



S.S. JAIN SUBODH P.G. COLLEGE
RAM BAGH CIRCLE, JAIPUR-302004

SYLLABUS
&
SCHEME OF EXAMINATION

Three/Four Years Bachelor of Science (Mathematics)
Medium of Instruction: Hindi and English

SEMESTER SCHEME

I-VI Semester
Examination-2025-26
And Onwards
As per NEP-2020

Name of College	S.S. Jain Subodh P.G. College
Name of Faculty	Science
Name of Discipline	Mathematics
Type of Discipline	Major

SEMESTER-WISE PAPER TITLES WITH DETAILS

Three/Four Years Bachelor of Science (Mathematics)								
				Mathematics	Credits			
S. No.	L e v e l	Se m	Type	Title	L	T	P	Total
1.	5	I	MJR	Discrete Mathematics & Optimization Techniques	6	0	0	6
2.	5	I	MJR	Introductory Number Theory	6	0	0	6
3.	5	II	MJR	Differential and Integral Calculus	6	0	0	6
4.	5	II	MJR	Operations Research	6	0	0	6
5.	6	III	MJR	Real Analysis & Differential Equations	4	0	0	4
6.	6	III	MJR	Mathematical Tools in SciLab	0	0	2	2
7.	6	III	MJR	Mathematical Statistics	6	0	0	6

8.	6	IV	MJR	Advanced Real Analysis & Numerical Analysis	4	0	0	4
9.	6	IV	MJR	Application of C-Programming in Mathematics	0	0	2	2
10.	6	IV	MJR	Advanced Analysis	6	0	0	6
11.	7	V	MJR	Abstract Algebra & Three Dimensional Geometry	6	0	0	6
12.	7	V	MJR	Optimization Methods	6	0	0	6
13.	7	VI	MJR	Complex Analysis & Mechanics	6	0	0	6
14.	7	VI	MJR	Linear Algebra & Partial Differential Equations	6	0	0	6

Examination Scheme for Theory Paper

70% weightage for End of Semester Exam (EoSE) and 30% weightage of Continuous Internal Assessment (CIA)

Passing Marks:

40% marks in each paper/ subject including sessional/ CIA and EoSE put together.

Question Paper Pattern

Total Marks for a subject/ paper: 150

Practical Max Marks: 50 (If Applicable)

CIA Max Marks: 30 (If Practical Applicable) /45 Marks

EoSE Max. Marks: 70 (If Practical Applicable) /105 Marks

The question paper (EoSE) will consist of two parts A & B.

Part A- 14/21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of two/three marks each and candidate can attempt any seven questions.

Part B- 56/84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 14/21 Marks.

Examination Scheme for Practical Paper

Max. Practical Marks = 50 Marks

Internal = 20 Marks

External = 30 Marks

Distribution of Marks:

Two Practical one from each group 10 Marks each = 20 Marks

Practical Record: 5 Marks

Viva-voice: 5 Marks

Note: 1. Each Candidate has to prepare his/ her practical record.

2. Each Candidate has to pass in Practical and Theory examination separately.

B.Sc. Mathematics Semester I
Discrete Mathematics & Optimization Techniques

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course is to expose discrete structures and involve topology and optimization of real-world problems.

Prerequisites: Mathematics courses of XII Std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: The course would enable the student

1. To understand the ideas in discrete structures viz. Partially ordered sets, Lattices, Graphs etc. and allied conceptual intricacies with applications.
2. To understand mathematical formulation of optimization problems and allied theoretical concepts for solution methodologies for linear programming problems, Transportation problems assignment problems.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Relations on a set, Equivalence class, partial order relations, Chains and Anti-chains. Lattices, Distributive and Complemented Lattices. Boolean algebra, conjunctive normal form, disjunctive normal form. Principle of inclusion and exclusion. Propositional calculus, Basic logical operations, Truth tables, Tautologies and contradictions.

Unit -II

Discrete numeric functions, generating functions, Recurrence relations, linear recurrence relation with constant coefficients and their solutions: Total solutions, Solution by the method of generating functions. Basic concepts of graph theory, Types of graphs, Walks, Paths & Circuits, Shortest path problem.

