Basic Arithmetic Operations Using Shell Script 4. Create a function in a shell script that accepts two numbers and returns the sum.	

Practical Set	5. Create a File and Check if It Exists 6. List All Files and Directories in a Specified Directory 7. Print Numbers from 1 to 10 Using a Loop 8. Use if Statement to Check File Existence 9. Write a script that shows the use of positional parameters (\$0, \$1, \$2) and prints the number of arguments (\$#). 10. Use awk, sed, and grep in a script: ○ grep for searching a keyword in a file ○ sed for replacing a word ○ awk for printing specific fields from a text file	30
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Course Outcomes: Students will be able to.....

- 1) debug and troubleshoot shell scripts to resolve errors and optimize performance.
- 2) automate system administration tasks like backups, monitoring, and file handling.
- 3) manage input/output redirection and manipulate files using shell commands.
- 4) execute shell scripts to automate tasks in Linux/Unix environments.

Reference Books:-

1. Shotts, William E. 2019. The Linux Command Line. 2nd ed. No Starch Press.
2. Newham, Cameron, and Bill Rosenblatt. 2005. Learning the Bash Shell. 3rd ed. O'Reilly.
3. Robbins, Arnold, and Nelson H. F. Beebe. 2005. Classic Shell Scripting. O'Reilly.
4. Taylor, Mark G. 2018. Shell Scripting: How to Automate Command Line Tasks. Independently published.
5. Bloom, Jason Cannon. 2016. Linux Command Line and Shell Scripting Bible. 3rd ed. Wiley.
6. Ball, Richard. 2020. Linux Shell Scripting Essentials. Packt.
7. Blum, Richard. 2021. Linux Command Line and Shell Scripting Techniques. Wiley.
8. Bartholomew, Steve. 2019. Mastering Linux Shell Scripting. Packt.

B.Sc. - Part – III, Semester V
BCSEP 359 Lab Course on BCSET 356
(Total Credits 2)

Course Objectives: Students will be able to.....

1. understanding of foundational data science concepts, processes, and applications across various domains.
2. study students' ability to apply statistical and analytical methods to extract insights from data.
3. equip students with practical skills in programming tools like Python or R for data manipulation and analysis.
4. introduce the fundamentals of machine learning for building and evaluating predictive models.

Practical	Practical list	No. of hours
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Practical Set	1)Titanic Survival Prediction 2)Stock Price Prediction 3)Customer Segmentation for Marketing 4)Credit Scoring (Fraud Detection) 5) Movie Recommendation System 6)Spam Email Classification 7) House Price Prediction 8) Social Media Sentiment Analysis 9)Employee Retention Analysis 10) Retail Sales Forecasting	30
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References:

- 1) Provost, Foster, and Tom Fawcett. 2013. Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking. Sebastopol, CA: O'Reilly Media.
- 2) Baumer, Benjamin S., Daniel T. Kaplan, and Nicholas J. Horton. 2017. Modern Data Science with R. Boca Raton, FL: CRC Press.
- 3) Cady, Field. 2017. The Data Science Handbook. Indianapolis, IN: Wiley.
- 4) Witten, Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal. 2016. Data Mining: Practical Machine Learning Tools and Techniques. 4th ed. Cambridge, MA: Morgan Kaufmann.
- 5) Zumel, Nina, and John Mount. 2014. Practical Data Science with R. Shelter Island, NY: Manning Publications.
- 6) Golemund, Garrett, and Hadley Wickham. 2017. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. Sebastopol, CA: O'Reilly Media.
- 7) Wickham, Hadley, and Mine Çetinkaya-Rundel. 2023. Data Science in Education Using R. Boca Raton, FL: CRC Press.
- 8) Kelleher, John D., and Brendan Tierney. 2018. Data Science. Cambridge, MA: MIT Press.

B.Sc. Part – III, Semester V **BCSEPVSC III - GIT Version Control** **(Total Credits 2)**

Course Objectives: Students will be able to

- 1) understand the fundamental concepts of version control and the role of Git in software development.
- 2) gain proficiency in resolving merge conflicts during team development.
- 3) acquire knowledge of tagging and release management using Git.
- 4) study problem-solving skills by working on real-world version control scenarios

Practical	Practical List	No. of hours
	1. Initialize a New Git Repository 2. Add and Commit Files 3. Check the Status of Your Repository 4. View Commit History	

Practical Set	5. Create a New Branch 6. Make Changes and Switch Branches 7. Merge Changes from One Branch to Another 8. Undo Local Changes 9. Delete Files from the Git Repository 10. Clone an Existing Repository 11. Connect a Local Repository to a Remote 12. Push Local Changes to a Remote Repository 13. Pull Remote Changes to Your Local Repository 14. Fetch Remote Changes Without Merging 15. Create and Tag a Release 16. Work with Git SubUnits 17. Resolve Merge Conflicts 18. Resetting Commits 19. Revert a Commit Using git revert 20. View Differences Between Commits	60
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Course Outcomes: Students will be able to

- 1) create and manage project releases using Git tags and versioning techniques.
- 2) collaborate efficiently on projects by using remote repositories.
- 3) manage and navigate branching workflows for feature development.
- 4) resolve merge conflicts independently and maintain code integrity.

Reference Books:-

1. Chacon, Scott, and Ben Straub. 2014. Pro Git. 2nd ed. Apress.
2. Loeliger, Jon, and Matthew McCullough. 2012. Version Control with Git. 2nd ed. O'Reilly Media.
3. Preston-Werner, Tom. 2011. GitHub Essentials. Packt Publishing.
4. O'Reilly Media. 2016. Git Pocket Guide. O'Reilly.
5. Ravishanker, Pradeep. 2020. Mastering Git. Packt.
6. Singh, Gaurav. 2019. Git Essentials. Independently published.
7. Silverman, Rick. 2015. Git for Teams. O'Reilly.
8. Knuth, Derek. 2017. Learning Git. Packet Publishing.

