PUNJABI UNIVERSITY PATIALA

OUTLINES OF TESTS
SYLLABI AND COURSES OF READING
For
B.Sc. (Computer Science, Statistics, Mathematics) Part -I
2023-24, 2024-25, 2025-26
Program Code – STAB3PUP

DEPARTMENT OF STATISTICS
PUNJABI UNIVERSITY, PATIALA

B.Sc. (Computer Science, Statistics, Mathematics) Part -I
Outlines of Text, Syllabi and Courses of Reading
For Examination of Session **2023-24, 2024-25, 2025-26**

Semester-I

Paper Code	Core / Elective	Title of paper /subject	Internal Asmt.	Prac Prac	Univ. Exam.	Total Credits
STAB1101T	Core	Mathematical Analysis-I [MATHEMATICS]	30	—	70	4
STAB1102[T+P]	Core	Statistical Methods [STATISTICS]	24	20	56	4
STAB1103[T+P]	Core	Productivity Tools [COMPUTER SCIENCE]	24	20	56	4

Semester-II

Paper Code	Core / Elective	Title of paper /subject	Internal Asmt.	Prac Prac	Univ. Exam.	Total Credits
STAB1201T	Core	Mathematical Analysis-II [MATHEMATICS]	30	—	70	4
STAB1202[T+P]	Core	Probability Theory [STATISTICS]	24	20	56	4
STAB1203[T+P]	Core	Object Oriented Programming Using C++ [COMPUTER SCIENCE]	24	20	56	4

- In addition to the above written core courses, the students will have to opt Punjabi(compulsory) and English(compulsory) courses as per the university guidelines and regulations.

- Viva-voce of practical part will be conducted by the internal examiner and the external examiner (appointed by the Head of department/college from teachers not involved with the teaching of that paper).

STAB1101T: Mathematical Analysis-I
Subject: Mathematics
4 credits - 48 contact hours (L3 T1 P0 C1)
Time Allowed: 3 Hours
Type: Core

Total Marks: 100
Uni. Exam: 70
Internal Assessment: 30
Min. Pass Marks: 35%

Course Objectives

The course is designed for undergraduate students to provide a concrete foundation of calculus by introducing first the basic set theory and then moving to the concept of Countability of sets. For the working knowledge to deal with the mathematical concepts of subsequent semesters the concepts of limit, continuity and differentiation in one variable with its various applications is also introduced. The behavior of sequence and series of real numbers is proposed in detail which helps in monitoring the output of functions.

Course Outcomes

1. The course provides Foundation for mathematical rigor needed for subsequent semesters.

2. Introduction and concrete foundation of various concepts related to sets

3. Knowledge of Principle of Countability.

4. Encounter with the set of real numbers as an uncountable set.

5. Idea about Bounded and unbounded sets, least upper and greatest lower bounds of a set.

6. Gain knowledge of Sequences and various concepts related to it like convergence, limit points, bounded and monotonic sequences, Cauchy sequence and completeness of R.

7. Applicability of various tests of convergence of Sequence and series.

8. Introduction and concrete foundation of various concepts like limit, continuity, differentiation of functions of one variable.

9. Various applications of differentiation to finding maxima and minima and Taylor series expansion.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having 11 short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 12 marks and each short answer type question in Section C will be of 2 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C

Section-A

The language of sets and functions, countable and uncountable sets. Real numbers, least upper bounds and greatest lower bounds.

Sequences: limit points of a sequence, convergent sequences, bounded and monotone sequences, the limit superior and limit inferior of a sequence. Cauchy sequences and the completeness of R.

Infinite Series of non-negative terms: convergence and divergence of series, absolute and conditional convergence. Various tests for convergence of series. Connection between infinite series and decimal expansions of real numbers.

Section-B

Alternating series: Leibnitz's theorem, absolute and conditional convergence. Series of arbitrary terms, convergence, divergence and oscillation. Abel's and Dirichlet's tests.