Unit -III

Planar graphs, Operations on graphs (union, join, products). Matrix representation of graphs, Adjacency matrices, Incidence matrices. Hamiltonian and Eulerian graphs. Tree, Spanning tree, Minimum spanning tree, Distance between vertices, Center of tree, Binary tree, Rooted tree.

Unit-IV

Linear programming problems. Feasible solution, Basic feasible solution. Some basic properties and theorems on convex sets. Simplex algorithm, Transportation problems. Assignment problems.

Suggested Books and References –

1. V. K. Balakrishnan, Introductory Discrete Mathematics, Prentice-Hall, 1996.
2. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
3. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
4. Kenneth H. Roson, Discrete Mathematics and Its Applications, Tata Mc-GrawHiils, New Delhi, 2003.
5. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
6. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>s

B.Sc. Mathematics Semester I
Introductory Number Theory

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the Course is to provide students with a comprehensive understanding of Euclidean algorithm, Congruence and Cryptography.

Prerequisites: Mathematics courses of XII std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: The course would enable the student

1. To apply Euclid's algorithm and Chinese Remainder Theorem.
2. To understand the definitions of congruences, residue classes and Application to Cryptography.
3. To apply number theoretic functions in various branches of mathematics.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Divisibility – Division Algorithm, Divisibility in \mathbb{Z} , g.c.d., the Euclidean algorithm, l.c.m., Primes, Infinitude of primes, Fundamental theorem of Arithmetic. Fibonacci sequence, Fibonacci numbers and their properties.

Unit -II

Congruence – Linear congruence, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem, Fermat's factorization, Euler's factorization. Number theoretic functions:

tau and sigma-functions, the Mobius function and inversion formula, Greatest integer function, Euler's phi function, Euler's generalization of Fermat's theorem. and the properties of phi function.

Unit -III

Cryptography, Application of Number theory to Cryptography, Diophantine equations – $ax + by = c$, $ax + by + cz = d$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^2$, $x^4 + y^4 = z^4$, Fermat's last theorem.

Unit-IV

Quadratic congruence, Quadratic residues, Legendre symbol and its properties, Quadratic reciprocity. Order of an integer and its properties, Primitive roots for primes, Composite numbers having primitive roots, Theory of indices.

Suggested Books and References –

1. S.Telang and M. Nadkarni, Number Theory, Tata McGraw-Hill, 2001.
2. David M. Burton, Elementary Number Theory (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.
3. I. Niven and H. Zukerman, An Introduction to the theory of Numbers, Wiley Eastern University Edition, New Delhi, 1985.
4. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>s

B.Sc. Mathematics Semester II
Differential and Integral Calculus

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course is to provide students with a comprehensive understanding of the fundamental concepts of calculus as a tool for dynamic systems; diverse topics find applications in many branches of science.

Prerequisites: Mathematics course of XII std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: By the end of the course, students should be able to:

1. Understand the concept of curvature, pedal equations, partial differentiation, envelope, asymptotes.
2. Understand the concept of maxima-minima, curve tracing, double and triple integration and their applications.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Taylor's theorem. Maclaurin's theorem. Power series expansion of a function. Power series expansion of $\sin x$, $\cos x$, e^x , $\log_e(1+x)$, $(1+x)^n$. Derivative of the length of an arc, Pedal equations. Curvature: Various formulae, Centre of curvature and Chord of curvature.

Unit -II

Partial differentiation. Euler's theorem for homogeneous functions. Chain rule of partial differentiation. Total differentiation, Differentiation of implicit functions. Envelopes: One parameter family of curves when two parameters are connected by a relation. Maxima and Minima of functions of two variables. Lagrange's method of undetermined multipliers.

Unit -III

Asymptotes: Definition, Parallel to coordinate axes, General rational algebraic curves, inspection method, Intersection of a curve and its asymptotes. Multiple points. Curve tracing of Cartesian, Polar and parametric curves. Beta and Gamma functions.

Unit-IV

Double integrals in Cartesian and Polar Coordinates, Change of order of integration. Triple integrals. Dirichlet's integral. Rectification, Area, Volume and Surface of solids of revolution.