B.Sc. Part – III, Semester V
BCSEPVSC IV - Figma
(Total Credits 2)

Course Objectives: Student should be able to.....

- 1) understand the interface, tools, and functionalities of Figma.
- 2) learn to design wireframes, prototypes, and high-fidelity interfaces for web and mobile applications.
- 3) master the creation and management of reusable components and design systems
- 4) gain hands-on experience with advanced features like Auto Layout, prototyping, and interactive components.

Unit	Practical List	No. of hours
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Practical Set	1. Familiarize yourself with Figma's interface, menus, and tools. 2. Design a wireframe for a single webpage. 3. Experiment with Figma's text tools, applying different fonts, weights, and alignments. 4. Create and use a button component in multiple frames. 5. Design a form using Figma's Auto Layout feature. 6. Link two frames to create a simple click-through prototype. 7. Learn to mask images into shapes and apply effects. 8. Design a simple icon (e.g., a search or home icon). 9. Design a responsive layout for desktop and mobile. 10. Create a button component with different states (e.g., default, hover, disabled). 11. Add interactions like hover effects or slide animations to a prototype. 12. Build a complex UI element (e.g., a card) using nested components. 13. Work on a file with a teammate to explore real-time collaboration. 14. Design a layout using a custom grid system. 15. Create a style guide with typography, color, and components. 16. Design a home screen for a mobile app. 17. Develop a complete design system for a project. 18. Set up a project with shared libraries and assets for team collaboration. 19. Create a dynamic table using advanced Auto Layout features. 20. Create smooth transitions between screens using Smart Animate.	60
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Course Outcomes: Student will be able to ...

- 1) navigate and utilize Figma's tools and features efficiently.
- 2) create professional wireframes, mockups, and prototypes for diverse applications.
- 3) develop reusable components, styles, and scalable design systems.
- 4) implement responsive design principles for interfaces across different devices and screen sizes.

Reference Books:-

- 1) McDonald, Kelsey. Designing with Figma. Self-published, 2021.
- 2) Purdila, Adi. Figma Design Handbook. Smashing Magazine, 2020.
- 3) Sapio, Danny. The Ultimate Guide to Figma. Self-published, 2022.
- 4) Kholmatova, Alla. Design Systems: A Practical Guide to Creating Design Languages for Digital Products. New York: Smashing Magazine, 2017.
- 5) Frost, Brad. 2016. Atomic Design. Create Space Independent Publishing Platform.
- 6) Krug, Steve. 2014. Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability. 3rd ed. San Francisco: New Riders.

B.Sc. Part – III, Semester V
BCSEFPF I - Lab Course on Field Project
(Total Credits 2)

Course Objectives: Student should be able to...

- 1) know the theoretical knowledge to real-world situations.
- 2) understand problem-solving and analytical skills.
- 3) use communication and teamwork abilities.
- 4) gain hands-on experience in a professional setting.

Unit	BCSEFPF I : Field Project	No. of hours

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Course Outcomes: Student will be able to ...

- 1) demonstrate the ability to apply academic concepts to practical challenges.
- 2) develop effective project planning and execution skills.
- 3) produce a comprehensive field report or project deliverable.
- 4) communicate findings and recommendations clearly to stakeholders.

Reference Books:-

B.Sc. Part – III, Semester V
BCSEPCEP I - Lab Course on Community Engagement Program
(Total Credits 2)

Course Objectives: Student should be able to...

- 1) foster a sense of social responsibility and civic engagement.
- 2) understanding of community needs and issues.
- 3) use academic skills to contribute meaningfully to society.
- 4) study empathy, leadership, and cross-cultural communication skills.

Unit	BCSEPCEP I : Community Engagement Program	No. of hours
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Course Outcomes: Student will be able to ...

- 1) identify and analyze key social issues affecting communities.
- 2) apply problem-solving skills to address community challenges.
- 3) demonstrate effective communication and collaboration with diverse groups.
- 4) reflect on personal growth and civic responsibility through engagement.

Reference Books:-

B.Sc. Part – III, Semester VI
BCSET 361 Advanced Java
(Total Credits 2)

Course Objectives: Students will be able to.....

- 1) study the concepts of AWT (Abstract Window Toolkit).
- 2) understand Java Database Connectivity.
- 3) learn Servlet concepts.
- 4) acquire knowledge and Design Java Server Pages.

Units	Content	No. of hours
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1	Swing and JavaFX Swing, Concept, Component of swing: JFrame, JComponent, JLabel, JTextField, JCheckBox, JPanel, JRadioButton, JTabbedPane, JButton, JMenu, JTable, Introduction to JavaFX: JavaFX, JavaFX Core Components, Layout Containers: StackPane, BorderPane, GridPane, FlowPane, Common Controls: Label, Button, TextField, TextArea, ComboBox, Event Handling: setOnAction(),	9
2	Java Database Connectivity (JDBC) Introduction, Types of Drivers, JDBC program: Connection, PreparedStatement, Result Set, Executing commands and SQL queries, Discuss with Example.	7
3	Servlet Introduction of servlet: servlet working, Installation, Life cycle of servlet, Uses of servlet, Servlet API: packages- jakarta.servlet, jakarta.servlet.http, Session, servlet JDBC.	7
4	Java Server Page (JSP) Concept, Life cycle methods in JSP, JSP and Servlet difference, Components of JSP: Directives, Tags, Scripting Elements, Implicit objects of JSP, Connecting to database, Simple applications using JSP,	7

Course Outcomes: Students will be able to

- 1) improving skill about AWT.
- 2) design and implement JDBC.
- 3) develop servlet concepts.
- 4) implement JSP.

