

**FACULTY OF SCIENCES**

**SYLLABUS**

**of**

**Bachelor of Science (Honours)  
Mathematics (Semester: III -VI)**

**(Under Continuous Evaluation  
System)**

**Session: 2023-24**



**The Heritage Institution**

**KANYA MAHA VIDYALAYA  
JALANDHAR**

**(Autonomous)**

## Bachelor of Science (Honours) Mathematics

Session: 2023-24

### Programme Specific Outcomes

Upon successful completion of this course, students will be able to:

PSO1: Solve complex Mathematical problems by critical understanding, analysis and synthesis. Students will also be able to provide a systematic understanding of the concepts and theorem of Mathematics and their applications in the real world to an advanced level, enhance career prospects in a huge array of field suitable to succeed at an entry level position in Mathematics post graduate program.

PSO2: Demonstrate proficiency in Mathematics and the Mathematical concepts needed for a proper understanding of Physics, Chemistry, Electronics, Computer Science and Economics.

PSO3: Create and develop Mathematical software application using a systematic approach & apply discrete Mathematical concept to practical application.

PSO4: Demonstrate knowledge of Calculus I & II, Matrices and Theory of Equations, Analytical and Solid Geometry, Statics & Tensor Calculus and able to apply this knowledge to analyze a variety of Mathematical Phenomena.

PSO5: Demonstrate knowledge of physical chemistry & apply this knowledge to analyze a variety of chemical phenomena & will be able to interpret and analyze quantitative data.

PSO6: Understand and demonstrate the knowledge of Mechanics, area, volume and displacement with differential equation of the orbit.

PSO7: Understand the basic concepts and basic principles of Demand and Supply, Measurement of Price Elasticity of Demand and apply Economic theories to derive cost function from Production Function.

PSO8: Learn implications of Revenue curves and their mutual relationships.

PSO9: Develop statistical approach and mathematical thinking among students to problem solving on a diverse variety of disciplines.

PSO10: Have knowledge of computer fundamentals, able to handle practical programming problems using C and analyze large volume of data using various statistical techniques

Kanya Maha Vidyalaya, Jalandhar (Autonomous)  
Scheme and Curriculum of Examinations of Three-Year Degree Programme  
Bachelor of Science (Honours) Mathematics  
Semester-III  
Session- 2023-24

Bachelor of Science (Honours) Mathematics Semester-III								
Sr. No.	Course Code	Course type	Course Title	Max.Marks				Examination Time in hours
				Total	L	Ext. P	CA	
1	BOML-3331	C	Calculus III	100	80	-	20	3
2	BOML-3332	C	Ordinary Differential Equations and Special Functions	100	80	-	20	3
3	BOML-3333	C	Probability Theory	100	80	-	20	3
4	BOML-3334	C	Linear Algebra	100	80	-	20	3
5	BOMM-3135	C	Python Programming	100	50	30	20	3+3
6	AECE-3221	AC	* Environmental Studies (Compulsory)	100	60	20	20	3
7	SECP-3512	AC	* Personality Development	25	20	-	5	1
Total Marks				500				

Note:

\* Marks of these papers will not be added in total marks and only grades will be provided

C-Compulsory

AC-Audit Course

Bachelor of Science (Honours) Mathematics

Semester–III

Session- 2023-24

Course Title: Calculus III

Course Code: BOML-3331

#### Course Outcomes

After passing this course, the students will be able to:

CO1: Evaluate Partial derivatives, Limits and continuity, Homogenous Functions, Euler's Theorem and recognize the various notations used in partial derivatives.

CO2: Analyze functions using Chain Rule, Jacobians, Directional Derivatives and Gradient Vectors.

CO3: To find optimization value for a function of two variables.

CO4: Apply double integration technique in finding the area of a region and triple integrals to find volume.

Bachelor of Science (Honours) Mathematics

Semester–III

Session- 2023-24

Course Title: Calculus III

Course Code: BOML-3331

Examination Time: 3 Hours

Max. Marks:100

Theory: 80

CA:20

Instructions for Paper Setter

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

#### Unit I

Real Valued functions of several variables with emphasis on functions of two variables, Limits and continuity, Partial derivatives, Homogenous Functions, Euler's Theorem

#### Unit II

Total differentiation, Differentiation of composite functions, Implicit functions, Chain Rule, Jacobians, Directional Derivatives, Gradient Vectors.

#### Unit III

Saddle Points, Maxima and Minima of functions of two variables, Lagrange's Multiplier method, Higher dimensional analogues of Lagrange's Mean value Theorem and Taylor's theorem for functions of two variables.

#### Unit IV

Double integration over rectangular and non-rectangular regions, change of order of integration, double integration in polar co-ordinates, triple integration over parallelepiped and other solid regions, Applications of double and triple integrals to area, volume, centre of gravity, moment of inertia etc.

Text Book:

George B. Thomas and Ross L. Finney, Calculus and Analytic Geometry, Pearson publication, 9<sup>th</sup> Edition, 1998. (Scope as in Ch.12-13)

Reference Books:

1. Sudhir R. Ghorpade and B.V. Limaye, A course in calculus and real analysis, Springer, 2006.
2. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publication, 10<sup>th</sup> Edition, 2011.

Bachelor of Science (Honours) Mathematics  
Semester–III

Session- 2023-24

Course Title: Ordinary Differential Equations and Special Functions

Course Code: BOML-3332

Course Outcomes

After the successful completion of this course, the students will be able to:

CO1: Identify differential equation, its order and degree, exact differential equations. Solve equations of first order and higher degree and demonstrate the concept of Linear Differential equation with constant coefficients.

CO2: Demonstrate the concept of linear differential equations with variable coefficients and find its solution using power series method

CO 3: Understand the concept of Bessel's Function with their properties like Orthogonal Property, Recurrence Relations, and Generating Function etc. and to recognize some of the Partial Differential Equations that can be solved by application of Bessel Function.

CO 4: Understand the concept of Legendre's Function with their properties like Orthogonal Property, Recurrence Relations, Rodrigue's formula and Generating Function etc. and to recognize some of the Partial Differential Equations that can be solved by application of Legendre Function.

Bachelor of Science (Honours) Mathematics

Semester–III

Session- 2023-24

Course Title: Ordinary Differential Equations and Special Functions

Course Code: BOML-3332

Examination Time:3 Hours

Max. Marks:100

Theory: 80

CA:20

Instructions for Paper Setter:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit –I

Exact differential equations. First order and higher degree equations solvable for  $x$ ,  $y$ ,  $p$ . Clairaut's form and singular solutions. Geometrical meaning of a differential equation. Orthogonal trajectories. Linear differential equations with constant coefficients.

Unit II

Linear differential equations with variable coefficients, Variation of Parameters method, reduction method, series solutions of differential equations. Power series method, Bessel and Legendre equations (only series solution).