Suggested Books and References –

1. Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand & Co., N. D., 2013.
2. H.S.Dhami, Differential Calculus, Age Int. Ltd., New Delhi, 2012.
3. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
4. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002.
5. G.B. Thomas, R. L. Finney, M. D. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>

B.Sc. Mathematics Semester II
Operations Research

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course is to enable students to learn concepts in optimization techniques viz. game theory, Inventory models, job sequencing and queueing theory.

Prerequisites: Mathematics courses of XII std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: By the end of the course, students should be able to:

1. Analyze inventory models, costs, and constraints for efficient management.
2. Apply game theory principles to strategize and optimize outcomes.
3. Understand queueing theory and solve queueing models for various scenarios.
4. Master sequencing models for optimal task scheduling and job processing.
5. Apply replacement models for effective resource management and decision-making.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Inventory Models – Definitions, Types of inventory models, costs involved in inventory models, Classification of inventory models. Static demand models in Inventory control: EOQ models without shortage, EOQ models with shortage, limitations of EOQ formula,

EOQ model with finite replenishment rate.

Unit -II

Theory of Games – Introduction, Basic definitions, Minimax (Maximin) criterion and Optimal strategy. Solution of game with saddle point. Minimax-Maximin principle for mixed strategy games, Fundamental theorem of Game theory. Solution of 2×2 mixed strategy game. Solution of 2×2 mixed strategy game by the method of oddments. Dominance principle. Graphical method for solving $2 \times n$ or $m \times 2$ game, Linear programming method for the solution of $m \times n$ game.

Unit -III

Queueing Theory – Introduction, classification of queueing models. Distribution of arrivals. Distribution of inter-arrival time, Distribution of departures, Distribution of service time. Solution of queueing models: Model 1 (M/M/1): (∞ /FCFS), Model 2 (M/M/1): (N/FCFS), Model 3 (M/M/C): (∞ /FCFS), Model 4 (M/M/1): (N/FCFS).

Unit-IV

Sequencing Models: Sequencing problems, processing n jobs through two machines. Processing n jobs through three machines, processing two jobs through m machines and processing n jobs through shortest cyclic Route Models. Minimal path problem (shortest Acyclic Route Models).

Suggested Books and References –

1. J.K. Sharma, Operation research- Theory and Application, Macmillan Pub. India Ltd.
2. Kanti Swaroop, P. K. Gupta and Manmohan, Operation Research, Sultan Chand & Co., N.D., 2007.
3. S. D. Sharma, Operations Research, Kedar Nath Ram NATH and co. Meerut, 2005.
4. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research Concepts and Cases (9th Edition), Tata McGraw Hill, 2010.
5. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>

B.Sc. Mathematics Semester III
Real Analysis & Differential Equations

1 Credit – 25 Marks

4 Credit- 100 Marks

Question Paper: 70 Marks

Internal Assessment: 30 Marks

Objectives: The primary objective of this course is to introduce the real number with algebraic, order, completeness properties, and convergence/ divergence of sequences. The course also offers the solution strategies to differential equations viz. Linear, homogeneous linear, linear equations with constant coefficients and allied types.

Prerequisites: Mathematics course of XII std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: By the end of the course, students should be able to:

1. Apply Bolzano-Weierstrass and Heine-Borel theorems to real number sets.
2. Test sequence convergence using Cauchy's principle and analyse continuous functions on closed intervals.
3. Solve first-order and higher-degree differential equations and linear differential equations with constant coefficients.
4. Solve second-order linear differential equations using transformation techniques and assess linear independence of solutions.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 14 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 56 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 14 Marks.

Unit - I

Bounded set, Neighbourhood, Limit point, Bolzano-Weierstrass theorem, closed and Open sets. Concept of compactness and connectedness. Heine-Borel theorem.

Unit - II

Real sequences- Limit and Convergence of a sequence, Monotonic sequences. Cauchy's sequences, Subsequences, Cauchy's general principle of convergence. Continuous functions: Properties of continuous functions on closed intervals.

Unit -III

Exact differential equations and equations which can be made exact. First order but higher degree differential equations solvable for x, y and p . Linear differential equations with constant coefficients, Complementary function and Particular integral.

