



Sir P. T. Sarvajani College of Science (Autonomous)
Surat-395001
(Affiliated with Veer Narmad South Gujarat University, Surat)



SYLLABUS
FOR
B. Sc. Sem. III & IV
Program: B. Sc.
Course: Mathematics

From
Academic year
2025-26



Graduate Attributes

After the successful completion of modules in different courses of B.Sc. MATHEMATICS, the learner will be able to:

GA 1: Apply concepts of Mathematics and acquired skill sets to unknown problems in order to establish an effective approach or strategy for dealing with them.

GA 2: Explore and derive quantitative data in the realms of Mathematics.

GA 3: Develop analytical and observation skills through different examples.

GA 4: Approach any real life problem with proper assumption, logic and constraints.

GA 5: Prepare for jobs, career development, and lifelong learning in Mathematics, by using acquired ICT skills and mathematical skills.

Programme Specific Outcomes

PSO - 1 Derive a solution by the use of Definition.

PSO - 2 Use of theorems to solve problems under the given scenario.

PSO - 3 For the solution of Difficult examples usage of abstract knowledge.

PSO - 4 Generalise results for a general set up.

PSO - 5 For problem solving generation of ideas.

PSO - 6 create meritorious students by gained knowledge.



Content

Sr. No	Semester	Course number	Course Code	Course title
1	III	CC V	MHMJ-S3P5-2CR25	Numerical Methods-I
2		CC VI	MHMJ-S3P6-2CR25	Multivariate Differential Calculus
3		CC VII	MHMJ-S3P7-4CR25	Linear Algebra-I
4		MDC III	MHMDC-S3P1-4CR25	Applications of Matrices
5			MHMDC-S3P2-4CR25	Probability Distribution and Testing of Hypothesis
6		SEC III	MHSEC-S3PR1-2CR25	Vedic Mathematics and its Technique-III
7			MHSEC-S3PR2-2CR25	Linear Programming
		IKS	MHIKS-S3P1-2CR25	Ancient Indian Mathematics
9		Practical III	MHMJ-S3PR5-2CR25	Lab Course-V
10			MHMJ-S3PR6-2CR25	Lab Course-VI
1	IV	CC VIII	MHMJ-S4P8-2CR25	Numerical Methods-II
2		CC IX	MHMJ-S4P9-2CR25	Multivariate Integral Calculus
		CC X	MHMJ-S4P10-4CR25	Linear Algebra-II
3		Minor III	MHMN-S4P3-2CR25	Differential Calculus of Several Variables
4			STMN-S4P3-2CR25	Probability Distribution
8		SEC IV	MHSEC-S4PR1-2CR25	Mathematical Modelling
9			MHSEC-S4PR2-2CR25	Vedic Mathematics and its Technique-IV
		IKS	MHIKS-S4P2-2CR25	Ancient Indian Mathematicians
11		Practical II	MHMJ-S4PR8-2CR25	Lab Course-VIII
12			MHMJ-S4PR9-2CR25	Lab Course-IX
13	MHMN-S4PR3-2CR25		Lab Course-III	
14	STMN-S4PR3-2CR25		Lab Course-III	



Detailed Syllabus

B. Sc. (Mathematics) Semester - III/IV

(With effect from the Academic year 2025-25)