Unit III

Bessel's Functions: Recurrence relations, Generating Function, Orthogonal Property, Trigonometric Expansions involving Bessel's Functions.

Unit –IV

Legendre's Functions: Recurrence Relations, Generating Function, Rodrigue's Formula, Orthogonal Property, Trigonometric Series, Laplace definite integrals, Christoffel's expansion

Text Book:

M.D.Raisinghania, Ordinary and Partial Differential Equations, S Chand Publishing, New Delhi, 11<sup>th</sup> Edition, 2009.

Reference Books:

1. E.A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publications, Inc., New York.
2. D.A.Murray, Introductory Course in Differential Equations, Orient Longman Private Limited, Hyderabad, 11<sup>th</sup> edition,2003.
3. G.F.Simmons, Differential Equations, McGraw Hill Education, 2<sup>nd</sup> edition, 2017.
4. E.D. Rainville, Special Functions, The Macmillan Company, New York.

Bachelor of Science (Honours) Mathematics

Semester–III

Session- 2023-24

Course Title: Probability Theory

Course Code: BOML-3333

Course Outcomes

After passing this course, the students will be able to:

CO1: Translate the real world problem into probability based mathematical model. They will be able to analyze, examine and control real time data.

CO2: Distinguish between discrete and continuous random variable primarily in their application and usage in real life.

CO3: Apply general properties and applications of expectation, variance and moments.

CO4: Identify the characteristics of different continuous and discrete distribution. In

particular they will be able to differentiate between widely used events with Binomial and Poisson distribution; and apply Normal distribution in real time applications.

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Bachelor of Science (Honours) Mathematics

Semester–III

Session-2023-24

Course Title: Probability Theory

Course Code: BOML-3333

Examination Time:3 Hours

Max. Marks:100

Theory: 80

CA: 20

Instructions for Paper Setter: Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The students can use only Non Programmable& Non Storage Type Calculator and statistical tables.

The question paper must contain 30% of the article/theory from the syllabus.

#### Unit I

Measures of central tendency: Mean, Median, Mode, and Measure of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Skewness, Kurtosis, Sample Space, Probability axioms, Probability on finite sample space, Conditional probability and Independence, Baye's theorem.

#### Unit II

Random variables, Probability mass function, Probability density function, Distribution function, Function of a random variable and its distribution. Multiple random variables, Joint distribution, Marginal and Conditional distributions.

#### Unit III

Mathematical Expectation, Conditional Expectation, Variance, Covariance, Moments, Moment generating function, Chebychev's inequality, Bernoulli's Law of large numbers.

#### Unit –IV

Discrete Probability Distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric distribution. Continuous Probability Distributions: Uniform, Normal, Gamma, Beta, Exponential distribution (For All distributions only Mean, Variance, Moment Generating Function)

#### Text Book:

S.C Gupta and V.K Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 11<sup>th</sup> edition, 2018. (Scope in Chapters 2-8).

#### Reference Book:

A.M. Mood , F.A. Graybill , D.C. Boes: Introduction to the Theory of Statistics, Chennai: McGraw Hill Education (India) Pvt. Ltd, 3rd edition, 2017.

Bachelor of Science (Honours) Mathematics  
Semester–III

Session- 2023-24

Course Title: Linear Algebra

Course Code: BOML-3334

Course Outcomes

After passing this course, the students will be able to:

CO1: Express the algebraic concepts such as binary operation, groups, rings and fields. Define a vector space and subspace of a vector space and check the linear dependence and linear independence of vectors

CO2: To understand the concepts of basis and dimension of vector space.

CO3: To understand matrix representation of a linear transformation

CO4: To find rank and normal form of a matrix, invertible matrix and to solve system of linear equations.

Bachelor of Science (Honours) Mathematics  
Semester-III  
Session-2023-24  
Course Title: Linear Algebra  
Course Code: BOML-3334

Examination Time: 3 Hours

Max. Marks: 100

Theory: 80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Definition and examples of vector spaces, properties of vector spaces, subspaces, examples of subspaces, sums and direct sums of subspaces, finite dimensional vector space: span of a list of vectors, linear independence and dependence of vectors.

Unit II

Basis of a vector space, extension of a list to a Linear Independent basis, reduction of a spanning list to a basis, direct complement of subspace, dimension theorems, quotient space, dimension of a quotient space.

Unit III

Linear maps, Null space, Range space, Rank-Nullity Theorem, Matrix of a linear map, invertibility of a linear map, algebra of linear maps.

Unit IV

Elementary matrix operations, elementary matrices, rank of a matrix, equality of row and column rank, normal form for a matrix, invertible matrix as a product of elementary matrices, system of linear equations

Text Book:

S. Axler, Linear Algebra Done Right, Springer, Second edition, 1997.

Reference Books:

1. S. H. Friedberg, A.J. Insel and L.E. Spence., Linear Algebra, PHI Learning Pvt. Ltd, New Jersey, 1979
2. V. Sahai and V. Bist., Linear Algebra, Narosa Publishing House Pvt. Ltd, Delhi, 2013

**Bachelor of Science (Honours) Mathematics Semester III**

**Session 2023-24**

**PYTHON PROGRAMMING**

**Course Code: BOMM-3135**

**Course Outcomes:**

After completion of this course, the students will be able to:

CO1: Comprehend basics of Python programming like operators, data types, I/O, etc.

CO2: Apply various control statements of Python Programming Language for designing solutions to different real world problems.

CO3: Implement various built-in and user defined function, packages and modules to solve mathematical problems.

CO4: Apply different matrix operations using NumPy and perform file manipulations.

**Bachelor of Science (Honours) Mathematics Semester III**

**Session 2023-24**

**PYTHON PROGRAMMING**

**Course Code: BOMM-3135**

**Examination Time: (3+3) Hours**

**Max. Marks: 100**

**Theory: 50**

**Practical: 30**

**CA: 20**

**Instructions for the Paper Setters:**

Eight questions of equal marks (10 marks each), (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**UNIT I**

Introduction to python and Setting up the Python development Environment, Basic syntax, interactive shell, editing, saving, and running a script, Concept of data types, Declaring and using Numeric data types: int, float, complex Lists and Tuples and their basic operations, Python console Input / Output. Arithmetic operators and expressions, Conditions, Comparison operators, Logical Operators, Is and In operators.

**UNIT II**

**Calculation of area, surface area and volume of geometrical objects. String Handling, Unicode**

strings, Strings Manipulation: - compare strings, concatenation of strings, slicing strings in python, converting strings to numbers and vice versa. Dictionaries Control statements: if-else, Nested If-Else, Loops (for, while) Loop manipulation using pass, continue, break and else.

### UNIT III

Built in function and modules in python, user defined functions, passing parameters, arguments and return values; formal vs actual arguments, Lambda function in python, Recursion, organizing python codes using functions, modules and external packages.