Unit-IV

Homogeneous linear differential equations, Linear differential equations of second order. Solution by transformation of the equation by changing the dependent variable/the independent variable, Method of variation of parameters, Method of undetermined coefficients.

Suggested Books and References –

1. Royden H, Fitzpatrick PM. Real analysis. China Machine Press; 2010.
2. Rudin W. Principles of mathematical analysis. New York: McGraw-hill; 1964.
3. Bartle RG, Sherbert DR. Introduction to real analysis. New York: Wiley; 2000.
4. Mapa SK. Introduction to Real Analysis. Sarat Book Distributors; 2014.
5. Malik SC, Arora S. Mathematical analysis. New Age International; 1992.
6. Ross SL, Differential Equation-Jhon Wiley & Sons. Inc. New York. 1984.
7. Raisinghania MD, Ordinary and partial differential equations. S. Chand Publishing; 2013.

Suggested E-resources: <https://www.coursera.org/>, <https://www.khanacademy.org/>,
<https://alison.com/tag/maths>

B.Sc. Mathematics Semester III
Mathematical Tools in SciLab

1 Credit – 25 Marks

2 Credit- 50 Marks

External Assessment: 30 Marks

Internal Assessment: 20 Marks

Objectives: The objective of the course is to equip students with skills to create, analyze, and understand graphs. To teach the use of computational and programming functions with Scilab. To understand and apply methods for solving linear equations and other mathematical problems.

Prerequisites: Mathematics course of XII std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: By the end of the course, students should be able to:

1. Understand graphical and numerical techniques and their execution on Scilab.
2. Students should gain practical expertise in solving problems involving graphs, matrices, and equations.
3. Students should be prepared to utilise various mathematical techniques to solve different mathematical problems.

Mark distribution:

Max. Practical Marks = 50 Marks

Internal = 20 Marks

External = 30 Marks

Distribution of Marks:

Two Practical one from each group 10 Marks each = 20 Marks

Practical Record: 5 Marks

Viva-voice: 5 Marks

Group-A

1. Plotting the graphs of the following functions ax , $\sqrt{ax+b}$, $|ax+b|$, $c \pm |ax+b|$, $x^{\pm n}$, $x^{1/n}$ ($n \in \mathbb{Z}$), e^{ax+b} , $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|\sin(ax+b)|$, $|\cos(ax+b)|$

explaining the effects of change in the real constant a , b and c on graphs. Plotting graphs of hyperbolic functions and inverse trigonometric functions, plotting and analyzing the graphs of polynomials and their derivatives.

2. Matrix operations: addition, multiplication, inverse, transpose, determinant, rank and inbuilt functions eye, ones, zeros. Solving the system of linear equations by using Matrix Division (\backslash Operator), using 'linsolve' function, using 'inv' function, using 'mldivide' function.

Group-B

1. Complex numbers: Operations like addition, subtraction, multiplication, division, Modulus and inbuilt functions conj, imag, imult, isreal, real. Finding Roots of equations by using 'fsolve' function, using 'roots' function, using 'mnewton' function.
2. Solving linear programming problems by using inbuilt functions of Scilab Solving Ordinary Differential Equations (ODEs) by using the 'ode' function

Suggested Books and References –

1. Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists, APress; 1st ed. Edition.
2. Claude Gomez, Engineering and Scientific Computing with Scilab, Birkhauser Boston Inc; 1999th edition.
3. Tejas Sheth, Scilab: A Practical Introduction to Programming and Problem Solving, Createspace Independent Pub.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/maths>

B.Sc. Mathematics Semester III
Mathematical Statistics

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The main objective of this course is to introduce the theory underlying modern statistics to give the student a solid grounding in Mathematical Statistics.

Prerequisites: Mathematics courses of XII std. of Central Board of Secondary Education or equivalent.

Course Learning Outcomes:

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

1. Organize, manage and present data.
2. Analyse statistical data graphically using frequency distributions and cumulative frequency distributions.
3. Analyse statistical data using measures of central tendency, dispersion and location.
4. Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.
5. Translate real-world problems into probability models.
6. Derive the probability density function of transformation of random variables.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit – I

Frequency distributions and measures of location, Measures of dispersion, Skewness and Kurtosis, Moments of frequency distributions.