Course No.	Course Title	Course Code	Credits	Hours	Module	Lectures per module (1 Hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER III									
Major Courses THEORY									
CC V	Numerical Methods-I	MHMJ-S3P5-2CR25	2	30	2	15	25	25	50
CC VI	Multivariate Differential Calculus	MHMJ-S3P6-2CR25	2	30	2	15	25	25	50
CC VII	Linear Algebra-I	MHMJ-S3P7-4CR25	4	60	4	15	50	50	100
Multidisciplinary Courses									
I	Applications of Matrices	MHMDC-S3P1-4CR25	4	60	4	15	50	50	100
II	Probability Distribution and Testing of Hypothesis	MHMDC-S3P2-4CR25	4	60	4	15	50	50	100
Skill Enhance Course (SEC)									
I	Linear Programming	MHSEC-S3PR1-2CR25	2	60	-	-	25	25	50
II	Vedic Mathematics and its Technique-III	MHSEC-S3PR2-2CR25	2	60	-	-	25	25	50
IKS in Mathematics									
I	Ancient Indian Mathematics	MHIKS-S3P1-2CR25	2	30	2	15	25	25	50
Major Courses Practical									
I	Lab Course-V	MHMJ-S1PR5-2CR25	2	60	-	-	25	25	50
II	Lab Course-VI	MHMJ-S1PR6-2CR25	2	60	-	-	25	25	50
SEMESTER IV									
Major courses THEORY									
CC VIII	Numerical Methods-II	MHMJ-S4P8-2CR25	2	30	2	15	25	25	50
CC IX	Multivariate Integral Calculus	MHMJ-S4P9-2CR25	2	30	2	15	25	25	50
CC X	Linear Algebra-II	MHMJ-S4P10-4CR25	4	60	4	15	50	50	100
Minor Course THEORY									
I	Differential Calculus of Several Variables	MHMN-S4P3-2CR25	2	30	2	15	25	25	50
I	Probability Distribution	STMN-S4P3-2CR25	2	30	2	15	25	25	50



Skill Enhance Course (SEC)									
I	Mathematical Modelling	MHSEC-S4PR1-2CR25	2	60	-	-	25	25	50
II	Vedic Mathematics and its Technique-IV	MHSEC-S4PR2-2CR25	2	60	-	-	25	25	50
IKS in Mathematics									
I	Ancient Indian Mathematicians	MHIKS-S4P2-2CR25	2	30	2	15	25	25	50
Major Courses Practical									
I	Lab Course-VII	MHMJ-S4PR8-2CR25	2	60	-	-	25	25	50
II	Lab Course-VIII	MHMJ-S4PR9-2CR25	2	60	-	-	25	25	50
Minor Courses Practical									
I	Lab Course-III	MHMN-S4PR3-2CR25	2	60	-	-	25	25	50
I	Lab Course-III	STMN-S4PR3-2CR25	2	60	-	-	25	25	50



S.Y.B.Sc. (Mathematics) Semester-III

Major Course- V

COURSE TITLE: Numerical Methods-I

COURSE CODE: MHMJ-S3P5-2CR25 [CREDITS - 02]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> 1. Apply error estimation techniques and compute errors using the general error formula, assessing the accuracy of numerical methods. 2. Solve algebraic and transcendental equations using numerical methods, including the Bisection, False Position, Iteration, and Newton-Raphson methods. 3. Implement formulas such as Newton's Forward, Backward, Gauss's Central, and Lagrange's interpolation for both equal and unequal intervals. 		
Module 1	Numerical Solutions of Algebraic and Transcendental Equations	[15L]
<p>Learning Objective</p> <ol style="list-style-type: none"> 1. Derive and apply general error formulas to assess the accuracy of numerical solutions. 2. Understand the underlying principles and algorithms of the Bisection Method, Method of False Position, Iteration Method, and Newton-Raphson Method. 		
<p>Learning Outcomes:</p> <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Apply various interpolation methods and finite difference concepts to solve interpolation problems for equal intervals. 2. Compare the efficiency, accuracy, and applicability of the Bisection Method, Method of False Position, Iteration Method, and Newton-Raphson Method. 		
1.1	Error estimation: Errors and their computations, A general error formula.	[3L]
1.2	Numerical Solutions of Algebraic and Transcendental Equations: Bisection Method, Method of False position, Iteration Method, Newton-Raphson's Method.	[12L]
Module 2	Finite Differences	[15L]
<p>Learning Objective</p> <ol style="list-style-type: none"> 1. Understand the concept of finite differences and their application in polynomial differences, including operators and relations between them. 		



2. Learn and apply Newton's Forward and Backward Difference interpolation formulas, as well as Gauss's Central interpolation formulae for equal intervals.
3. Explore finite differences with unequal intervals, focusing on divided differences, Newton's Divided Differences, and Lagrange's interpolation formula.

Learning Outcomes:

At the end of this module the learner will be able to

1. apply finite difference operators and calculate differences of polynomials for both equal and unequal intervals.
2. implement Newton's Forward, Backward, and Gauss's Central interpolation formulas to estimate values at given data points.
3. solve interpolation problems using Newton's Divided Differences and Lagrange's interpolation formula for unequal intervals.