**Math Module: Constants, Arithmetic functions, Power functions, Logarithmic functions, Trigonometric and Angular functions.**

### UNIT IV

**Matrix operations using NumPy array (Multiplication, Addition, matrix multiplication, inverse, determinant, adjoint, Eigenvalues, etc).**

Files: manipulating files and directories, OS and Sys modules; creating and reading a geometric file (csv or tab separated) understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek. Introduction to graphic. **Plotting graphs and objects.**

#### References / Textbooks:

1. Mark Lutz, Learning Python, O'Reilly Media, 2013.
2. David Beazley, Python cookbook, O'Reilly Media, 2013.
3. David Beazley, Python Essential Reference, Addison-Wesley Professional, 2009.
4. John Zelle, Python programming: An Introduction to Computer Science, Franklin, Beedle & Associates Inc, 2004.
5. Alex Mortelli, Python in a Nutshell, O'Reilly Media, 2006.

Note: The latest editions of the books should be followed.

## **PERSONALITY DEVELOPMENT**

**Course Title: Personality Development**

**Nature of course: Audit Course ( Value added)**

**Course duration: 30 hours**

**Course intended for: Semester III students of Under Graduate Program**

- B.Sc (Economics)
- B.Sc. (Economics) with additional
- Course of Banking
- B.Sc. (Bio- Technology)
- B.Sc. (Medical)
- B.Sc. (Hons.) Physics
- B.Sc. (Hons.) Mathematics
- B.Sc. (Non -Medical)
- B.Sc. (Computer Science)
- B.C.A
- B.Sc.(Information Technology)
- B. Voc. (Animation)
- B. Voc. (Retail Management)
- B. Voc.( Management & Secretarial Practices)
- B. Voc( Textile Design & Apparel Technology)
- B.Voc(Nutrition, Exercise & Health)
- B. Voc.(Beauty & Wellness)
- B. Voc. (Hospitality and Tourism)
- B. Voc( Artificial Intelligence & Data Science)

**Course credits: 2 (For Credit based Continuous Evaluation Grading System)**

**Course Code: SECP-3512**

### **PURPOSE**

To enhance holistic development of students and improve their employability skills.

### **INSTRUCTIONAL OBJECTIVES**

- To re-engineer attitude and understand its influence on behaviour.
- To develop inter-personal skills and be an effective goal-oriented team player.
- To develop communication and problem solving skills.
- To develop professionals with idealistic, practical and moral values.

### **LEARNING OUTCOMES**

- On completion of the course, students will be able to hone their personality by
- Realisation of the importance and incorporation of positive thinking and attitude in life
- Enhancement of self confidence and analysis of self capabilities

- Learning the different communication skills for self expression
- Effective use of time to combat stress and increase in productivity
- Enhancing personality by physical grooming and fitness
- Understanding the role of design principles and appropriateness of apparel
- Incorporating social etiquettes in daily life and conduct
- Excelling in decision making and leadership qualities

## CURRICULUM

Course credits-2

Total Contact Hours-30

MODULE	TITLE	HOURS
1.	<b>Positive Thinking &amp; Attitude</b>	2
2.	<b>Self Analysis &amp; Self Confidence</b>	2
3.	<b>Communication Skills</b>	10
	<ul style="list-style-type: none"> <li>• <b>Basic Communication Skills</b></li> <li>• <b>Body Language</b></li> <li>• <b>Interview Skills</b></li> <li>• <b>Résumé Writing</b></li> <li>• <b>Group Discussion</b></li> <li>• <b>Telephone and E-mail etiquette</b></li> <li>• <b>Public Speaking</b></li> </ul>	
4.	<b>Time Management</b>	2
5.	<b>Stress and Conflict Management</b>	2
6.	<b>Physical Fitness and Personal Grooming</b>	2
7.	<b>Appropriateness of Apparel</b>	2
8.	<b>Social Etiquette</b>	2
9.	<b>Decision Making process &amp; Problem Solving Skills</b>	5
	<ul style="list-style-type: none"> <li>• <b>Leadership Skills</b></li> <li>• <b>Goal Setting</b></li> <li>• <b>Motivation</b></li> </ul>	
10.	<b>Closure</b>	1

### EXAMINATION

1. Total marks of the course will be 25 (Final Examination: 20 Marks; Internal Assessment: 5Marks)
2. The pattern of the final examination will be multiple choice questions. 25 multiple choice type questions will be set. The student shall attempt 20 questions. Each question will carry 1 mark (20 X 1 = 20). Total time allotted will be 1 hour.
3. Internal Assessment will consist of Attendance: 2 Marks, Internal: 3 Marks.( Total Internal Assessment:5 Marks)



## **SYLLABUS**

### **MODULE 1: Positive Thinking & Attitude**

- Factors Influencing Attitude
- Essentials to develop Positive Attitude
- Challenges & lessons from Attitude

### **MODULE 2: Self Analysis & Self Confidence**

- Who am I
- Importance of Self Confidence
- SWOT Analysis

### **MODULE 3: Communication Skills**

#### **(i) Basic Communication Skills**

- Speaking skills
- Listening skills
- Presentation skills

#### **(ii) Body Language**

- Forms of Non-Verbal Communication
- Interpreting body language clues
- Effective use of body language

#### **(iii) Interview Skills**

- Type of Interviews
- Ensuring success in job interviews
- Appropriate use of Non-verbal Communication

#### **(iv) Résumé Writing**

- Features
- Different types of résumé for Different posts

#### **(v) Group Discussion**

- Difference between Group discussion and debate
- Importance of Group Discussion
- Group Decision
- Ensuring success in group discussions

#### **(vi) Telephone & E-mail Etiquette**

- Telephone etiquette
- E-mail etiquette

#### **(vii) Public Speaking**

- Introductory speech
- Informative speech
- Persuasive speech
- Extempore session

#### **MODULE 4: Time Management**

- Importance of time management
- Values & beliefs
- Goals and benchmarks – The ladders of success
- Managing projects and commitments
- Prioritizing your To-do's
- Getting the results you need

#### **MODULE 5: Stress & Conflict Management**

- Introduction to stress
- Types of stressors
- Small changes and large rewards
- Stress prevention
- Overcoming unhealthy worry
- Stress at home and workplace
- Dealing with frustration and anger
- Stress reducing exercises
- Understanding conflicts
- Violent and Non-violent conflicts
- Source of conflict
- Structural and cultural violence

#### **MODULE 6: Physical Fitness and Personal Grooming**

- Fitness and exercise
- Balanced & healthy diet
- Skin care & Hair care
- Make-up skills

#### **MODULE 7: Appropriateness of Apparel**

- Apparel & Personality
- Psycho-social aspects of apparel
- Style-tips for smart dressing & effective use of design elements

#### **MODULE 8: Social Etiquette**

- Civic Sense
- Workplace skills
- Meeting and greeting people
- Table Setting and table manners