Unit – II

Theory of probability. Mathematical expectation, Moment generating and Cumulative functions.

Unit –III

Discrete probability distributions (Binomial, Poisson, Geometric and Hypergeometric). Continuous probability distributions (Rectangular and Normal distributions).

Unit-IV

Methods of least squares and curve fitting. Correlation and Regression.

Suggested Books and References –

1. Gupta SC, Kapoor VK. Fundamentals of mathematical statistics. Sultan Chand & Sons; 2020.
2. Kapur JN, Saxena HC. Mathematical Statistics. S. Chand; 1976.
3. Meyer PL. Introductory probability and statistical applications. Oxford and IBH Publishing; 1965.
4. Spiegel MR, Srinivasan RA, Schiller JJ. Schaum's outline of theory and problems of probability and statistics. Erlangga; 2000.
5. Goon AM, Gupta MK, Dasgupta B. Fundamentals of Statistics. World Press Private Limited; 1975.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/maths>

B.Sc. Mathematics Semester IV
Advanced Real Analysis & Numerical Analysis

1 Credit – 25 Marks

4 Credit- 100 Marks

Question Paper: 70 Marks

Internal Assessment: 30 Marks

Objectives: The primary objective of this course is to enable students to understand fundamental concepts of differentiable functions, apply Darboux's, Rolle's theorems, Riemann integration, mean value theorems, and to learn numerical techniques i.e. interpolation, Numerical integration, roots of equation, solution of initial value problem.

Prerequisites: Real Analysis & Differential Equations

Learning Outcomes: By the end of the course, students should be able to:

1. Analyze multivariable functions using differentiability and partial derivatives.
2. Solve problems using Riemann Integrability and integral calculus theorems.
3. Use interpolation formulas for data approximation and numerical differentiation.
4. Apply numerical methods to solve equations and differential equations.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 14 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 56 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 14 Marks.

Unit - I

Properties of derivable functions, Darboux's and Rolle's theorem. Notion of limit, continuity and differentiability for functions of two variables. Directional derivative, total derivative, expression of total derivative in terms of partial derivatives.

Unit - II

Riemann integration – Lower and Upper Riemann integrals, Riemann integrability, Mean value theorems of integral calculus, Fundamental theorem of integral calculus. Functions of bounded variations.

Unit -III

Differences. Relation between differences and derivatives. Differences of a polynomial. Newton's formula for forward and backward interpolation. Divided differences. Newton's divided difference, Lagrange's interpolation formula. Numerical Differentiation. Derivatives from interpolation formulae.

Unit-IV

Numerical integration, Derivations of general quadrature formulas, Trapezoidal rule. Simpson's one-third, Simpson's three-eighth and Gauss's quadrature formulae. Numerical solution of Algebraic and Transcendental equations: Bisection method, Secant method, Regula-Falsi method, Iteration method, Newton- Raphson Method. Numerical solutions of ordinary differential equations of first order with initial condition using Euler and modified Euler's method.

Suggested Books and References –

1. Royden H, Fitzpatrick PM. Real analysis. China Machine Press; 2010.
2. Rudin W. Principles of mathematical analysis. New York: McGraw-hill; 1964.
3. Bartle RG, Sherbert DR. Introduction to real analysis. New York: Wiley; 2000.
4. Mapa SK. Introduction to Real Analysis. Sarat Book Distributors; 2014.
5. Malik SC, Arora S. Mathematical analysis. New Age International; 1992.
6. Burden RL, Faires JD. Numerical analysis, brooks;1997.
7. Iyengar SR, Jain RK. Numerical Methods. New Age International; 2009.
8. Sastry SS. Introductory methods of numerical analysis. PHI Learning Pvt. Ltd.; 2012.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/maths>

B.Sc. Mathematics Semester IV
Application of C-Programming in Mathematics

1 Credit – 25 Marks

2 Credit- 50 Marks

External Assessment: 30 Marks

Internal Assessment: 20 Marks

Objectives: The objective of the course is to enable students learn the basic knowledge of developing algorithms for various Mathematical problems and preparing codes for these algorithms in C language.

Prerequisites: Mathematics course of XII std. of Central Board of Secondary Education or equivalent.