2.1	Finite Differences, Relation between operators, Differences of Polynomials.	[3L]
2.2	Finite Differences with equal Intervals: Newton's Forward and Backward Difference interpolation Formulae, Gauss's Central interpolation Formulae (Forward and Backward).	[6L]
2.3	Finite Differences with Unequal Intervals: Concept of Divided Differences, Newton's Divided Differences, Lagrange's Interpolation Formula.	[6L]

References:

1. M. K. Jain, S. R. K. Iyenger, R. K. Jain: Numerical Methods for Scientific and Engineering Computations, New-Age International Ltd, 7/e, 2019.
2. S. S. Sastry: Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 5/e.
3. James I. Buchanan, Peter R. Turner: Numerical Methods and Analysis, Mc Graw Hill Book Co., London., 1992.
4. Kaiser A. Kunz : Numerical Analysis, Mc Graw Hill Book Co., London., 2011.
5. Goel, Mittal: Numerical Analysis, Pragati Prakashan, Meerut, 16/e, 2021



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Apply error estimation techniques and compute errors using the general error formula, assessing the accuracy of numerical methods.	X	X	X		X	
Solve algebraic and transcendental equations using numerical methods, including the Bisection, False Position, Iteration, and Newton-Raphson methods.	X	X		X	X	
Implement formulas such as Newton's Forward, Backward, Gauss's Central, and Lagrange's interpolation for both equal and unequal intervals.	X	X	X		X	

Question Paper Template

Unit	Remembering / Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	20%	40%	-	30%	-	100%
II	10%	-	50%	-	40%	-	100%



S.Y.B.Sc. (Mathematics) Semester-III

COURSE TITLE: LAB COURSE-V

COURSE CODE: MHMJ-S3PR5-2CR25 [CREDITS- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Demonstrate Mathematical skills.
2. Correlate their Mathematical theory concepts through practical.

PRACTICAL Major MHMJ-S3PR5-2CR25 (Lab Course - V)

- 1 Numerical Solutions of Algebraic and Transcendental Equations: Bisection Method.
- 2 Numerical Solution of Algebraic and Transcendental Equations: Method of False-Position
- 3 Numerical Solutions of Algebraic and Transcendental Equations: Iteration Method.
- 4 Numerical Solution of Algebraic and Transcendental Equations: Newton-Raphson Method
- 5 Finite Differences and Symbolic relation between operators.
- 6 Newton's forward and backward difference interpolation.
- 7 Gauss's Central Interpolation Formula.
- 8 Newton's Divided Difference Interpolation Formula
- 9 Lagrange's Interpolation Formula



S.Y.B.Sc. (Mathematics) Semester-III

Major Course - VI

COURSE TITLE: Multivariate Differential Calculus

COURSE CODE: MHMJ-S3P6-2CR25 [CREDITS - 02]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> 1. Define and use fundamental concepts of multivariate differential calculus including limits, continuity and differentiability. 2. Perform differential calculus operations on functions of several variables including continuity, partial derivatives and directional derivatives. 3. Recognize mathematical formulae and methods of derivation of multivariable functions. 4. Evaluate partial derivatives and understand various applications of partial differentiation. 5. Apply and use the concept of an applications of partial differentiation to solve some practical problems involving partial differentiation to estimate maxima and minima of multivariable function. 6. Find tangent plane and normal line to the surface, Taylor's and Maclaurin's series expansions and Jacobian of multivariable function. 		
Module 1	Limits and Continuity of Bivariate function and Partial Differentiation	[15L]
<p>Learning Objective</p> <p>This module is intended to</p> <ol style="list-style-type: none"> 1. To provide students with fundamental concepts and techniques of multivariable calculus. 2. Study the limit of a Bivariate function and verify continuity of function for two variables. 3. Understand partial derivatives and establish the relationship between partial derivative of a function and the product of functions with its degree. 		
<p>Learning Outcomes:</p> <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Define and find limits and continuity of a function of two variables. 2. Evaluate partial derivatives of first and higher order. 3. Recognize mathematical formulae and methods of derivation of multivariable functions. 4. Understand the relationship between partial derivative of a function and the product of functions with its degree in terms of Euler's theorem on Homogeneous functions. 		
1.1	Limits and Continuity of a function of Bivariate function	[3L]
1.2	Partial derivatives of first and Higher orders, Differentiation of a Function of a Function, the Mixed Derivative Theorem	[3L]