## **MODULE 9: Decision Making Process and Problem Solving Skills**

- Anatomy of a decision
- How to use problem solving steps and problem solving tools
- How to distinguish root causes from symptoms to identify right solution for right problems
- How to improve problem solving and decision making by identifying individual problem solving styles
- The creative process for making decisions
- Tools to improve creativity
- Implementing the decision – Wrap up

### **(i) Leadership Skills**

- Handling peer pressure and bullies
- Team work
- Decision making
- Taking initiatives

### **(ii) Goal Setting**

- Wish list
- SMART goals
- Blueprint for success
- Short-term, Long-term, Life-term Goals

### **(iii) Motivation**

- Factors of motivation
- Self talk
- Intrinsic & extrinsic motivators

## **Books Recommended**

1. Rossi, P.(2011).*Everyday Etiquette: How to navigate 101 common and uncommon social situations*. St Martins Pr.
2. Pietrzak, T.,& Fraum,M. (2005). *Building career success skills*. ASTD Press.
3. Treffinger, D.J., Isaksen, S.G., & Brian, K. (2005). *Creative problem solving: An Introduction*.
4. Carr, A. (2004).*Positive Psychology: The science of happiness and human strengths*. Burnner-Routlrde.
5. Oberg, B.C. (1994).*Speech craft: An Introduction to public speaking*. Meriwether Publishing.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

Scheme and Curriculum of Examinations of Three-Year Degree Programme  
 Bachelor of Science (Honours) Mathematics Semester-IV  
 Session: 2023-24

Bachelor of Science (Honours) Mathematics Semester-IV							
Course Code	Course Type	Course Title	Max.Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-4331	C	Vector calculus	100	80	--	20	3
BOML-4332	C	Partial Differential Equations	100	80	--	20	3
BOML-4333	C	Group Theory	100	80	--	20	3
BOMM-4334	C	Statistical Methods	100	50	30	20	3+3
BOMM-4135	C	Foundation of Statistical Computing	100	50	30	20	3+3
SECS-4522	AC	*Social Outreach	25	-	20	5	No Exam
		Total Marks	500				

Note:

\*Marks of these papers will not be added in total marks and only grades will be provided.

C Compulsory

AC Audit Course

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Vector Calculus

Course Code: BOML-4331

Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the physical concept of vectors and perform basic calculus on vector-valued functions.

CO 2: Solve physical problems based on calculus using vector-valued functions and calculate the tangent vector and normal vector at a point on a space curve described by a vector-valued position function.

CO 3: Find the values of gradient, divergence and curl operator of given vectors in orthogonal system and understand the concept of line integral.

CO 4: Find the application of Gauss theorem and Stokes's theorem in real life problems.

Bachelor of Science (Honours) Mathematics  
Semester-IV  
Session-2023-24  
Course Title: Vector Calculus  
Course Code: BOML-4331

Examination Time: 3 Hours

Max. Marks: 100

Theory: 80

CA: 20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

#### Unit I

Scalar and vector product of three vectors, Product of four vectors, Reciprocal vectors, Vector differentiation, Scalar valued point functions, Vector valued point functions, Directional derivatives and the Gradient, Tangent plane and normal to a given surface.

#### Unit II

Gradient of a scalar point function, Divergence and Curl of a vector point function, Divergence and Curl of sums and products and their related vector identities, Laplacian operator.

#### Unit III

Orthogonal Curvilinear Coordinates, Conditions for orthogonality, Gradient, Divergence and Curl in terms of orthogonal curvilinear coordinates, Line integrals: Scalar and vector line integrals, line integrals along curves, Work done, Conservative vector fields, Green's theorem in plane.

#### Unit IV

Surface integral, Volume integral, Gauss Divergence Theorem, Stokes theorem and the problems based on these theorems.

Reference Books:

1. D. E. Bourne and P. C. Kendall, Vector analysis and Cartesian tensors, CRC Press, Taylor and Francis Group, London, Third edition, 1992 (Scope as in Chapters: 2-6)
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 42nd edition, 2012 (Scope as in Chapters: 3 (3.8-3.10) and 8)

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Partial Differential Equations

Course Code: BOML- 4332

Course Outcomes

After passing this course, the students will be able to:

CO 1: Formulate partial differential equations & Apply Lagrange's Method to find solutions of partial differential equations and understand basic properties of standard partial differential equations.

CO 2: Perform various methods to solve homogeneous partial differential equations and apply Charpit method in solving problems.

CO 3: Use computational tools to solve Non homogeneous linear P.D.E. with constant coefficients, reducible and irreducible linear P.D.E. with constant coefficients, method of finding the complementary function and particular integral.

CO 4: Classify and transform partial differential equations into canonical form.

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Partial Differential Equations

Course Code: BOML- 4332

Examination Time: 3 Hours

Max. Marks: 100

Theory: 80

CA : 20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Partial Differential Equations of First Order: origin of first order partial differential equations. Formation of partial differential equations, Cauchy problem of first order equations, Linear P.D.E. of first order, Lagrange's Method

Unit-II

Integral surface through a given curve, Surface orthogonal to given system of surfaces, Non linear P.D.E of first order, Charpit's method, Homogeneous linear P.D.E. with constant coefficients, method of finding the complementary function and particular integral.

Unit-III

Non homogeneous linear P.D.E. with constant coefficients, reducible and irreducible linear P.D.E. with constant coefficients, method of finding the complementary function and particular integral.

Unit-IV

Partial differential equations of the second order. Origin of 2nd order equations. Linear P.D.E. with constant coefficients and their complete solutions. Second order equation with variable coefficient and their classification and reduction to standard form.

Text Book:

M D Raisinghania, Ordinary and Partial Differential Equations, S Chand Publishing, New Delhi, 11<sup>th</sup> Edition, 2009

Reference Books:

1. H.T.H. Piaggio: Differential equations, CBS Publishers
2. IAN N.Sneddon, Elements of partial differential equations, Dover Publisher, 2006



Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Group Theory

Course Code: BOML - 4333

Course Outcomes

Upon completion of this course, students should be able to:

CO 1: Understand the concept of integers, divisors, division algorithm and equivalence relation and its classes.

CO 2: Demonstrate understanding of algebraic structures and its properties with regard to working with various number system. Understand the concept of groups, subgroups, centralizer, normalizer and various properties of groups.

CO 3: Explain the notion of cosets, normal subgroup, quotient group, cyclic group, generator of cyclic group.

CO 4: Describe all permutation concepts, order, permutation as a product of two cycles, even odd permutations, alternating group.

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Group Theory

Course Code: BOML – 4333

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Properties of Integers: Well ordering Principle, Division algorithm, Greatest common divisor, G.C.D. as a linear combination, Euclidean algorithm, Euclid's Lemma, Least common multiple, Fundamental Theorem of arithmetic, Integers modulo  $n$ , Binary relations, Equivalence relations, Equivalence classes partition.