Learning Outcomes: By the end of the course, students should be able to:

1. Understand the logic for a given problem.
2. Write the algorithm of a given problem.
3. Draw a flow chart of a given problem.
4. Recognize and understand the syntax and construction of C programming code.

Mark distribution:

Max. Practical Marks = 50 Marks

Internal = 20 Marks

External = 30 Marks

Distribution of Marks:

Two Practical one from each group 10 Marks each = 20 Marks

Practical Record: 5 Marks

Viva-voice: 5 Marks

Programming languages and problem solving on computers, Algorithm, Flow chart, Programming in C- Constants, Variables, Arithmetic and logical expressions, Input-Output, Conditional statements, Implementing loops in Programs, Defining and manipulating arrays and functions.

Group-A

1. Printing n terms of Fibonacci sequence and finding factorial n, summation n, summation of square of n etc.

2. Defining a function and finding sum of n terms of a series/sequence whose general term is given.
3. Finding gcd and lcm of two numbers by Euclid's algorithm.
4. Checking prime/composite numbers and finding the number of primes less than n, where n is a positive integer.
5. Finding mean, standard deviation and Permutation, Combination.
6. Numerical integration using Trapezoidal rule.
7. Numerical integration using Simpson's $\frac{1}{3}$ rule.
8. Numerical integration using Simpson's $\frac{3}{8}$ rule.

Group-B

1. Solution of algebraic and transcendental equations by Bisection method.
2. Solution of algebraic and transcendental equations by Regula-falsi method.
3. Solution of algebraic and transcendental equations by Newton-Raphson method.
4. Solution of Initial value problems by Euler's method.
5. Solution of Initial value problems by Runge-Kutta fourth order method.

Suggested Books and References –

1. B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
2. E. Balagurnsamy : Programming in ANSI C, Tata McGraw Hill, 2004.
3. Y. Kanetkar : Let Us C ; BPB Publication, 1999.
4. C. Xavier : C-Language and Numerical Methods, New Age International, 2007.
5. V. Rajaraman : Computer Oriented Numerical Methods, Prentice Hall of India, 1980.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>

B.Sc. Mathematics Semester IV
Advanced Analysis

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: This course aims to equip students with advanced mathematical tools and analytical skills necessary for tackling real-world problems in mathematics, physics, engineering, and related fields.

Prerequisites: Real Analysis & Differential Equations

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Solve variational problems using Euler's equation and numerical methods.
2. Ensure series of functions converge uniformly using appropriate convergence tests.
3. Analyze metric space properties including open sets and limit points.
4. Apply compactness and connectedness concepts in metric spaces to practical scenarios.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Calculus of Variations- Variation and its properties. Euler's equation. Functionals. Functionals dependent on Higher order derivatives and functions of several independent variables. Variational problems in parametric form. The moving boundary value problem for a

function of the form $\int_{x_1}^{x_2} f(x, y, z) dx$ Euler's finite difference method. Ritz method for variational problem.

Unit - II

Sequence and series of functions – Pointwise and Uniform convergence, Cauchy's criterion, Weierstrass M-test, Abel's test, Dirichlet's test for uniform convergence of series of functions, Uniform convergence and Continuity of series of functions, Term by term differentiation and integration.

Unit -III

Metric space – Definition and examples, Open and Closed sets, Interior and Closure of a set, Limit point of a set in metric space.

Unit-IV

Compact metric space. Connected metric space.

Suggested Books and References –

1. Royden H, Fitzpatrick PM. Real analysis. China Machine Press; 2010.
2. Rudin W. Principles of mathematical analysis. New York: McGraw-hill; 1964.
3. Bartle RG, Sherbert DR. Introduction to real analysis. New York: Wiley; 2000.
4. Mapa SK. Introduction to Real Analysis. Sarat Book Distributors; 2014.
5. Malik SC, Arora S. Mathematical analysis. New Age International; 1992.
6. Kumaresan S. Topology of metric spaces. Alpha Science Int'l Ltd.; 2005.
7. Gupta AS. Calculus of variations with applications. PHI Learning Pvt. Ltd.; 1996.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>

B.Sc. Mathematics Semester V
Abstract Algebra & Three Dimensional Geometry

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course on Group Theory, Ring Theory, and three dimensional geometry, as outlined in the syllabus, is to provide students with a thorough understanding of fundamental algebraic structures, their applications and basic three dimensional geometrical shapes.