Calculus of a single variable: Continuity, attainment of supremum and infimum of a continuous function on a closed bounded interval, uniform continuity. Differentiability of functions. Rolle's theorem and mean value theorems. Higher derivatives, maxima and minima Taylor's theorem - various forms of remainder, infinite Taylor expansions.

TEXT BOOKS

- Tom M Apostol. *Mathematical analysis*. Nasora Publishing House, New-Delhi, 1985.

- Richard R Goldberg. *Methods of real analysis*, 2nd ed. Wiley, 1976.

- Terence Tao. *Analysis I*. Vol. 185. Hindustan Book Agency, 2009.

RECOMMENDED READINGS

- Robert G Bartle and Donald R Sherbert. *Introduction to real analysis*, 4th ed. John Wiley & Sons, Inc. 2009.

- Subhash Chandra Malik and Savita Arora. *Mathematical analysis*. New Age International, 2009.

- Halsey Lawrence Royden and Patrick Fitzpatrick. *Real analysis*. Vol. 2. Macmillan New York, 1968.

- George B Thomas and Ross L Finney. *Calculus*. 9th Ed. Pearson Education, 1996.

- William Wade. *Introduction to Analysis*. Pearson Higher Ed, 2021.

STAB1102[T+P]: Statistical Methods
Subject Statistics
4 credits
(36-24) contact hours (L3 T+P2 C1)
Time Allowed: 3 Hours
Min. Pass Marks: 35%(Theory Part) & 35%(Practical Part)

Total Marks: 100
Uni. Exam: 56
Internal Assessment: 24
Practica Marks:20
Type: Core

Course Objectives

The objective of this course is to make the students conversant with various techniques used in summarization and analysis of univariate, bivariate and multivariate data. Handling of variable and attribute data to study their characteristics and association, regression analysis and hypothesis testing will be aimed at. The topics are quite helpful to students for many statistical analyses.

Course Outcomes

After completing this course students will be able to

1. Know about basics of the subject of statistics and concepts of central tendency, dispersion, skewness and kurtosis.

2. Calculate central, non-central and factorial moments. Also know about various statistical measures for measuring characteristics of given data based upon quantiles and moments.

3. Understand what bivariate data is and concepts of correlation and regression. They will also be able to calculate coefficients of correlation and determination. Also will be able to fit linear regression equations to the given data and learn about the various properties of linear regression coefficients.

4. Understand where the concept of multivariate data is used and be able to find partial correlation, multiple correlation, correlation ratio and intra-class correlation and fit multi linear regression to this data.

5. Solve practical problems with the help of computer programming and or software packages R, MATLAB, STATISTICA, EXCEL, CALC etc.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having 8 short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 8 marks and each short answer type question in Section C will be of 3 marks.
At least 70% of the exam questions should be theoretical in nature.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

Section-A

Types of data: Quantitative and Qualitative, Discrete and Continuous. Collection of Primary Data through designing Questionnaire and Schedule. Secondary Data; Major Sources including some Government Publications. Concept of Population and Sample, Scales of Measurements. Construction of tables with one or more factors of classification. Frequency distributions; Cumulative frequency distributions. Diagrammatic and graphical representation of grouped data; Histogram, Frequency Polygon and Ogives, Stem and leaf chart, Box plot.

Analysis of Quantitative Data: Concept of Central Tendency, its measures. Concept of Dispersion; Absolute and Relative measures of Dispersion. Statistical Moments: Raw, Central and factorial. Inter-relations of moments, Sheppard's Correction for Moments (without derivation). Concepts of Skewness and Kurtosis and their Measures including those based on Quartiles and Moments.

Section-B

Bivariate Data: Scatter Diagram, Product Moment Correlation Coefficient and its properties. Coefficient of Determination, Spearman's Rank Correlation Coefficient. Concept of Errors in Regression. Principle of Least Square. Fitting of Linear Regression and related results.

Multivariate Data: Concepts of Multiple Regression. Multiple and Partial Correlation Coefficients trivariate case only(without derivation) and their Applications.