1.3	Total Derivative and the Chain rule, Partial Differentiation of Implicit functions	[3L]
1.4	Homogenous functions	[2L]
1.5	Euler's Theorem on Homogenous Functions	[4L]
Module 2	Applications of Partial Differentiation	[15L]
Learning Objective This module is intended to 1. Develop student understanding and skills for applications of partial differentiation to other areas.		
Learning Outcomes: At the end of this module the learner will be able to 1. Use and understand the concept of applications of partial differentiation to solve some practical problems involving partial differentiation to estimate maxima and minima of multivariable function. 2. Use the concept of applications of partial differentiation to find tangent plane and normal line to the surface. 3. Obtain Taylor's and Maclaurin's series expansions and Jacobian of multivariable function.		
2.1	Tangent Plane and Normal Line to a Surface	[2L]
2.3	Taylor's Expansions for Functions of Two Variables	[3L]
2.4	Maclaurin's Expansions for Functions of Two Variables	[3L]
2.5	Maxima-Minima for functions of two variables: Necessary and sufficient conditions for extreme values.	[3L]
2.6	Lagrange's Method of Undetermined Multipliers	[2L]
2.7	Jacobians	[2L]

References:

1. Shanti Narayan and P.K Mittal: Differential Calculus, S. Chand Co., New Delhi.
2. David V. Widder: Advanced Calculus, PHI Learning Prv. Ltd., New Delhi, 2/e, 1989.
3. Shanti Narayan and P.K Mittal: A text book of Vector Calculus, 4/e, S. Chand Co., New Delhi.
4. Hari Kishan: Vector Algebra and Calculus, Atlantic Pub. & Distributors (P) Ltd., New Delhi.
5. E. Kreyszig: Advanced Engineering Mathematics, 10/e, John Wiley, New York, 2011.
6. B.S. Grewal: Higher Engineering Mathematics, 42/e, Khanna Publishers, 2012.
7. H. K. Dass: Advanced Engineering Mathematics, S. Chand and Company Pvt. Ltd., New Delhi, 2008.



Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Define and use fundamental concepts of multivariate differential calculus including limits, continuity and differentiability.	X	X	X	X	X	
Perform differential calculus operations on functions of several variables including continuity, partial derivatives and directional derivatives.	X	X	X	X	X	
Recognize mathematical formulae and methods of derivation of multivariable functions.	X	X	X	X	X	
Evaluate partial derivatives and understand various applications of partial differentiation.	X	X	X	X	X	
Apply and use the concept of an applications of partial differentiation to solve some practical problems involving partial differentiation to estimate maxima and minima of multivariable function	X	X	X	X	X	X
Find tangent plane and normal line to the surface, Taylor's and Maclaurin's series expansions and Jacobian of multivariable function.	X	X	X	X	X	X

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	20%	-	40%	-	100%
II	10%	20%	30%	-	40%	-	100%



S.Y.B.Sc. (Mathematics) Semester-III

COURSE TITLE: LAB COURSE-VI

COURSE CODE: MHMJ-S3PR6-2CR25 [CREDITS- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Apply partial differentiation and understand various applications of partial differentiation to get accurate solution practically.
2. Develop the understanding of objectives and features of multivariate differential calculus.
3. Demonstrate mathematical and computational skills.
4. Correlate their mathematical theory concepts through practical.

PRACTICAL Major MHMJ-S3PR6-2CR25 (Lab Course - VI)

1	Find limit and check continuity of Bivariate function.
2	Obtain partial derivatives of higher orders, total derivative and the chain rule and examples based on differentiation of a function of a function.
3	Obtain Partial Differentiation of Implicit functions and Euler's theorem on Homogenous Functions.
4	Find Tangent plane and normal line to a surface and solution of Taylor's expansions for functions of two variables.
5	Solution of Maclaurin's expansions for functions of two variables.
6	Estimate Maxima-Minima for functions of two variables for extreme values.
7	Examples based on Lagrange are Method of Undetermined Multipliers
8	Jacobians for two and three variables.