Reference Books:-

1. Hall, Marty. 2004. Core Servlets and JavaServer Pages. 2nd ed. Prentice Hall.
2. Sharma, Kogent Learning Solutions Inc. 2008. Java Server Programming, J2EE Edition. Dreamtech Press.
3. Mukhar, Budi Kurniawan. 2004. Servlets and JSP: A Tutorial. Apress.
4. White, Robert. 2020. Java Web Services. CreateSpace.
5. Sharan, Rajiv. 2011. JSP and Servlets: A Comprehensive Study. PHI Learning.
6. Kumar, Mahesh P. 2007. Web Technology. Tata McGraw-Hill.
7. Jothi, Somasundaram. 2021. Advanced Java Programming. SciTech Publications.
8. Ullman, Chris. 2017. Beginning JSP, JSF, and Tomcat. Apress.

B.Sc. Part – III, Semester VI

BCSET 362 C # Programming II

(Total Credits 2)

Course Objectives: Students will be able to

- 1) study the basic concepts of Exception handling
- 2) understand concepts of ASP.Net.
- 3) learn server controls and Database connectivity.
- 4) acquire ASP.Net state management.

Units	Content	No. of
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		hours
1	Exception Handling and Threading Try, catch, throw, finally, Nested try, Custom exception, Custom exception, Definition Threading, Applications with Multiple Threads, Thread Priorities, Synchronization.	8
2	Introduction to ASP.Net Web browser, web server, HTTP request response structure, HTML form elements, GET/POST method, Client side and Server side programming, Web form lifecycle, Page events, Visual Studio IDE.	7
3	Server Controls and Database connectivity Textbox, List controls, Link button, Image map, Image, Image button, File Upload, Calendar, Literal control, Radio button, Checkbox, Validation Controls, Navigation controls- Menu, TreeView, SiteMapPath, Master Page, Sitemap, Sitemap Datasource, Database: Connections, command, Data adapters, and datasets, namespaces, Connection to database using MS-Access, SQL Server.	8
4	Asp.Net State Management Cross page postback property of button, Response.Redirect, Server.transfer, Response.Write, Client Side: Hidden field control, View State, Cookies, Server Side: Session, Application, Global.asax.	7

Course Outcomes: Students will be able to

- 1) implement skill of basics exception handling
- 2) use ASP.Net concepts.
- 3) apply database connectivity using server controls.
- 4) design and implement state management

Reference Books

1. Balagurusamy, E. 2010. *Programming in C#: A Primer*. 4th ed. New Delhi: Tata McGraw-Hill Education.
2. Kogent Learning Solutions Inc. 2013. *ASP.NET 4.5 Covers C# and VB Codes: Black Book*. New Delhi: Dreamtech Press.
3. Koirala, Shivprasad. 2012. *ASP.NET Interview Questions*. 6th ed. Mumbai: BPB Publications.
4. Spaanjaars, Imar. 2013. *Beginning ASP.NET 4.5 in C# and VB*. New Delhi: Wiley India Pvt. Ltd.

5. Mehta, Vineet. 2011. *C# Programming and .NET Framework*. New Delhi: Pearson Education India.
6. Harwani, B.M. 2010. *ASP.NET 4.0 Black Book*. New Delhi: Dreamtech Press.
7. Puskar, Mahesh. 2020. *C# Projects: Practical Coding Exercises*. Independently published.

B.Sc. Part – III, Semester VI
BCSEP 367 Lab Course on BCSET 361
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study the concepts of AWT (Abstract Window Toolkit).
 - 2) understand Java Database Connectivity.
 - 3) learn Servlet concepts.
 - 4) identify and Design Java Server Pages.
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Practicals	Practical List	No. of hours
Practical Set	1. Create a Swing application with basic components: JLabel, JTextField, JButton. 2. Create a Swing Application to Display a Message 3. Design a Swing login form with username/password fields and a login button. Validate input. 4. Use JCheckBox and JRadioButton in a form to collect user preferences (e.g., subscription, gender). 5. Use JTextField, JRadioButton, JCheckBox, JButton. Add input validations (e.g., empty fields, email format). 6. Build a JTable to display student data (name, roll, marks) statically. 7. Create a Swing menu using JMenuBar, JMenu, and JMenuItem. 8. Design a JavaFX form using GridPane layout with TextField, PasswordField, and TextArea. 9. Create a JavaFX interface using BorderPane or FlowPane with multiple UI elements. 10. Develop a JavaFX UI using StackPane that switches between different views. 11. Write a JDBC program to connect to a MySQL database and display a message if connected. 12. Insert student data into a database using Prepared Statement. 13. Display records from a database using Result Set and print them on the console. 14. Create a simple servlet that prints "Hello from Servlet" in the browser. 15. Develop a servlet form that accepts name/email and displays it on the next page. 16. Create a login servlet with session management (login/logout) using HttpSession. 17. Connect servlet with JDBC to display data from a database on a webpage. 18. Create a JSP page that displays the current date/time and uses basic tags. 19. Design a form in JSP, accept input, and display the result using implicit objects. 20. Use JSP directives, scriptlets, and expressions to perform simple calculations.	60

Course Outcomes: Students will be able to ..

- 1) implement skill about AWT.
- 2) design and implement JDBC.

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- 3) develop servlet concepts.
 - 4) create JSP applications .

Reference Books:-

1. Ghosh, Gopalan. 2021. Java Web Applications. BPB Publications.
2. Budi, Kurniawan. 2013. Developing Java Web Services. Apress.
3. Deshmukh, Subrahmanyam Allamaraju. 2007. SCWCD Exam Study Kit. Manning.
4. Krutz, Ronald L. 2001. Advanced Java Programming. Wiley.
5. Sharan, Rajiv. 2008. Java Servlets and JSP. PHI.
6. Dietel, Paul. 2008. Java How to Program. 7th ed. Pearson.
7. Hall, Marty. 2001. More Servlets and JSP. Prentice Hall.
8. Li, Ying Bai. 2011. Practical Database Programming with Java. Wiley.