Analysis of Categorical Data: Basic concepts. Contingency of Data, Independence and Association of Attributes. Various Measures of Association for Two Way Classified Data.

TEXT BOOKS

- A. M. Gun, M.K. Gupta and B. Dasgupta, *Fundamentals of Statistics*, Vol. I, Third Edition. World Press, Calcutta, 2016.
- S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*. S. Chand and Sons, 2020.

RECOMMENDED READINGS

- John E Freund, Irwin Miller and Marylees Miller, *John E. Freund's Mathematical Statistics With Applications*. Pearson Education India, 2004.

Practical Evaluation Process

BREAK-UP OF MARKS

S.No.	BREAK-UP COMPONENT	Weightage
1.	Number of experiments performed Written report Record of the experiments	50%
2.	Viva Voce	50%

STAB1103[T+P]: Productivity Tools

Subject: Computer Science
4 credits
(36 24) contact hours (7.3 T 0 .T2 C 3)
Time Allowed: 3 Hours
Min. Pass Marks: 35%(Theory Part) & 35%(Practical Part)

Total Marks: 100
Uni. Exam: 56
Internal Assessment: 24
Practical Marks:20
Type: Core

Course Objectives

The course aims to introduce students to essential office tools, namely Word, Excel, PowerPoint, and Outlook. Students will become familiar with their functionalities, user interfaces, and practical applications. By the end of this s, students should be able to create, format, and edit documents in Word, perform basic spreadsheet tasks and data analysis in Excel, design visually engaging presentations in PowerPoint, and effectively manage emails and calendars using Outlook.

Course Outcomes

After completing this course students will be able to

1. Demonstrate proficiency in using Word, Excel, PowerPoint, and Outlook. They will be able to confidently create and format documents, spreadsheets, and presentations as well as manage emails and calendars efficiently

2. Acquire essential data analysis skills using Excel, including data organization, sorting, filtering, and pivot tables. They will be able to generate meaningful insights and visually represent data using various chart types.

3. Develop effective communication and presentation skills using PowerPoint. They will be able to design visually engaging slides, incorporate multimedia elements, and deliver impactful presentations.

4. Through hands-on practice with Outlook, students will learn effective time management and organization. They will be able to manage emails, schedule appointments, and track tasks to optimize productivity.

5. Learn to automate repetitive tasks using macros and custom functions in Excel. This skill will enable them to streamline workflows and enhance overall productivity in various academic and professional contexts

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having 8 short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 8 marks and each short answer type question in Section C will be of 3 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

Section-A

Overview of Office and its applications, Introduction to Word and PowerPoint. Understanding the user interface and features.

Word Essentials: Creating, saving, and opening documents; Formatting text, paragraphs, and pages; Working with headers, footers, and page numbers; Inserting images, tables, and hyperlinks.

Word Advanced Techniques: Managing styles and templates. Working with references and citations. Collaborating with track changes and comments. Utilizing mail merge for bulk document production.

Microsoft PowerPoint Basics: Creating and saving presentations. Slide layout and design tips. Adding text, images, and multimedia elements. Utilizing slide transitions and animations.

PowerPoint Advanced Techniques: Working with master slides and themes. Incorporating charts and graphs. Presenting with confidence: tips for effective delivery. Exporting and sharing presentations.

Section-B

Introduction to Excel: Understanding spreadsheets and workbooks. Navigating Excel's interface and basic functions. Data entry, formatting, and cell referencing.

Excel Formulas and Functions: Performing calculations with formulas. Using common functions (SUM, AVERAGE, COUNT, etc.). Applying conditional formatting.
Introduction to data analysis tools (sorting, filtering, and pivot tables)

Data Visualization in Excel: Creating charts and graphs. Formatting and customizing visuals. Utilizing sparklines and data bars. Best practices for data presentation.

Introduction to Outlook: Managing emails, folders, and contacts. Using the calendar and scheduling appointments. Organizing tasks and setting reminders.