S.Y. B. Sc. (Mathematics) Semester-III

Major Course - VII

COURSE TITLE: Linear Algebra-I

COURSE CODE: MHMJ-S3P7-4CR25 [CREDITS - 04]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> 1. Provide an elementary introduction of Linear Algebra through the concept of Vector space and subspace and understand the concept of Linear Combination and span of a set of vectors. 2. Prove basic results in linear algebra using appropriate proof-writing techniques such as properties of subspaces, linear independence of vectors; basis and dimension and linearity linearity, injectivity and surjectivity of functions. 3. Understand direct sum and obtain linearly independent and dependent set of vectors. 4. Determine basis and dimension of vector spaces and subspaces and obtain basis of Row Space, Column Space and Null Space. 5. Study the properties of inner product spaces and apply Gram-Schmidt's process to orthogonalize sets and use orthogonal and orthonormal bases to solve application problems. 		
Module 1	Vector Spaces	[15L]
Learning Objective		
<p>This module is intended to</p> <ol style="list-style-type: none"> 1. Identify the concept of vector space and subspace. 2. Understand the concept of Linear Combination and span of a set of vectors and use of to them to prove theorems and solve examples based on it. 		
Learning Outcomes:		
<p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Understand an elementary introduction of Linear Algebra through the concept of vector space and subspace. 2. Understand the concept of Linear Combination and span of a set of vectors. 		
1.1	Definition, examples, results and properties of Vector Space	[3L]
1.2	Subspaces, Necessary and sufficient condition for a subspace	[3L]



1.3	Examples, results and theorems on subspaces	[3L]
1.4	Union and intersection of Subspaces	[3L]
1.5	Finite Linear Combination of vectors, examples and results	[1L]
1.6	Span of a set of vectors, theorems on span and examples	[2L]
Module 2	Direct sum, Linear dependence and independence	[15L]
Learning Objective This module is intended to		
1. Understand the concept of direct sum and use of it in the context of vector space and subspace.		
2. Study and obtain linearly independent and dependent set of vectors along with use of the concept of collinear and coplanar.		
Learning Outcomes: At the end of this module the learner will be able to		
1. Use the concept of direct sum in the context of vector space and subspace.		
2. Obtain linearly independent and dependent set of vectors and also verify the set of vectors are linearly independent or dependent for a given vector space.		
2.1	Sum and Direct Sum of Subspaces	[3L]
2.2	Definition of Linearly dependence and Linearly independence	[3L]
2.3	Examples and theorems on Linearly independent and dependent set of vectors	[4L]
2.4	Verification of Linear dependence or independence	[3L]
2.5	Definition of Collinear and Coplanar, theorems based on Collinear and Coplanar	[2L]
Module 3	Basis and Dimension	[15L]
Learning objectives: This module is intended to		
1. Understand and find basis and dimension of vector spaces and subspaces with the Extension of a linearly independent set to a basis.		
2. Obtain basis of Row Space, Column Space and Null Space.		
Learning outcome: At the end of this module the learner will be able to		
1. Determine basis and dimension of vector spaces and subspaces with the Extension of a linearly independent set to a basis.		
2. Apply the use of basis to find Row Space, Column Space and Null Space.		
3.1	Dimension and basis of a vector space, examples, results and theorems on Basis	[2L]
3.2	Extension of a linearly independent set to a basis	[4L]