Prerequisites: Mathematics course of XII std. of Central Board of Secondary Education or equivalent.

Course Learning Outcomes:By the end of the course, students should be able to:

1. Develop a theoretical foundation in algebraic structures including groups, rings, integral domains and fields.
2. Apply theoretical concepts to solve problems involving group theory and ring theory.
3. Analyze and differentiate algebraic structures and their interrelations.
4. Understand the applications of algebraic structures in various mathematical and scientific disciplines.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Binary operations, Algebraic structure, Groups, Order of group, finite and infinite order groups and their order specific theorems, Subgroups and their properties, Permutation group, Cyclic group. Cosets, Lagrange's theorem.

Unit - II

Morphism of groups, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorems of Homomorphism.

Unit -III

Definition and simple properties of Rings and Subrings. Morphism of rings. Integral domain and field. Characteristics of a Ring and Field.

Unit-IV

Sphere: Equation of Sphere, Plane section of sphere, intersection of a sphere by a line, tangent line and tangent plane of a sphere, angle of intersection of two spheres. Cone: Equation of cone, right circular cone, enveloping cone. Cylinder: Equation of cylinder, enveloping cylinder, right circular cylinder.

Suggested Books and References –

1. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.
2. I.N.Herstein, Topics in Algebra, Wiley-Eastern Ltd., New Delhi.
3. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010).
4. N.S.Gopalkrishnan, University Algebra, New Age International, 1986.
5. G.C.Sharma, Modern Algebra, Shival Agrawal & Co., Agra,1998.
6. S.L. Loney, The Elements of Coordinate Geometry, Macmillan and co. London, 1895.
7. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>

B.Sc. Mathematics Semester V
Optimization Methods

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course “Optimization Methods” with the outlined syllabus is to equip students with a comprehensive understanding and practical skills in solving optimization problems using advanced mathematical techniques.

Prerequisites: Discrete Mathematics & Optimization Techniques

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand and apply the simplex method, two-phase method, and the dual simplex method to solve linear programming problems with bounded variables.
2. Grasp Duality concepts and solve Integer Programming Problems.
3. Perform Sensitivity analysis and utilize Revised Simplex method.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Theory of Simplex method, two phase method, bounded variables problems in linear programming, The Dual Simplex method.

Unit - II

Duality in linear programming: Concept of duality, General rules for converting any primal into its dual, Duality theorems, primal-dual correspondence, rules for obtaining dual optimal solution

from that of primal and primal optimal solution from the dual.

Unit -III

Integer linear programming: Definitions, Gomory's all integer programming technique: Construction of Gomory's constraint, Gomory's cutting plane algorithm for all integer programming problems, Branch and Bound method: Branch and bound algorithm and its geometrical interpretation.

Unit-IV

Sensitivity analysis: Introduction, changes in the coefficients 'cj' of the objective function, changes in the component 'bi' of vector **b**, changes in the component 'ajj' of matrix **A**. Revised Simplex method: Introduction, Revised Simplex algorithm when artificial variables are not needed.

Suggested Books and References –

1. Kanti Swaroop, P.K.Gupta and Manmohan, Operation Research, Sultan Chand & Sons., N.Delhi, 2007.
2. S.D.Sharma, Operations Research, Kedar Nath Ram Nath and co. Meerut, 2005.
3. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research Concepts and Cases (9th Edition), Tata McGraw Hill, 2010.
4. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
5. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>s

B.Sc. Mathematics Semester VI
Complex Analysis & Mechanics

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course is to enable students to understand and apply complex analysis, principles of equilibrium and work, and solve mechanical problems.

Prerequisites: Mathematics course of XII std. of Central Board of Secondary Education or equivalent.