Outlook Productivity Tips: Customizing Outlook for efficient use. Email etiquettes and time management. Integrating tasks and calendar for better planning. Outlook's collaboration features (sharing calendars, scheduling meetings)

TEXT BOOKS

- Joan Lambert and Curtis Frye. *Microsoft Office 2016*. Microsoft Press, Redmond, DC, USA, 2016

RECOMMENDED READINGS

- Carl Siechert and Ed Bott. *Microsoft Office inside out: 2013 edition*. Pearson Education, 2013

Practical Evaluation Process

BREAK-UP OF MARKS

S.No.	BREAK-UP COMPONENT	Weightage
1	Number of experiments performed	50%
	Written report	
	Record of the experiments	
2	Viva-Voce	50%

STAB1201T: Mathematical Analysis-II

Subject: Mathematics
4 credits   48 contact hours (L3 T1 P00 C4)
Time Allowed: 3 Hours
Type: Core

Total Marks: 100
Uni. Exam: 70
Internal Assessment: 30
Min. Pass Marks: 35%

Course Objectives

The aim of this course is to acquaint the students with understanding of the concept of functions of two and three variables, partial derivatives and their applications, multiple integrals, including double and triple integrals.

Course Outcomes

1. The course provides Foundation for mathematical rigor needed for subsequent semesters.

2. Introduction and concrete foundation of various concepts related to sets.

3. Knowledge of Principle of Countability.

4. Encounter with the set of real numbers as an uncountable set.

5. Idea about Bounded and unbounded sets, least upper and greatest lower bounds of a set.

6. Gain knowledge of Sequences and various concepts related to It like convergence, limit points, bounded and monotonic sequences, Cauchy sequence and completeness of R.

7. Applicability of various tests of convergence of Sequence and series.

8. Introduction and concrete foundation of various concepts like limit, continuity, differentiation of functions of one variable.

9. Various applications of differentiation to finding maxima and minima and Taylor series expansion.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having 11 short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 12 marks and each short answer type question in Section C will be of 2 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

Section-A

Introduction to Multivariable Functions: Definition of functions of two and three variables, Domains, ranges and level curves. Graphing functions in three dimensions.

Partial Derivatives: Definition and computation of partial derivatives. Higher-order partial derivatives. Applications of partial derivatives in optimization.

Gradient and Directional Derivatives: Definition of gradient vector. Directional derivatives and their interpretation. Applications of gradient and directional derivatives

Multivariable Chain Rule: Chain rule for functions of two variables. Chain rule for functions of three variables. Applications of the chain rule.

Double Integration: Introduction to double integrals. Evaluating double integrals over rectangular and non rectangular regions. Applications of double integrals in area and volume calculations.

Polar and Cylindrical Coordinates: Polar coordinate system and conversions. Double integration in polar coordinates. Introduction to cylindrical coordinates.

Section-B

Triple Integration: Introduction to triple integrals. Evaluating triple integrals over various regions. Applications of triple integrals in volume calculations.

Spherical Coordinates: Spherical coordinate system and conversions. Triple integration in spherical coordinates. Applications of spherical coordinates

Line Integrals: Introduction to line integrals. Computing line integrals along curves. Applications of line integrals.

Surface Integrals: Introduction to surface integrals. Computing surface integrals over parameterized surfaces. Applications of surface integrals

Vector Fields: Definition and visualization of vector fields. Divergence and curl of vector fields. Applications of vector fields.Statement and applications of the divergence theorem. Statement and applications of Stoke's theorem

TEXT BOOKS

- Subhash Chandra Malik and Savita Arora. *Mathematical analysis* New Age International. 2009.

- George B Thomas and Ross L Finney. *Calculus.* 9th Ed. Pearson Education. 1996.

RECOMMENDED READINGS

- William Wade. *Introduction to Analysis.* Pearson Higher Ed. 2021.