3.3	Dimension of sum	[3L]
3.4	Row space, Column Space and Null space	[2L]
3.5	Basis of Null Space	[2L]
3.6	Basis of Row space and Column Space	[2L]
Module 4	Inner Product Spaces	[15L]
Learning objectives: This module is intended to <ol style="list-style-type: none">1. Understand the concept of Inner product spaces and its properties with proofs of some important results and illustrations.2. Study orthogonal bases and Gram-Schmidt's process to orthogonalize sets and use orthogonal and orthonormal bases to solve application problems.		
Learning outcome: At the end of this module the learner will be able to <ol style="list-style-type: none">1. Prove basic results in linear algebra using appropriate proof-writing techniques such as properties of Inner product spaces.2. Understand norm of a vector and apply it to prove Cauchy-Schwarz inequality and Triangular inequality for Inner product spaces.3. Apply Gram-Schmidt's process to orthogonalize sets and use orthogonal and orthonormal bases to solve application problems.		
4.1	Definition of Inner Product spaces, results and examples	[3L]
4.2	Norm of a vector and examples	[2L]
4.3	Cauchy-Schwarz inequality	[3L]
4.4	Triangular inequality	[2L]
4.5	Orthogonal vectors, orthogonal set and vector projection	[2L]
4.6	Orthonormal set and Gram-Schmidt Orthogonalization Process	[3L]



References:

1. V. Krishnamurthy, V. P. Mainra & J. L. Arora: An Introduction to Linear Algebra, Affiliated East-West Press P. Ltd., New Delhi. Edition 2019 (Reprint).
2. H. Anton and C. Rorres : Elementary Linear Algebra with supplemental applications, International Student Version, Wiley India Private Ltd., New Delhi, 11/e, 2023 (Reprint).
3. David C. Lay: Linear Algebra and its applications, Pearson Education, Inc. and Dorling Kindersley Publishing inc, 3/e, 2003.
4. S. Kumaresan: Linear Algebra: A Geometric Approach, Prentice Hall of India, 2004.
5. G. Strang: Linear Algebra and its applications, Brooks/Cole, a part of Cengage Learning India Private Ltd., New Delhi, 4/e, 2008(Reprint).
6. Serge Lang : Introduction to Linear Algebra, Springer, India. Addition-Wesley Publication Co.(Student Edition)
7. Balakrishnan: Linear Algebra, Tata-McGraw Hill Edition.
8. I. H. Sheth : Linear Algebra, Nirav Prakashan.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Provide an elementary introduction of Linear Algebra through the concept of Vector space and subspace and understand the concept of Linear Combination and span of a set of vectors.	X	X	X	X	X	
Prove basic results in linear algebra using appropriate proof-writing techniques such as properties of subspaces, linear independence of vectors; basis and dimension and linearity, injectivity and surjectivity of functions.	X	X	X	X	X	
Understand direct sum and obtain linearly independent and dependent set of vectors.	X	X	X	X	X	
Determine basis and dimension of vector spaces and subspaces and obtain basis of Row Space, Column Space and Null Space.	X	X	X	X	X	
Study the properties of inner product spaces and apply Gram-Schmidt's process to orthogonalize sets and use orthogonal and orthonormal bases to solve application problems.	X	X	X	X	X	



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Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total Marks
I	10%	40%	30%	-	20%	-	100%
II	10%	30%	40%	-	20%	-	100%
III	10%	30%	30%	-	30%	-	100%
IV	10%	30%	30%	-	30%	-	100%



S.Y.B.Sc. (Mathematics) Semester-III

Multidisciplinary Course-1

COURSE TITLE: Applications of Matrices

COURSE CODE: MHMDC-S3P1-4CR25 [CREDITS - 04]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> To perform matrix operations and solve the matrix equation using elementary matrix operations. Acquire the idea of representing a system of equation in matrix form and its advantages. Determine the determinant of a square matrix. Gain the process of matrix operations, matrix transformation and row operations. Determine the rank of a matrix and solve related problems. Apply matrices in geometry, physics, chemistry and combinatorics. Solve a system of linear equations by using the idea of matrices. Find eigenvalues and corresponding eigenvectors for a square matrix and check for its diagonalizability. Understand characteristic equation, acquire the knowledge of eigen values and eigen vectors and their application. Apply Cayley-Hamilton theorem to find the inverse of a matrix. 		
Module 1	Basic Concepts: Matrices and Matrix Operations	[15L]
<p>Learning Objective This module is intended to</p> <ol style="list-style-type: none"> Introduce the students about the different types of matrices and matrix operations with their properties. Study some special matrices in detail. 		
<p>Learning Outcomes: At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> Understand various types of matrices along with their operations and properties of matrices prove some important results based on it. To perform matrix operations and implement it to solve examples using elementary matrix operations such as addition, subtraction, multiplication and scalar multiplication. Solve examples based on some special matrices and also obtain trace of matrix and discuss its properties. 		
1.1	Introduction of matrices	[2L]
1.2	Different types of matrices	[3L]
1.3	Operations on matrices,	[2L]