Unit-II

Definition & examples of groups, Elementary properties of groups, Uniqueness of the identity element, Cancellation, Uniqueness of inverses, Subgroups, Examples of subgroups, Tests for a set to be a subgroup, Centralizer, Normalizer, Centre of a group.

Unit-III

Product of two subgroups, Properties of cosets, Lagrange's theorem, Normal subgroups, Factor groups, Cyclic groups, Properties of cyclic groups, Generators of cyclic groups, Fundamental theorem of cyclic groups.

Unit-IV

Permutation groups, Cyclic notation for permutations, Permutation as product of disjoint cycles, Order of a permutation, Commutativity of product of disjoint cycles, Permutation as a product of 2-cycles, Even and odd permutations, Alternating group.

Reference Books:

1. D. Burton, Elementary Number Theory, McGraw-Hill Education, New York, Seventh Edition, 2011 (Scope as in Chapters: 2, 3, 8).
2. J. A. Gallian, Contemporary Abstract Algebra, CRC Press, Taylor & Francis Group, New York, Ninth Edition, 2015 (Scope as in Chapters: 1-5, 7, 9).

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Statistical Methods

Course Code: BOMM-4334

Course Outcomes

Upon completion of this course, students should be able to:

CO 1: Understand the concept of correlation, and apply its techniques to identify correlation between given set of data and regression curves depicting relation among the physical quantities.

CO 2: Understand all the concepts related to sampling distribution.

CO 3: Demonstrate understanding the logic and framework of the inference of hypothesis testing as making an argument.

CO 4: Interpret the results of the hypothesis test.

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2023-24

Course Title: Statistical Methods

Course Code: BOMM-4334

Examination Time: (3+3) Hours

Max. Marks: 100

Theory: 50

Practical: 30

CA : 20

Instructions for the Paper Setters:

Eight questions of equal marks (10 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The students can use only Non Programmable & Non Storage Type Calculator and statistical tables.

The question paper must contain 30% of the article/theory from the syllabus.

Unit-I

Bivariate data, Karl–Pearson's correlation coefficient and its Properties, Spearman's rank correlation coefficient, fitting of straight line, regression analysis.

Unit-II

Sampling Distributions: Chi-square, t and F-distributions with their mean and variance. Relation between Chi-square, t and F-distributions.

Unit-III

Large Sample test (Z Test): Test of single mean and difference of means, test for single proportion and difference of proportions, t test for single mean and equality of means.

Unit –IV

Chi-square test - as goodness of fit and association of attributes, F-test as test of equality of population of variance.

Note:

Practical: Based on syllabus of Statistical Methods for inferential Statistics.

Text Book:

S.C Gupta, V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons, New Delhi, eleventh edition, 2019.

Reference Book:

R. V. Hogg, Joseph W. Mackean, and C. Allen, Introduction to Mathematical Statistics, Pearson Education, Sixth edition, 2009.

**Bachelor of Science (Honours) Mathematics Semester-IV**

**Session: 2023-24**

**COURSE CODE: BOMM-4135**

**FOUNDATION OF STATISTICAL COMPUTING**

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Comprehend basics of Statistical Computing and managing data structures like vector, matrix, etc.

CO2: Create, operate and manage lists and data frames.

CO3: Apply control and I/O statements for generating outputs.

CO4: Simulate various descriptive and analytical algorithms using R language along with their visualization.

**Session: 2023-24**

**COURSE CODE: BOMM-4135**

**FOUNDATION OF STATISTICAL COMPUTING**

**Examination Time: (3+3) Hrs.**

**Max. Marks: 100**

**Theory: 50**

**Practical: 30**

**CA: 20**

**Instructions for Paper Setter -**

Eight questions of equal marks (10 marks each) are to set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be divided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section

**UNIT - I**

**Data Statistics:** Sampling, Cumulative statistics, Statistics for Data frames, matrix objects and lists.

Introduction to R, Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists

**UNIT - II**

Creating Data Frames – Matrix-like operations in frames , Merging Data Frames, Applying functions to Data frames, Factors and Tables , factors and levels , Common functions used with factors , string operations

**UNIT - III**

Input/ Ouput: scan() , readline() Function, Printing to the Screen Reading and writing CSV and text file. Control statements: Loops, Looping Over Nonvector, Sets, if-else , writing user defined function, scope of the variable, R script file

## UNIT - IV

Graphics in R: Graph Syntax ((title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions, par() command to generate multiple plots.

Note:

Practical: Based on simple mathematical problems and based on syllabus of Statistical Methods for descriptive Statistics.

### References / Textbooks:

1. Andrie de Vries and Joris Meys, R Programming for Dummies, Wiley (2016), 2<sup>nd</sup> Edition.
2. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (2017), 1<sup>st</sup> Edition.
3. Sandip Rakhsit, Statistics with R Programming, McGraw Hill Education (2018), 1<sup>st</sup> Edition.
4. Garrett Golemund, Hands on Programming with R, O'Reilly (2014), 1<sup>st</sup> Edition
5. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley (2013)
6. Tilman M. Davies, The Book of R: A first Course in Programming and Statistics, No Strach Press (2016), 1<sup>st</sup> Edition

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

Scheme and Curriculum of Examinations of Three Year Degree Programme  
 Bachelor of Science (Honours) Mathematics Semester-V  
 Session: 2023-24

Bachelor of Science (Honours) Mathematics Semester-V							
Course Code	Course Type	Course Title	Max. Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-5331	C	Number Theory	100	80	-	20	3
BOML-5332	C	Discrete Mathematics	100	80	-	20	3
BOML-5333	C	Linear Integral Equations	100	80	-	20	3
BOML-5334	C	Riemann Integration	100	80	-	20	3
BOML-5335	C	Metric Spaces	100	80	-	20	3
SECJ-5551	AC	*Job Readiness Course	25	20	-	5	
Total Marks			500				

Note:

\*Marks of these papers will not be added in total marks and only grades will be provided.

C -Compulsory

AC-Audit Course



Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023 -24  
Course Title: Number Theory  
Course Code: BOML-5331

Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Find solutions of specified linear Diophantine equation and system of linear congruences.

CO 2: Apply Fermat's to prove relation involving prime numbers.

CO 3: Apply the Wilson's and Euler's theorem to solve numerical problems and explore properties of phi function in real world problems.

CO 4: Understand application of important arithmetic functions.

Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023 -24  
Course Title: Number Theory  
Course Code: BOML-5331

Examination Time: 3 Hours

Max. Marks: 100

Theory: 80

CA: 20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

The question paper must contain 30% of the article/theory from the syllabus.

Unit-I

The Diophantine equation  $ax + by = c$  and its solution, Basic properties of congruences, Complete and Reduced set of residues modulo  $n$ , Special divisibility tests.

Unit-II

Polynomial congruences, Lagrange's theorem, Linear congruences, Chinese remainder theorem, The Fermat's theorem, Pseudo prime, Absolutely Pseudo prime.