B.Sc. Part – III, Semester VI
BCSEP 368 Lab Course on BCSET 362
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study the concept of Server control
- 2) understand the concept SQL Database
- 3) learn the Data connectivity in C#
- 4) know the state management cookies and Session

Practical	Practical List	No. of hours
Practical Set	1. Write a program in C# to demonstrate try-catch block by dividing two numbers. 2. Create a program that uses throw to manually raise an exception if age is less than 18. 3. Write a program to use try-catch-finally and show that finally always executes. 4. Create a nested try-catch block program where an inner and outer exception can be caught separately. 5. Develop a custom exception class (e.g., Invalid Marks Exception) and demonstrate its usage. 6. Create a multithreaded program where two threads run simultaneously and print different messages. 7. Write a program to set different priorities to threads and observe the execution order. 8. Create a basic HTML form with input elements like textbox, radio buttons, and submit button. 9. Write a simple ASP.NET Web Form to accept user input and display it using GET and POST methods. 10. Design a web page and explain the request/response flow between client and server (in code comments). 11. Create a web form and show important page lifecycle events (Page_Load, Page_Init, Page_PreRender) with console outputs. 12. Create a simple web page that differentiates between client-side and server-side scripting (with examples). 13. Create a webpage with validation controls (Required Field Validator, Range Validator, Regular Expression Validator) for a registration form. 14. Implement navigation controls (Menu, TreeView, SiteMapPath) and link them using a Master Page. 15. Create a database connection to MS Access from ASP.NET and insert a record. 16. Connect a web form to SQL Server database using DataAdapter and DataSet, display data in a GridView. 17. Create a cross-page postback example where a button click transfers	60

	data to another page. 18. Write a program to demonstrate the use of ViewState, Cookies, Sessions, and Application state to store and retrieve user information. 19. Write Program on server-side state management. 20. Write Program to design master page for university website.	
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Course Outcomes: Students will be able to

- 1) implement the concept of Server control
- 2) use the concept of SQL Database
- 3) perform the Data connectivity in C#
- 4) develop the state management, cookies and Session

Reference Books:-

1. Puskar, Mahesh. 2020. C# Projects: Practical Coding Exercises. Independently published.
2. Nagel, Christian. 2018. Professional C# and .NET Core 2.0. Wrox.
3. Gaddis, Tony. 2019. Starting Out with Visual C#. Pearson.
4. Randolph, Dustin Metzgar. 2017. .NET Core in Action. Manning.
5. Arora, Amit. 2020. C# Coding Projects and Lab Manual. Notion Press.
6. Evjen, Bill. 2010. Beginning ASP.NET 4.0 in C#. Wrox.
7. Sharp, John. 2019. Microsoft Visual C# Step by Step. Microsoft Press.
8. Wenz, Christian. 2012. Programming ASP.NET MVC 4. O'Reilly.

B.Sc. (Entire) Part – III, Semester VI
BCSET 363 PHP Programming II
(Total Credits 2)

Course Objectives: Students will be able to

- 1) study the concepts of Object-oriented Programming in PHP.
- 2) understand Exception handling in PHP.
- 3) know the applications in PHP using MySQL.
- 4) learn Web development in PHP

Units	Content	No. of hours
1	Exception Handling Introduction to Errors and Exceptions, Exception Handling Constructs in PHP, try, catch, finally blocks, The throw statement, Built-in Exception Classes, Exception class, creating Custom Exception Classes, Extending the Exception class, Advanced Exception Handling, Multiple catch blocks, Nested try-catch	8
2	Web Development in PHP Static and dynamic web pages, Communication between HTML and PHP, HTML Special chars() function, Form validation, Handling Multi-Valued form fields, Uploading a file in PHP.	7
3	MYSQL Introduction to Databases, Installation, Connection with MySQL, Creating database, Creating tables, Inserting values in table, Displaying, changing, searching, deleting records from the table.	7
4	PHP Session & application Session Management and Cookies, Understanding sessions and cookies, Creating and destroying sessions, Storing session data, Managing user authentication and authorization, Website application, Login application, Registration application, etc.	8

Course Outcomes: Students will be able to.....

- 1) develop PHP program using oops concept.
- 2) implement PHP program using Exception Handling.
- 3) use skill of connecting database using PHP.
- 4) design and develop Project.

Reference Books:-

1. PHP & MySQL: Novice to Ninja, Tom Butler, Kevin Yank, SitePoint 2021 (6th Edition)
2. PHP Objects, Patterns, and Practice Matt Zandstra ,Apress, 2021 (6th Edition)
3. Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5, Robin Nixon, O'Reilly

Media, 2021 (6th Edition)

4. Modern PHP: New Features and Good Practices, Josh Lockhart,O'Reilly Media, 2015
5. PHP Cookbook: Solutions & Examples for PHP Programmers ,David Sklar, Adam Trachtenberg,O'Reilly Media, 2014 (3rd Edition)
6. Programming PHP, Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, O'Reilly Media, 2020 (4th Edition)

B.Sc. Part – III, Semester VI
BCSET 364 Software Testing
(Total Credits 2)

Course Objectives: Student should be able to...