1.4	Properties of operations on matrices	[2L]
1.5	Adjoint of matrix and Inverse of a matrix	[3L]
1.6	Some special matrices, Trace of matrix and its properties	[3L]
Module 2	Elementary Row Operations	[15L]
Learning Objective This module is intended to 1. Understand the students to find determinant of square matrix along with concept of minor and cofactor. 2. Study elementary row operations and use of it to find rank of matrix using elementary row operations and determinant method.		
Learning Outcomes: At the end of this module the learner will be able to 1. Determine the determinant of a square matrix and process to find minor and cofactor. 2. Gain and the process of matrix operations, matrix transformation and row operations. 3. Evaluate the rank of a matrix and solve related problems. 4. Understand the difference between Row Echelon form and Row reduced Echelon form and use of it to find Rank of a matrix by determinant Method and by Row reduced Echelon form.		
2.1	Introduction to Determinants, minor and cofactor and properties of determinants	[3L]
2.2	Evaluation of Determinants of a Square Matrix by Row Reduction	[3L]
2.3	Elementary row operations: Row Echelon form and Row reduced Echelon form	[4L]
2.4	Linear independence of rows, Row Rank and Rank of a matrix by determinant Method	[3L]
2.5	Rank of a matrix by Row reduced Echelon form	[2L]
Module 3	Gauss Elimination and Gauss-Jordan Elimination method and Solution of Systems of Linear Equations	[15L]
Learning objectives: This module is intended to 1. apply elementary row operations to solve system of linear equations using Gauss Elimination method, matrix method (row reduced echelon form) and determinant method. 2. Understand invertibility of matrices and use of it to evaluate inverse of matrix by Gauss Jordan method.		
Learning outcome: At the end of this module the learner will be able to 1. Acquire the idea of representing a system of equation in matrix form and its advantages.		



2. Solve system of linear equations using Gauss Elimination method and find inverse of a matrix using Gauss Jordan method.		
3. Solve a system of homogeneous and non-homogeneous linear equations by using the idea of matrices.		
4. Apply the use of Determinant method to solve system of linear equations and solve a system of linear equations dependent on rank.		
3.1	Gauss Elimination Method	[2L]
3.2	Invertibility of Matrices, Inverse of a matrix by Elementary Transformation (Gauss Jordan Method)	[3L]
3.3	Equivalent system of linear equations	[2L]
3.4	Matrix method to solve a system of homogenous and non-homogenous linear equations (row-reduced echelon form)	[4L]
3.5	Determinant method to solve system of linear equations (Cramer's Rule)	[2L]
3.6	Solution of a system of linear equations dependent on rank	[2L]
Module 4	Eigen Values and Eigen Vectors	[15L]
Learning objectives: This module is intended to		
1. Explore the concept of eigen values and eigen vectors as a tool to provide an elementary knowledge of Matrix theory.		
2. Use of eigen values and eigen vectors to compute algebraic and geometric multiplicity and apply Cayley-Hamilton theorem to find the inverse of a matrix.		
3. Introduce the students about similar matrices and study basis of eigen vector and power of matrix.		
Learning outcome: At the end of this module the learner will be able to		
1. Find eigen values and corresponding eigen vectors for a square matrix and check for its diagonalizability.		
2. Understand characteristic equation, acquire the knowledge of eigen values and eigen vectors and their applications to compute algebraic and geometric multiplicity.		
3. Apply Cayley-Hamilton theorem to find the inverse of a matrix.		
4. Understand the concept of similar matrices and find basis of eigenvectors and power of matrix.		
4.1	Characteristic equation of a matrix, method to find characteristic equation using determinant, Minors of a matrix	[2L]
4.2	Eigen Values and Eigen Vectors of a matrix	[3L]
4.3	Algebraic and Geometric multiplicity of an eigenvalue	[2L]
4.4	Cayley-Hamilton Theorem and its application to find an inverse of a matrix	[3L]
4.5	Similar matrices and Diagonalization of matrices	[3L]
4.6	Basis of Eigenvectors, Power of a matrix	[2L]