Course Learning Outcomes: By the end of the course, students would have achieved the following:

1. Grasped the concepts of Taylor's and Laurent's theorems as they apply to complex functions.
2. Conducted analysis on the singularities of analytic functions, including branch points, meromorphic functions, entire functions, and residues at singularities using the Cauchy residue theorem.
3. Understand and calculate velocity and acceleration in various directions and analyze motion in resisting media.
4. Analyze the equilibrium of coplanar forces, calculate moments, and understand the effects of friction.
5. Apply the principles of virtual work to mechanical systems and analyze motion on smooth curves in vertical planes.
6. Mathematical treatment to the configuration called catenary.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Complex valued function: Limits, Continuity and Differentiability. Analytic functions, Cauchy-Riemann equations. Harmonic functions, Construction of an analytic function. Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function.

Unit - II

Taylor's theorem. Laurent's theorem. Maximum modulus theorem. Singularities of an analytic function, Branch point, Meromorphic and Entire functions, Residue at a singularity, Cauchy's residue theorem.

Unit -III

Velocity and acceleration – along radial and transverse directions, along tangential and normal directions, Motion in resisting medium – Resistance varies as velocity and square of velocity, Motion on a smooth curve in a vertical plane.

Unit-IV

Equilibrium of coplanar forces, moments, Friction, Virtual Work and catenary.

Suggested Books and References –

1. Brown JW, Churchill RV. Complex variables and applications. McGraw-Hill,; 2009.
2. Kasana HS. Complex variables: theory and applications. PHI Learning Pvt. Ltd.; 2005.
3. Ponnusamy S, Silverman H. Complex variables with applications. Springer Science & Business Media; 2007.
4. A.S.Ramsey, Statics, CBS Publishing & Distributors, New Delhi.
5. M. Ray, A Text Book of Dynamics, S. Chand & Co., 2003.
6. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
7. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>

B.Sc. Mathematics Semester VI
Linear Algebra & Partial Differential Equations

1 Credit – 25 Marks

6 Credit- 150 Marks

Question Paper: 105 Marks

Internal Assessment: 45 Marks

Objectives: The objective of the course is to provide students with a foundation in the theory of vector spaces, linear transformations and to teach them the theory and methods for solving first-order PDEs.

Prerequisites: Real Analysis & Differential Equations and Abstract Algebra & Three Dimensional Geometry.

Course Learning Outcomes: By the end of the course, students should be able to:

1. Apply theoretical concepts to solve complex problems involving vector spaces, linear transformations, and PDEs.
2. Connect abstract concepts from linear algebra to practical problems in engineering, physics, and other fields.
3. Develop a deeper understanding of the structure and properties of mathematical systems and their interrelationships.

Mark distribution in question paper:

The question paper (EoSE- End of Semester Examination) will consist of two parts A & B

Part A- 21 Marks

Part A is compulsory comprises 10 very short answer-type questions (with a limit of 20 words) of three marks each and candidate can attempt any seven questions.

Part B- 84 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each Question Carries will carry 21 Marks.

Unit - I

Introduction to Vector Spaces, Subspaces, Algebra of subspaces, Linear combination of vectors, Linear span, Linear independence, Bases and dimension, Dimension of subspaces. Linear and direct sum of subspaces.

Unit - II

Linear transformations, Null space, Range, Rank and nullity of a linear transformation, Matrix representation of a linear transformation, Algebra of linear transformations, Invertibility and isomorphisms.

Unit -III

Partial differential equations of the first order, Lagrange's linear equation, Non-linear partial differential equations of order one : various standard forms, Charpit's method.

Unit-IV

Homogeneous and non-homogeneous linear partial differential equations with constant coefficients. Equations reducible to linear partial differential equations with constant coefficients.

Suggested Books and References –

1. Sahai V, Bist V. Linear algebra. Alpha Science Int'l Ltd.; 2002.
2. Lipschutz S, Lipson M. Schaum's outline of theory and problems of linear algebra. Erlangga; 2001.
3. Spence LE, Insel AJ, Friedberg SH. Elementary Linear Algebra: A Matrix Approach. (No Title). 2008.
4. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Co., 2003.
5. M.Ray, A Text Book on Differential Equations, Students and Friends Co., Agra,1998.
6. I.N. Snedon, Elements of Partial Differential Equations, TMH, 2001.

Suggested E-resources: <https://www.coursera.org/> , <https://www.khanacademy.org/> , <https://alison.com/tag/math>