- 1) discuss various software testing issues.
- 2) learn how to plan, and design test cases.
- 3) study software problems and defects.
- 4) learn a testing report

Units	Content	No. of hours
1	Introduction to Testing Introduction to Software testing, Testing Objectives, Testing principles and Testing fundamentals, Types of Testing, White Box Testing and Types of white box testing, Black Box Testing and Types of black box testing.	8
2	Software Testing Strategies Software Testing Process, Unit Testing, Integration Testing- Top-down, Bottom up, System Testing, Acceptance Testing (alpha, Beta testing), Big Bang Approach, Performance Testing, Regression Testing, Load Testing.	7
3	Software Testing Life Cycle Overview of the stages of STLC, Test strategy, Test planning and Test design, Test execution, Test reporting and Test Case Design, Entry criteria, Exit Criteria, Test Cases for Entry and Exit Criteria.	7
4	Defect Life Cycle Bug/Defect Life Cycle, Difference between Bug and Defect, Failure, Error, Defect Tracking and Reporting, Types of Bugs, Identifying the Bugs, Reporting the Bugs, Introduction to automated testing- Install and configure selenium testing tool.	8

Course Outcomes: Student will be able to ...

- 1) apply software testing knowledge and engineering methods.
- 2) implement Plan test cases.
- 3) design test cases.
- 4) develop defect report

Reference Books:

1. Ammann, Paul, and Jeff Offutt. 2016. *Introduction to Software Testing*. 2nd ed. Cambridge: Cambridge University Press.

2. Beizer, Boris. 1995. *Black-Box Testing: Techniques for Functional Testing of Software and Systems*. New York: John Wiley & Sons.
3. Myers, Glenford J., Corey Sandler, and Tom Badgett. 2011. *The Art of Software Testing*. 3rd ed. Hoboken, NJ: John Wiley & Sons.
4. Kaner, Cem, Jack Falk, and Hung Quoc Nguyen. 1999. *Testing Computer Software*. 2nd ed. New York: John Wiley & Sons.
5. Burnstein, Ilene. 2003. *Practical Software Testing: A Process-Oriented Approach*. New York: Springer.
6. Jorgensen, Paul C. 2013. *Software Testing: A Craftsman's Approach*. 4th ed. Boca Raton, FL: CRC Press.
7. Fewster, Mark, and Dorothy Graham. 1999. *Software Test Automation: Effective Use of Test Execution Tools*. Boston: Addison-Wesley.

Course Objectives: Students will be able to

1. understand and apply the concepts of formal languages and automata theory.
2. analyze the computational power of different models of computation.
3. study various grammar types and their applications.
4. learn the fundamentals of computability and complexity theory.

Units	Content	No. of hours
1	Finite Automaton Introduction: Symbol, Alphabet, String, Prefix & Suffix of Strings, Formal Language, Operations on Languages, Deterministic finite Automaton – Definition, DFA as language recognizer, DFA as pattern recognizer, Nondeterministic finite automaton – Definition and Examples, NFA To DFA (Myhill Nerode Method), NFA with ϵ -transitions Definition and Examples, NFA with ϵ -Transitions to DFA & Examples, Finite automaton with output – Mealy and Moore machine, Definition and Examples, Minimization of DFA, Algorithm & Problem using Table Method	9
2	Regular Expressions and Languages Regular Expressions (RE): Definition & Example, Regular Expressions Identities, Regular language-Definition and Examples, Conversion of RE to FA-Examples, Pumping lemma for regular languages and applications, Closure Properties of regular Languages.	8
3	Context-Free Grammars and Languages Grammar - Definition and Examples, Derivation-Reduction - Definition and Examples, Chomsky Hierarchy, CFG: Definition & Examples, LMD, RMD, Parse Tree, Ambiguous Grammar: Concept & Examples, Simplification of CFG: Removing Useless Symbols, Unit Production, ϵ -production and Nullable Symbol, Normal Forms: Greibach Normal Form (GNF) and Chomsky Normal Form (CNF), Regular Grammar: Definition, Left linear and Right Linear Grammar-Definition and Example, Equivalence of FA & Regular Grammar.	7
4	Push Down Automata Definition of PDA and examples, Construction of PDA using empty stack and final State, Method: Examples using stack method, Definition DPDA & NPDA, their correlation and Examples of NPDA, CFG (in GNF) to PDA: Method and examples	6

Course Outcomes: Students will be able to.....

1. apply the fundamental concepts of automata theory and formal languages.
2. design and analyze finite automata, regular expressions, and grammars.
3. develop context-free grammars and.
4. execute pushdown automata for various languages.

Reference Books:-

- 1) Sipser, Michael. 2012. *Introduction to the Theory of Computation*. 3rd ed. Boston, MA: Cengage Learning.
- 2) Hopcroft, John E., Rajeev Motwani, and Jeffrey D. Ullman. 2006. *Introduction to Automata Theory, Languages, and Computation*. 3rd ed. Boston, MA: Addison-Wesley.
- 3) Lewis, Harry R., and Christos H. Papadimitriou. 1997. *Elements of the Theory of Computation*. 2nd ed. Upper Saddle River, NJ: Prentice Hall.
- 4) Arora, Sanjeev, and Boaz Barak. 2009. *Computational Complexity: A Modern Approach*. Cambridge: Cambridge University Press.
- 5) Martin, John C. 2010. *Introduction to Languages and the Theory of Computation*. 4th ed. New York: McGraw-Hill.
- 6) Linz, Peter. 2016. *An Introduction to Formal Languages and Automata*. 6th ed. Burlington, MA: Jones & Bartlett Learning.
- 7) Sudkamp, Thomas A. 2006. *Languages and Machines: An Introduction to the Theory of Computer Science*. 3rd ed. Boston, MA: Pearson Education.
- 8) Mishra, K. L. P., and N. Chandrasekaran. 2006. *Theory of Computer Science: Automata, Languages and Computation*. 3rd ed. New Delhi: PHI Learning.