STAB1202[T+P] : Probability Theory

Subject **Statistics**

4 credits

(36 - 24) contact hours (L3T0T2C3)

Time Allowed 3 Hours

Min. Pass Marks 35%(Theory Part) & 35%(Practical Part)

Total Marks 100

Uni. Exam: 56

Internal Assessment: 24

Practical Marks:20

Type: Core

Course Objectives

The aim of this course is to acquaint the students with the knowledge of different notions of probability theory, random variables, their distributions and generating functions.

Course Outcomes

After completing this course students will be able to

1. Understand the concepts of random experiment, sample space and algebra of events.

2. Distinguish between different definitions to probability and solve problems.

3. Understand the concept of conditional probability and its uses.

4. Understand the concepts of one and two dimensional random variables and their probability distribution

5. Understand and apply the concept of expectation of a random variable.

6. Learn the concept of generating functions and its uses.

7. Understand the concept of joint, marginal and conditional distributions

8. Solve practical problems with the help of computer programming and/or software packages R, MATLAB, STATISTICA, EXCEL, CALC etc.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having 8 short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 8 marks and each short answer type question in Section C will be of 3 marks.

At least 70% of the exam questions should be theoretical in nature.

## INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C

Section-A

Important Concepts in Probability: Random Experiment, Trial, Sample Point and Sample Space, Definition of an Event, Mutually Exclusive, Exhaustive, Independent and Equally Likely Events. Definition of the Probability, Classical and Relative Frequency approach to Probability, their Demerits and Axiomatic Approach to Probability, Properties of Probability Based on Axiomatic Approach, Conditional Probability, Bayes Theorem and Its Applications.

Random Variable: Definition of Discrete Random Variables, Probability Mass Function, Continuous Random Variable, Probability Density Function, Illustrations of Random Variables and Its Properties, Cumulative Distribution Function and its elementary properties.

Expectation of a Random Variable and its properties: Moments, Measures of Location and Dispersion, Chebyshev's Inequality and its applications.
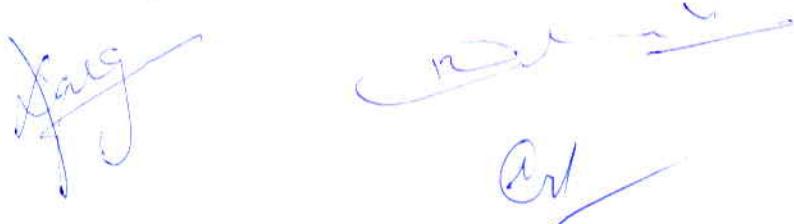
Section-B

Generating Functions: Moment Generating Function and Probability Generating Function. Characteristic function and its basic properties, Inversion and Uniqueness Theorems.

Two Dimensional Random Variables: Joint, Marginal and Conditional Distributions (Concepts and Simple Applications).

Discrete distributions: uniform, Bernoulli, binomial, Poisson and geometric distributions.

Continuous Distributions: uniform, exponential and normal (univariate and bivariate) distributions.

TEXT BOOKS

- B. Ramdas Bhat. *Modern probability theory.* New Age International, 2007.

- A. M. Gun, M.K. Gupta, and B. Dasgupta. *An Outline of Statistical Theory Vol. I* Third Edition. World Press, Calcutta, 2016.

- Vijay K Rohatgi and AK Md Ehsanes Saleh. *An introduction to probability and statistics.* John Wiley and Sons, 2015.

RECOMMENDED READINGS

- Kai Lai Chung. *A course in probability theory.* Academic press, 2001

- S. C. Gupta and V. K. Kapoor. *Fundamentals of Mathematical Statistics.* S. Chand and Sons, 2020

- Zhengyan Lin and Zhidong Bai. *Probability inequalities.* Springer Science & Business Media, 2011

- George G Roussas. *Introduction to probability.* Academic Press, 2013.