Unit-III

Wilson's theorem. Euler's Phi function, Euler's theorem, some properties of the Phi Function, Gauss theorem.

Unit-IV

Number-Theoretic functions: The Sum and Number of divisors, The Mobius Inversion formula, The Greatest integer function for treating divisibility problems.

Text Book:

D. Burton, Elementary Number Theory, McGraw-Hill Education, Boston, Seventh edition, 2012 (Scope as in Chapters 2, 4-7).

Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023 -24  
Course Title: Discrete Mathematics  
Course Code: BOML-5332  
Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Understand Boolean algebra , K-Map and application of Boolean Algebra to switching circuits.

CO 2: Understand the use of Graphs and Models.

CO 3: Understand the language of trees with various types of trees and methods of traversing trees.

CO 4: Have substantial experience to comprehend formal logical and write an argument using logical notation and determine if the argument is valid or not.

Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023 -24  
Course Title: Discrete Mathematics  
Course Code: BOML-5332

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit- I

Boolean Algebra – Boolean Algebra, Unary Operation, Binary Operation, Laws of Boolean Algebra, Principle of Duality, Boolean Function, Fundamental Product, Sum of Product form, Complete sum of Product form, Minterm, Disjunctive Normal form, Conjunctive Normal form, obtaining a Disjunctive Normal form, obtaining a Conjunctive Normal form, Karnaugh Map upto four variables, Applications of Boolean Algebra to Switching Circuits.

Unit- II

Graph, Subgraph, Paths, Directed and Undirected graphs, Connected graphs, Weakly connected graphs, Regular and bipartite graphs, Weighted graphs, Euler path and graphs, Hamiltonian path and graphs, planar graphs.

Unit- III

Chromatic number in graphs, shortest path in weighted graphs. Tree, directed tree, ordered tree, Binary tree, traversing binary tree, spanning tree, minimum spanning tree, Kruskal's algorithm to find minimum spanning tree.

Unit- IV

Propositional Calculus – Basic Logic Operations, Statement, Proposition, Propositional Variables, Truth Table, Combination of Propositions, Laws of the Algebra of Proposition, Variations in Conditional Statement, Principle of Duality, Logical Implication, Logical Equivalence of Proposition, Tautologies, Contradiction, Contingency, Argument, Proof of Validity, Quantifiers, Existential Quantifier, Universal Quantifier, Negation of Quantified Propositions, Propositions with Multiple Quantifier.

Text Book:

S. B. Gupta and C. P. Gandhi, Discrete Structures, University Science Press, Second edition, 2010 (Scope as in Chapters: 10, 11, 12, 13).

Bachelor of Science (Honours) Mathematics  
Semester-V  
Session : 2023 -24  
Course Title: Linear Integral Equations  
Course Code: BOML-5333  
Course Outcomes

On satisfying the requirements of this course, students will have the Knowledge of:

CO 1: Concept of Linear Integral equations and various kinds of Kernels, Volterra and Fredholm Integral equations of first and Second kind, reduction of initial value problem to a Volterra Integral equation and solution of Volterra Integral equation using method of Resolvent Kernel.

CO 2: Reduction of Boundary Value Problem to Fredholm Integral Equation and techniques to solve homogeneous and non-homogeneous Fredholm Integral equations.

CO 3: Laplace Transform and its basic properties and how to find solution of Volterra Integral Equations using Laplace Transform.

CO 4: Construction of Green's function and application of Green's function in finding the solution of Boundary Value Problem.

Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023 -24  
Course Title: Linear Integral Equations  
Course Code: BOML-5333

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Linear integral equations of the first and second kind of Fredholm and Volterra type, some basic identities, Types of kernels: Symmetric kernel, Separable kernel, Iterated kernel, resolvent kernel, Initial value problems reduced to Volterra integral equations, Solution of Volterra integral equation using: Resolvent kernel, Successive approximation.

Unit-II

Boundary value problems reduced to Fredholm integral equations, Solution of Fredholm integral equations using separable kernel, resolvent kernel. Methods of successive approximation to solve Fredholm equations of second kind. Solution of Homogeneous Fredholm integral equation: Eigen values, eigen vectors.

Unit-III

Integral transforms for solving integral equations: Basic properties of Laplace transforms, Solution of Abel's equation using Laplace transform, Application of Laplace transform to the Solution of Volterra integral equations with convolution type kernels.

Unit-IV

Green's function, Basic four properties of the Green's function, Procedure for construction of the Green's function by using its basic four properties, Construction of Green's function for boundary value problems, Solution of boundary value problems using Green's function, reducing boundary value problems to an integral equation using Green's function.

Text Book:

M.D. Raisinghania, Integral Equations & Boundary Value Problems, S. Chand Co. Pvt. Ltd., New Delhi, First Edition, 2007 (Scope as in Chapters 1-6, 9, 11).

Bachelor of Science (Honours) Mathematics

Semester-V

Session: 2023-24

Course Title: Riemann Integration

Course Code: BOML-5334

Course outcomes

After passing this course, the students will be able to:

CO 1: To understand the concepts of Riemann sum, partitions, Upper and lower Riemann integrals, Refinement of partitions, Darboux's Theorem and Necessary and sufficient conditions for Integrability.

CO 2: To know and describe the Particular classes of Integrable functions, Properties of Integrable functions, Integrability of the sum, difference, product, quotient and modulus, First and second mean value theorems of integral calculus.

CO 3: Explain the concept of Improper Integrals and conditions for existence, Comparison test for convergence of improper integrals, Abel's Test and Dirichlet test for convergence.

CO 4: To distinguish between the absolute convergence and conditional convergence and find the relation between Beta and Gamma functions & their converging behaviour

Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023-24  
Course Title: Riemann Integration  
Course Code: BOML-5334

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Definition and Existence of the Riemann Integral, Partitions and Riemann (or Darboux) sums, Some properties of Darboux Sums, Upper and lower Riemann integrals, Refinement of partitions, Darboux's Theorem, Necessary and sufficient conditions for integrability.

Unit-II

Particular classes of Integrable functions, Properties of integrable functions, Integrability of the sum, difference, product, quotient and modulus, The Fundamental theorem of integral calculus, First and Second mean value theorems of integral calculus.

Unit-III

Improper Integrals and conditions for existence, Comparison test for convergence of improper integrals, Abel's Test and Dirichlet test for convergence.

Unit-IV

Absolute convergence and conditional convergence of improper integrals, Beta and Gamma functions, Properties of Beta functions, Recurrence formulae for Gamma function, Relation between Beta and Gamma functions.

Text Book:

S. Narayan and M. D. Raisinghanian, Elements of Real Analysis, S. Chand & Co. Pvt. Ltd., New Delhi, Seventeenth Edition, 2016 (Scope as in chapters: 13, 16, 20).

Reference Books:

1. A. Kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, Taylor & Francis Group, New York, First Edition, 2014 (Scope as in chapters: 6).
2. S. C. Malik and S. Arora, Mathematics Analysis, New Age International Publishers, New Delhi, Second Edition, 2005 (Scope as in chapters: 9,11).