B.Sc. Part – III, Semester VI
BCSET 366 Internet of Things (IoT)
(Total Credits 2)

Course Objectives: Students will be able to

1. understand the basic concepts and architecture of IoT systems including devices, protocols, and communication models.
2. familiarize with various IoT enabling technologies such as sensors, actuators, embedded systems, and wireless communication.
3. learn IoT network protocols at various layers and understand their role in real-time IoT applications.
4. study the ability to design and implement basic IoT applications using popular platforms like Arduino, Raspberry Pi, or NodeMCU.

Units	Content	No. of hours
1	Introduction of IoT Overview of IoT: Definition of IoT and its components, Evolution of IoT and its significance in modern technology, Applications of IoT in various industries (e.g., healthcare, agriculture), Key Characteristics of IoT: Connectivity, Automation, real-time data processing, Scalability, Device-to-device, Device-to-cloud communication	9
2	IoT Architecture Three-Layer IoT Architecture, Perception Layer: Sensors, actuators, devices, Roles in data collection, Network Layer: Communication technologies, Protocols (Wi-Fi, Bluetooth, Zigbee, LoRa, etc.), Application Layer: Cloud platforms, data storage, and data processing, Edge Computing in IoT: Concept of edge computing.	8
3	Sensors and Actuators Sensors: Types of sensors (temperature, humidity, motion, light, gas, etc.), Actuators: Definition and types of actuators (motors, relays, servos, etc.), Difference between Sensor and Actuator.	7
4	IoT Communication Protocols Wireless Communication Protocols: Wi-Fi, Bluetooth, Zigbee, LoRa, and NB-IoT, Device-to-Device (D2D), Device-to-Cloud (D2C), and Device-to-Gateway (D2G), Protocols such as MQTT, CoAP, and HTTP for IoT applications.	6

Course Outcomes: Students will be able to

1. describe the architecture, components, and characteristics of IoT systems.
2. demonstrate the use of various sensors, actuators, and microcontrollers in building IoT applications.
3. Apply appropriate network communication protocols for different IoT scenarios.
4. design and develop basic IoT-based applications using platforms like Arduino or Raspberry Pi.
5. analyze the role of cloud computing, data analytics, and visualization in IoT systems.

Reference Books:-

- 1) Arshdeep Bahga, Vijay Madisetti – Internet of Things: A Hands-On Approach, Universities Press.
- 2) Rajkamal – Internet of Things: Architecture and Design Principles, McGraw Hill

Education.

- 3) Adrian McEwen, Hakim Cassimally – Designing the Internet of Things, Wiley
- 4) Ray, Partha Pratim. 2018. *Internet of Things for Healthcare Technologies*. Cham, Switzerland: Springer.
- 5) Raj, Pethuru, and Anupama C. Raman. 2017. *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*. Boca Raton, FL: CRC Press.
- 6) Shinde, Shrirang Ambaji. 2019. *Internet of Things*. Pune, India: TechKnowledge Publications.
- 7) ripathi, Rishi Kumar, and Jitendra Kumar. 2020. *Internet of Things (IoT) and Smart Systems*. New Delhi: BPB Publications.
- 8) Gawali, Dharmendra. 2021. *Internet of Things: Concepts and Applications*. Pune, India: Nirali Prakashan.

B.Sc. Part – III, Semester VI
BCSEP 369 Lab Course based on BCSET 363
(Total Credits 2)

Course Objectives: Students will be able to

1. study the concept of exception handling.
2. understand the concept of session in PHP
3. learn the Connection with MySQL in PHP
4. know the Data connectivity and Database operations in PHP

Practical	Practical List	No. of hours
Practical set	1. Write a function in PHP that throws an exception if a number is less than zero. 2. Write a script that uses try and catch to handle division by zero. 3. Write a PHP script to start a session and store a username in a session variable 4. Write a PHP script to check if a session variable is set and print a message like "User is logged in" or "User is not logged in". 5. Program to create static and dynamic web page using PHP. 6. Write a PHP script to destroy the session and log the user out. 7. Program on Data Connectivity. 8. Program based on Database Operations using MySQL. 9. Write a script to demonstrate the use of sessions. 10. Perform CRUD operations on a "Users" table.	30

Course Outcomes: Students will be able to

1. implement the concept of exception handling.
2. use the concept of session in PHP
3. perform Connection with MySQL in PHP
4. apply the Data connectivity and Database operations in PHP

Reference Books:-

1. PHP & MySQL: Novice to Ninja, Tom Butler, Kevin Yank, SitePoint 2021 (6th Edition)
2. PHP Objects, Patterns, and Practice Matt Zandstra, Apress, 2021 (6th Edition)
3. Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5, Robin Nixon, O'Reilly Media, 2021 (6th Edition)
4. Modern PHP: New Features and Good Practices, Josh Lockhart, O'Reilly Media, 2015
5. PHP Cookbook: Solutions & Examples for PHP Programmers, David Sklar, Adam Trachtenberg, O'Reilly Media, 2014 (3rd Edition)
6. Programming PHP, Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, O'Reilly Media, 2020 (4th Edition)

B.Sc. Part – III, Semester VI
BCSEP 369 Lab Course based on BCSET 364
(Total Credits 2)

Course Objectives: Student should be able to...

1. study various software testing issues.
2. learn how to plan, and design test cases.
3. manage software problems and defects.
4. understand a testing report

Practical	Practical List	No. of hours
Practical Set	1. Login Page Testing: Test the functionality and validation of a basic login page with various input combinations. 2. Calculator Functionality: Test basic calculator operations and error handling using white-box testing techniques. 3. Shopping Cart Validation: Verify the addition, removal, and total price calculation in a simple shopping cart. 4. Simple Performance Test: Measure a website's response time under simulated multi-user access. 5. Registration Form Testing: Test field validations and mandatory inputs in a user registration form. 6. Bug Reporting for a Simple App: Identify and document bugs in a note-taking app's basic operations. 7. Automated Login Test: Automate testing of login functionality using Selenium for valid and invalid scenarios. 8. Top-Down Integration Test: Test the integration of "Search Books" and "Issue Books" Units using a top-down approach. 9. Logout Functionality Testing: Verify successful logout and session invalidation on a basic web application. 10. Basic Test Life Cycle Case: Follow the STLC stages to test a "Forgot Password" feature, from planning to reporting.	30

Course Outcomes: Student will be able to

- 1) apply software testing knowledge and engineering methods.
- 2) design Plan test cases.
- 3) develop test cases.
- 4) implement defect report.