Practical Evaluation Process

BREAK-UP OF MARKS

S.No.	BREAK-UP COMPONENT	Weightage
1.	Number of experiments performed	50%
	Written report	
	Record of the experiments	
2.	Viva-Voce	50%

STAB1203[T+P]: Object Oriented Programming Using C++

Subject: **Computer Science**
4 credits
(36 + 24) contact hours (L3 T0 P2 C4)
Time Allowed: 3 Hours
Min. Pass Marks: 35%(Theory Part) & 35%(Practical Part)

Total Marks: 100
Uni. Exam: 56
Internal Assessment: 24
Practical Marks:20
Type: Core

Course Objectives

The objective of course is to develop programming skills of students, using object oriented programming concepts, learn the concept of class and object using C++ and develop classes for simple applications.

Course Outcomes

1. Write, compile and debug programs in C++ language.

2. Use different data types, operators and console I/O functions in a computer program.

3. Design programs involving decision control statements, loop control statements and case control structures.

4. Understand the implementation of arrays, pointers and functions and apply the dynamics of memory by the use of pointers.

5. Comprehend the concepts of structures and classes: declaration, initialization and implementation.

6. Apply basics of object oriented programming, polymorphism ,Inheritance and properties of constructors.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus and Section C will consist of one compulsory question having 8 short answer type questions covering the entire syllabus uniformly. Each question in Sections A and B will be of 8 marks and each short answer type question in Section C will be of 3 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each of the Section A and B and compulsory question of Section C.

Section-A

Evolution of OOP: Procedure Oriented Programming, OOP Paradigm, Advantages and disadvantages of OOP over its predecessor paradigms.
Characteristics of Object Oriented Programming: Abstraction, Encapsulation, Data hiding, Inheritance, Polymorphism, Code Extensibility and Reusability, User defined Data Types.
Introduction to C++: Identifier, Keywords, Constants, Operators: Arithmetic, relational, logical, conditional and assignment. Sizeof operator, Operator precedence and associativity.
Type conversion, Variable declaration, expressions, statements, manipulators Input and output statements, stream I/O. Conditional and Iterative statements, breaking control statements.
Storage Classes: Automatic, Static, Extern, Register, Arrays, Arrays as Character Strings, Structures, Unions, Bit fields, Enumerations and User defined types. Pointers: Pointer Operations, Pointer Arithmetic, Pointers and Arrays, Pointer to functions. Functions: Prototyping, Definition and Call, Scope Rules, Parameter Passing: by value, by address and by reference, Functions returning references, Const functions, recursion, function overloading, Default Arguments, Const arguments

Section-B

Inheritance: Multiple, Multilevel, Hierarchical.

Classes: Class Declaration and Class Definition, Defining member functions, making functions inline, Nesting of member functions, Members access control, this pointer, Union as space saving classes.

Objects: Object as function arguments, array of objects, functions returning objects, Const member functions, Static data members and Static member functions, Friend functions and Friend classes.

Constructors: properties, types of constructors (Default, parameterized and copy), Dynamic initialization, multiple constructors in classes.

Destructors: Properties, Virtual destructors, Destroying objects, Rules for constructors and destructors, Array of objects, Dynamic memory allocation using new and delete operators, Nested and container classes.

Scopes: Local, Global, Namespace and Class.

Inheritance: Defining derived classes, inheriting private members, single inheritance, types of derivation, Function redefining, constructors in derived class.

TEXT BOOKS

- H Deitel and P Deitel, *C++ How to program*, Pearson Education, 2013.
- Herbert Schildt, *C++ The Complete Reference*, The McGraw-Hill, 2002.

RECOMMENDED READINGS

- E Bhagurusamy, *Object oriented programming with C++*, McGraw Hill Education India Pvt Limited, 2017.
- Robert Lafore, *Object oriented programming in Microsoft C++*, Waite Group Press, 1992.

Practical Evaluation Process

BREAK-UP OF MARKS

S.No.	BREAK-UP COMPONENT	Weightage
1	Number of experiments performed	50%
	Written report	
	Record of the experiments	
2	Viva-Voce	50%