Bachelor of Science (Honours) Mathematics  
Semester-V  
Session: 2023-24  
Course Title: Metric Spaces  
Course Code: BOML-5335  
Course outcomes

After passing this course, the students will be able to:

CO1: Explain the fundamental concepts of Metric Spaces and their role in modern mathematics.

CO2: Understand the concept of compact sets , separated sets and state and prove Heine – borel theorem

CO3: Demonstrate sequence in a metric space and give argument related to convergence.

CO4: Give argument related to continuity, completeness, compactness, connectedness in metric spaces.

Bachelor of Science (Honours) Mathematics

Semester-V

Session: 2023-24

Course Title: Metric Spaces

Course Code: BOML-5335

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Metric on a set, Metric space, definitions and examples, open sets, interior and closure of a set, closed set, dense and nowhere dense sets, exterior, frontier and boundary points and their properties.

Unit-II

Compact subsets of a metric space, elementary properties of compact sets, Heine-Borel theorem, separated sets, connected subsets of a metric space.

Unit-III

Sequences in a metric space, Convergent Sequences, Cauchy Sequences, Complete Metric Spaces, Cantor's Intersection Theorem, Baire's Category Theorem.

Unit-IV

Continuous Functions in a metric space, continuity and compactness, continuity and connectedness, discontinuities, monotonic functions, uniform continuity

Text Book:

S. Narayan and M. D.Raisinghania, Elements of Real Analysis, S. Chand & Company, New Delhi, 12<sup>th</sup> Edition, 2011 (Scope as in Chapter- 19)

Reference Books:

1.S. C.Malik and S. Arora, Mathematics Analysis, New Age International Publishers, New Delhi, 5<sup>th</sup> Edition, 2021 (Scope as in Chapter- 19)

2.W. Rudin, Principles of Mathematical Analysis, McGraw-Hill Education, New York, 3<sup>rd</sup> Edition, 1976 (Scope as in Chapters- 2, 3(3.1-3.12), 4)

Kanya Maha Vidyalaya, Jalandhar (Autonomous)  
 Scheme and Curriculum of Examinations of Three Year Degree Programme  
 Bachelor of Science (Honours) Mathematics Semester-VI  
 Session: 2023-24

Bachelor of Science (Honours) Mathematics Semester-VI							
Course Code	Course Type	Course Title	Max. Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-6331	C	Complex Analysis	100	80	-	20	3
BOML-6332	C	Analytical Skills	100	80	-	20	3
BOML-6333	C	Numerical Analysis	100	80	-	20	3
BOML-6334	C	Special Functions	100	80	-	20	3
BOML-6335	C	Differential Geometry	100	80	-	20	3
Total Marks			500				

Note:

C -Compulsory

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023-24  
Course Title: Complex Analysis  
Course Code: BOML-6331  
Course outcomes

After passing this course, the students will be able to:

CO1: Justify the need for a complex number system and explain how it is related to other existing number system. Define a function of complex variable, limit, continuity and differentiability, Analytic functions, Conjugate function, Cauchy Riemann equations, Harmonic function and carry out basic mathematical operations with complex numbers.

CO2: State and prove Cauchy's theorem, Cauchy's integral formula, Cauchy's inequality, Poisson's integral formula, Morera's theorem and Liouville's theorem.

CO3: Define singularities of a function, know the different types of singularities and be able to determine the Residue at singularities of a function.

CO4: Learn The Fundamental Theorem of Algebra, The Argument principle, Rouché's theorem, Conformal transformations, Bilinear transformations, Critical points, Fixed points, and Problems on cross ratio and bilinear transformation.

Bachelor of Science (Honours) Mathematics

Semester-VI

Session: 2023-24

Course Title: Complex Analysis

Course Code: BOML-6331

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Functions of complex variables, Topology of real line and complex plane, limit, continuity and differentiability, Analytic functions, Conjugate function, Cauchy Riemann equations (Cartesian form), Harmonic function, Construction of analytic functions.

Unit-II

Complex line integral, Cauchy's theorem, Cauchy's integral formula and its generalized form, Cauchy's inequality, Poisson's integral formula, Morera's theorem, Liouville's theorem.

Unit-III

Taylor's theorem, Laurent's theorem, Zeros and Singularities of an analytic function, Residue at a pole and at infinity, Cauchy's Residue theorem.

Unit-IV

The Fundamental Theorem of Algebra, The Argument principle, Rouché's theorem, Conformal transformations, Bilinear transformations, Critical points, Fixed points, The cross ratio, Problems on cross ratio and bilinear transformation.

Text Book:

S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, Second Edition, 1995 (Scope as in Chapters: 1-5).

Reference Books:

1. S. Narayan, Theory of Functions of a Complex Variable, S. Chand Co. Pvt. Ltd., New Delhi, Fourth Edition, 2009 (Scope as in Chapters: 3, 5, 7, 9, 11).

2. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw-Hill Education, New York, Eighth Edition, 2004 (Scope as in Chapters: 1, 2, 4, 5, 6, 7, 9).

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023-24  
Course Title: Analytical Skills  
Course Code: BOML-6332  
Course outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of sequence and series, clock problems, blood relationship.

CO 2: Demonstrate procedural fluency with real number arithmetic operations and use these operations to represent real world scenarios and to solve stated problems and demonstrate number sense and conversion between fractions, decimals and percentages.

CO 3: Use simple and compound interest to do business calculations such as value of money, maturity value, present value, future value and able to differentiate which math method should be used for different problems and understand the concept of mensuration.

CO 4: Analyze data being presented in the form of tables, Venn diagrams, pie charts.

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023-24  
Course Title: Analytical Skills  
Course Code: BOML- 6332

Examination Time: 3 Hours

Max. Marks: 100  
Theory:80  
CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Sequence and Series: Analogies of Numbers and Alphabets, Completion of blank spaces following the pattern in A: b::C: d relationship, Odd thing out, Missing number in a sequence or a series.

Date, Time and Arrangement Problems: Calendar Problems, Clock Problems, Blood Relationship.

Unit -II

Arithmetic Ability: Algebraic operations BODMAS, Fractions, Decimals Fractions, Divisibility rules, LCM & GCD (HCF), Elementary Algebra.

Quantitative Aptitude: Averages, Ratio and proportion, Problems on ages, Time and Work, Work and Wages, Pipes and Cisterns, Time and Distance, Trains, Streams.

Unit -III

Mensuration: Measurement of Areas, Surface Areas and Volume.

Business Computations: Percentages, Profit & Loss, Partnership, Simple and Compound Interest.

Unit-IV

Data Analysis: The data given in a Table, Graph, Bar Diagram, Pie Chart, Venn diagram or a Passage is to be analyzed and the questions pertaining to the data are to be answered.