Reference Books:-

1. Ammann, Paul, and Jeff Offutt. 2016. *Introduction to Software Testing*. 2nd ed. Cambridge: Cambridge University Press.
2. Beizer, Boris. 1995. *Black-Box Testing: Techniques for Functional Testing of*

Software and Systems. New York: John Wiley & Sons.

3. Myers, Glenford J., Corey Sandler, and Tom Badgett. 2011. *The Art of Software Testing*. 3rd ed. Hoboken, NJ: John Wiley & Sons.
4. Kaner, Cem, Jack Falk, and Hung Quoc Nguyen. 1999. *Testing Computer Software*. 2nd ed. New York: John Wiley & Sons.
5. Burnstein, Ilene. 2003. *Practical Software Testing: A Process-Oriented Approach*. New York: Springer.

B.Sc. Part – III, Semester VI
BCSEP 369 Lab Course based on BCSET 365
(Total Credits 2)

Course Objectives: Students will be able to.....

- 1) introduce fundamental concepts of formal languages, grammars, and automata theory.
- 2) equip students with the ability to design and analyze finite automata and context-free grammars.
- 3) study skills to convert between different representations of languages and automata.
- 4) introduce fundamental concepts of formal languages, automata, and computational theory.

Practical	Practical List	No. of hours
Practical Set	1) Design a Deterministic Finite Automaton (DFA) that accepts strings over the alphabet $\{0, 1\}$ where the number of 1s is even. 2) Construct a Non-deterministic Finite Automaton (NFA) that accepts strings over the alphabet $\{a, b\}$ that contain at least one 'a'. 3) Convert the NFA from the previous question into an equivalent DFA using the subset construction method. 4) Design a Mealy machine that outputs '1' when the input string contains an even number of 'a's and '0' otherwise. 5) Write a regular expression for the language consisting of strings over $\{a, b\}$ that end with 'ab'. 6) Convert the regular expression from the previous question into an NFA. 7) Use the pumping lemma to prove that the language $\{a^n b^n \mid n \geq 0\}$ is not regular. 8) Convert the CFG from the previous question into an equivalent Pushdown Automaton (PDA). 9) Design a PDA that accepts the language $\{w \mid w \text{ contains balanced parentheses}\}$. 10) Deterministic Finite Automaton (DFA) can recognize all regular languages.	60

Course Outcomes: Students will be able to

- 1) construct and evaluate deterministic and non-deterministic finite automata.
- 2) design context-free grammars and convert them to pushdown automata.
- 3) apply pumping lemmas to prove properties of regular and context-free languages.
- 4) implement the fundamental concepts of formal languages, including alphabets, strings, grammars, and language classifications.

Reference Books:-

- 1) Hopcroft, J. E., Motwani, R., & Ullman, J. D. – Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education.
- 2) Michael Sipser – Introduction to the Theory of Computation, 3rd Edition, Cengage Learning.

- 3) John C. Martin – Introduction to Languages and the Theory of Computation, McGraw-Hill.
- 4) Thakur, Dhananjay, and Rameshwar Goudar. 2021. *Internet of Things: Architecture and Applications*. New Delhi: Cengage India.
- 5) Patel, Nilanjan Dey, Amira Ashour, and Suresh Chandra Satapathy, eds. 2018. *Internet of Things and Big Data Analytics for Smart Generation*. New Delhi: Springer India.
- 6) Tripathi, Rishi Kumar, and Jitendra Kumar. 2020. *Internet of Things (IoT) and Smart Systems*. New Delhi: BPB Publications.
- 7) Sharma, Priyanka, and Manju Khari. 2020. *Internet of Things and Secure Smart Environments: Successes and Pitfalls*. New Delhi: IGI Global.
- 8) Raj, Pethuru, and Anupama C. Raman. 2017. *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*. Boca Raton, FL: CRC Press.

B.Sc. Part – III, Semester VI
BCSEP 369 Lab Course based on BCSET 366
(Total Credits 2)

Course Objectives: Students will be able to.....

1. understand the fundamental principles of IoT, including its architecture, protocols, and components.
2. learn how IoT is transforming industries such as healthcare, agriculture, urban development, retail, logistics, and manufacturing.
3. analyze and evaluate real-world IoT implementations through case studies, identifying the challenges, solutions, and outcomes.
4. introduce the fundamental concepts, architecture, and building blocks of the Internet of Things (IoT).

Practical	Practical List	No. of hours
Practical Set	1. Smart Home Automation (Nest) 2. Smart Traffic Management (Barcelona) 3. Connected Healthcare (Philips HealthSuite) 4. Smart Inventory Management (Walmart) 5. Smart Water Management (Singapore's NEWater) 6. Smart Manufacturing (Siemens) 7. Predictive Maintenance (General Electric) 8. Smart Manufacturing (Toyota) 9. Connected Home Security (Ring) 10. IoT in Healthcare (Medtronic)	30

Course Outcomes: Students will be able to

1. use a strong theoretical foundation in IoT and be able to explain how IoT works in various contexts.
2. develop critical thinking skills, enabling them to analyze IoT applications and evaluate their success and failure factors.
3. implement how to leverage cloud platforms and big data analytics to enhance IoT systems.