Reference Books:

1. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Co. Pvt. Ltd., New Delhi, Eighth Edition, 2017 (Scope as in Chapters:1-4, 6, 8, 11-14, 16-20, 22-23, 27-28, 35 (Section I) and Chapters 36-39 (Section II)).
2. R.V. Praveen, Quantitative Aptitude and Reasoning, PHI Learning Pvt. Ltd., Delhi, Third Edition, 2016 (Scope as in Chapters: 1, 4-8, 13-21, 23-29, 32, 34, 36, 39 (Part I) and Chapters 1,3,5 (Part II)).

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023 -24  
Course Title: Numerical Analysis  
Course Code: BOML-6333  
Course Outcomes

After passing this course, the students will be able to:

CO 1. Know how to find the roots of transcendental equations.

CO 2. Perform computation for solving a system of equations and understand its application in all branches of engineering.

CO 3. Learn how to interpolate the given set of values and understand the curve fitting for various polynomials. They will be able to compute numerical integration and differentiation, numerical solution of ordinary differential equations.

CO 4. Learn numerical solution of differential equations.



Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023 -24  
Course Title: Numerical Analysis  
Course Code: BOML-6333

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setter:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

The students can use only Non-Programmable & Non-Storage Type Calculator.

#### Unit-I

Error generation, error propagation, error estimation and error bounds, Solution of non-linear equations, Bisection method, Method of false position, Newton-Raphson method, Generalized Newton-Raphson method, Iteration method, Muller's method, Rate of convergence of these methods.

#### Unit-II

Solution of linear system of equation: Direct method, Gauss elimination variant (Gauss Jordan and Crout reduction), Triangular Method, Iterative methods: Jacobi's method, Gauss Seidel method. Finite Differences: Forward, Backward, Central, Divided differences, shift operator, relationship between the operators and detection of errors by use of difference operator. Interpolation with divided difference, Newton's formula, Lagrangian method.

#### Unit-III

Finite difference interpolation, Gauss formula, Stirling formula, Bessel's formula, Error Estimation, Extrapolation. Numerical differentiation: Method based on interpolation. Numerical Integration: Trapezoidal rule, Simpson's rule, Weddle rule, Romberg integration, Gaussian integration method, Gaussian Legendre integration. Double numerical integration.

#### Unit-IV

Numerical solution of ordinary differential equations, Initial value problem, Taylor's method, Euler's methods, Picard's method, Milne's method, Runge-Kutta method, Predictor- Corrector's method.

Text Book:

M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, Delhi, Fifth edition, 2007 (Scope as in Chapters 2-6).

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023 -24  
Course Title: Special Functions  
Course Code: BOML-6334  
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of Hyper geometric function, its integral form and Contiguity of Hyper geometric functions and solution of hyper geometric equation as a function of its parameters.

CO 2: Understand the concept of Bessel's Function and their properties like Recurrence Relations, Generating Function etc., modified Bessel Function and to recognize some of the Partial Differential Equations that can be solved by application of Bessel Functions.

CO 3: Understand the concept of Legendre's Function and their properties like Orthogonal Property, Recurrence Relations, Rodrigue's formula and Generating Function etc. and understand Hyper geometric forms of Legendre's function.

CO 4: Understand the concept of Hermite Polynomials, basic properties like Orthogonality, Rodrigue's formula etc. and its relation with  $2^F_0$ .

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023 -24  
Course Title: Special Functions  
Course Code: BOML-6334

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Hypergeometric functions, The function  $F(a,b,c,z)$ , Integral form, Evaluation of  $F(a,b,c,1)$ , The contiguous function relations, The Hypergeometric differential equation, solution of hypergeometric equation,  $F(a,b,c,z)$  as a function of its parameters, Relation between  $z$  and  $1-z$ , A quadratic transformation, A theorem due to Kummer.

Unit -II

Bessel's functions of first and second kind, Bessel's differential equation, Recurrence relations, Generating functions, Bessel's integral, Modified Bessel functions, Neumann polynomials, Neumann series.

Unit –III

Legendre's function  $P_n(x)$ , A generating function, Recurrence relation, Legendre differential equation, The Rodrigues formula, Bateman's generating function, Hypergeometric forms of  $P_n(x)$  Laplace's first integral form, Orthogonality.

Unit -IV

Hermite Polynomials, Recurrence relations, Rodrigues formula, Integrals, The Hermite polynomial as  ${}_2F_0$ , Orthogonality.

Text Book:

S. S Trivedi, Special functions, Pragati Prakashan, Meerut, XXI edition, 2021 (Scope as in chapters 3,4,5,6,7)

Reference Book:

M.D. Raisinghania, Ordinary and Partial Differential equations, S. Chand publication, New Delhi , 18<sup>th</sup> edition, 2013 (Scope as in chapters 9,10,11,12,14)

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session 2023 -24  
Course Title: Differential Geometry  
Course Code: BOML-6335  
Course Outcomes

After passing this course, the students will be able to:

CO 1: Able to explain the concept of theory of space curve tangent, normal, binormal and rectifying plane.

CO 2: Able to understand contact between curves and surfaces , locus of centre of curvature, spherical curvature as well as calculate the curvature and torsion of curve

CO 3: Understand the concept of Spherical indicatrix, envelopes, and two fundamental forms,

CO 4: Understand tensor variables, metric tensor, contra-variant, covariant and mixed tensors & and able to apply tensors among mathematical tools for invariance and the reason why the tensor analysis is used and explain usefulness of the tensor analysis.

Bachelor of Science (Honours) Mathematics  
Semester–VI  
Session: 2023 -24  
Course Title: Differential Geometry  
Course Code: BOML-6335

Examination Time: 3 Hours

Max. Marks: 100

Theory:80

CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Curves in  $R^3$  : A simple arc, curves and their parametric representation, arc length, contact of curves, tangent line, osculating plane, principal normal, binormal, normal plane, rectifying plane.

Unit-II

Curvature and torsion, Serret-Frenet Formulae, Helics, Evolute and Involute of a parametric curve, Osculating circle and osculating sphere, spherical curves.

Unit –III

Surfaces in  $R^3$  : Implicit and Explicit forms of the equation of surface, two fundamental forms of a surface, Family of surfaces, Edge of regression, Envelops .

Unit -IV

Einstein's summation convention, Transformations of coordinates, Tensor's law for transformation, contravariant, covariant and mixed Tensors, addition, outer product, contraction, inner product and quotient law of tensors, metric Tensor and Riemannian metric.

Text Book:

1. G.S Malik, Differential Geometry, Pragati Prakashan, Meerut , IX edition , 2013 (Scope as in chapters 1-10)

Reference Books:

1. D Somasundaram, Differential Geometry: A first Course, Alpha Science International Limited, New Delhi, 2005 (Scope as in chapters 1,2)

2. C.E Weather burn, Differential Geometry, Cambridge University Press, Cambridge (Scope as in chapters 1,2,3,4)