References:-

- 1) Arshdeep Bahga, Vijay Madisetti – Internet of Things: A Hands-On Approach, Universities Press.
- 2) Rajkamal – Internet of Things: Architecture and Design Principles, McGraw Hill Education.
- 3) Adrian McEwen, Hakim Cassimally – Designing the Internet of Things, Wiley
- 4) Bahga, Arshdeep, and Vijay Madisetti. 2015. *Internet of Things: A Hands-On Approach*. Atlanta
- 5) Buyya, Rajkumar, Amir Vahid Dastjerdi, and Pethuru Raj. 2016. *Internet of Things: Principles and Paradigms*. Burlington, MA: Morgan Kaufmann.
- 6) McEwen, Adrian, and Hakim Cassimally. 2013. *Designing the Internet of Things*. Chichester, UK: Wiley.
- 7) Minerva, Roberto, Abhinav Varshney, and Domenico Rotondi. 2015. *Towards a Definition of the Internet of Things (IoT)*. Geneva, Switzerland: ITU.
- 8) Greengard, Samuel. 2015. *The Internet of Things*. Cambridge, MA: MIT Press.

B.Sc. Part – III, Semester VI
BCSEPVSC V- Lab Course based on MongoDB
(Total Credits 2)

Course Objectives: Students will be able to

1. learn to create, read, update, and delete data in MongoDB using shell commands and MongoDB drivers.
2. study the creation of efficient schema designs for relational and non-relational data.
3. understand powerful query operators, filtering, sorting, and projection techniques to retrieve and manipulate data.
4. know indexes to optimize query performance and improve system efficiency.

Practical	Practical List	No. of hours
Practical Set	1. Install MongoDB locally or use MongoDB Atlas for cloud-based databases. 2. Start the MongoDB shell and explore basic commands (show dbs, use <dbname>, etc.). 3. Install and set up MongoDB Compass for graphical database management. 4. Create a database and collections using MongoDB shell (use, createCollection). 5. Create collections and insert documents into them. 6. Use insertOne() and insertMany() to add data to MongoDB. 7. Use find() and findOne() to retrieve documents. 8. Modify documents using updateOne() and updateMany(). 9. Use deleteOne() and deleteMany() to remove documents. 10. Apply filters with operators like \$gt, \$lt, \$eq, and \$in. 11. Use projections to include/exclude fields in query results. 12. Implement sort(), limit(), and skip() in queries for pagination. 13. Use regular expressions for string pattern matching in queries. 14. Query embedded documents and arrays using dot notation. 15. Combine \$and, \$or, \$not operators in queries 16. Implement single-field and compound indexes to optimize query performance. 17. Analyze and optimize queries using the explain() method to understand query performance. 18. Learn about multikey, geospatial, and text indexes, and when to use them. 19. Create indexes for array fields to improve array query performance. 20. Set up user authentication, roles, and access control with MongoDB's role-based access control (RBAC).	60

Course Outcomes: Students will be able to

1. use efficiently MongoDB shell, Compass, and MongoDB Atlas for database management and querying.
2. develop efficient and scalable data models for applications, using embedded documents or

references as needed.

3. execute create, read, update, and delete operations on MongoDB databases, and understand when to use each type of operation.
4. write complex queries using MongoDB's query operators, aggregation framework, and indexes to retrieve and manipulate data.

Reference Books:-

1. Chodorow, Kristina. MongoDB: The Definitive Guide. 4th ed., O'Reilly Media, 2021.
2. Harrison, Peter. MongoDB Applied Design Patterns. O'Reilly Media, 2019.
3. Banks, Shannon. Mastering MongoDB 4.x: A Practical Guide to Database Design, Data Modeling, and Query Optimization. Packt Publishing, 2020.
4. Sathia Raj, S. MongoDB for Developers: A Guide to Build Scalable and Efficient Applications. Apress, 2021
5. Delisle, David Hows and Dan. 2016. *MongoDB Basics*. New York: Apress.
6. Meijer, Marcel. 2020. *Practical MongoDB Aggregations*. Amsterdam: Independent Publishing.
7. Mehta, Amol Nayak. 2014. *Learning MongoDB*. Birmingham, UK: Packt Publishing.
8. Brown, Steve. 2019. *Practical MongoDB: Architecting, Developing, and Administering MongoDB*. New York: Apress.

B.Sc. Part – III, Semester VI
BCSEPFP II- Lab Course based on Field Project
(Total Credits 2)

Course Objectives: Student should be able to.....

- 1) study theoretical knowledge to real-world situations.
- 2) learn problem-solving and analytical skills.
- 3) use communication and teamwork abilities.
- 4) gain hands-on experience in a professional setting.

Work	BCSEFP II: Field Project	No. of hours

Course Outcomes: Student will be able to ...

- 1) demonstrate the ability to apply academic concepts to practical challenges.
- 2) develop effective project planning and execution skills.
- 3) produce a comprehensive field report or project deliverable.
- 4) implement communicate findings and recommendations clearly to stakeholders.

Reference Books:-

B.Sc. Part – III, Semester VI
BCSEPOJT I- Lab Course based on Job Training
(Total Credits 2)

Course Objectives: Student should be able to...

- 1) provide practical exposure to real workplace environments.
- 2) bridge the gap between academic learning and industry practices.
- 3) study professional skills and work ethics.
- 4) enhance technical, managerial, or functional competencies.

Work	BCSEPOJT 1 - On Job Training	No. of hours

Course Outcomes: Student will be able to ...

- 1) apply academic knowledge effectively in a real work setting.
- 2) demonstrate job-specific technical and soft skills.
- 3) adapt to professional work culture and practices.
- 4) implement Communicate and collaborate efficiently in a team environment.

Reference Books:-