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Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
To perform matrix operations and solve the matrix equation using elementary matrix operations.	X	X	X	X	X	
Acquire the idea of representing a system of equation in matrix form and its advantages.	X	X	X	X	X	
Determine the determinant of a square matrix.	X	X	X		X	
Gain the process of matrix operations, matrix transformation and row operations.	X	X	X	X	X	
Determine the rank of a matrix and solve related problems.	X	X	X	X	X	
Apply matrices in geometry, physics, chemistry and combinatorics.	X	X	X	X	X	X
Solve a system of linear equations by using the idea of matrices.	X	X	X		X	
Find eigenvalues and corresponding eigenvectors for a square matrix and check for its diagonalizability	X	X	X	X	X	
Understand characteristic equation, acquire the knowledge of eigen values and eigen vectors and their application.	X	X	X	X	X	
Apply Cayley-Hamilton theorem to find the inverse of a matrix.	X	X	X	X	X	



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Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	20%	30%	-	40%	-	100%
II	05%	25%	30%		40%	-	100%
III	10%	10%	50%	-	30%	-	100%
IV	10%	20%	30%	-	40%	-	100%



S.Y. B. Sc. (Mathematics) Semester-III

Multidisciplinary Course

COURSE TITLE: Probability distributions and Testing of hypothesis

COURSE CODE: MHMDC-S3P2-4CR25 [CREDITS - 04]

Course learning outcome

At the end of this course, Students will be able to

1. Identify the real-life situations to apply discrete probability distributions like Uniform, Bernoulli, Binomial, Poisson and Geometric Probability distributions and compute related probabilities & properties.
2. Identify the real-life situations to apply Continuous probability distributions like Normal, Exponential and Gamma probability distributions and compute related probabilities & properties.
3. Identify the real-life situations to apply large sample tests with Testing of hypothesis.
4. Identify the real-life situations to apply small sample tests with Testing of hypothesis.
5. Understand the p value approach in statistical test of significance.

Module 1 Discrete probability distributions

[16L]

Learning Objective

1. To discuss various univariate distributions. Such as Uniform, Bernoulli, Binomial, Poisson and Geometric Probability distributions.
2. To expose the applicability of various distributions in different disciplines.

Learning Outcomes:

At the end of this module the learner will be able to

1. Obtain a probability distribution of random variable (univariate case) in the given situation.
2. Understand some standard discrete probability distributions such as Bernoulli, Binomial, and Poisson distribution.

1.1	Uniform distribution: Definition, Mean, Variance and its applications. Bernoulli distribution: Definition, Mean, Variance.	[2L]
1.2	Binomial Distribution: Definition, Condition for application of it, Uses, Mean, Variance. Applications of binomial distribution with numerical examples.	[6L]
1.3	Poisson Distribution: Definition, Condition for application of it, Uses, Mean, Variance. Applications of Poisson distribution with numerical examples.	[6L]



1.4	Geometric Distribution: Definition, Uses, Mean, Variance. Applications of Geometric distribution with numerical examples.	[2L]
Module 2	Continuous probability distributions	[16L]
Learning Objective		
<ol style="list-style-type: none">1. To discuss various continuous distributions. Such as Normal, Exponential and Gamma probability distributions.2. To expose the applicability of various distributions in different disciplines.		
Learning Outcomes:		
At the end of this module the learner will be able to		
<ol style="list-style-type: none">1. Obtain a probability distribution of random variable in the given situation.2. Apply application of standard continuous probability distribution to different situations.		
2.1	Normal distribution: Definition, Importance, Mean, Variance, Area Property of normal Curve. Different properties of Normal distribution (without proof). Applications of Normal distribution with numerical examples.	[10L]
2.2	Exponential distribution: Definition, Importance, Mean, Variance. Applications of Exponential distribution with numerical examples.	[3L]
2.3	Gamma distribution: Definition, Importance, Mean, Variance. Applications of Gamma distribution with numerical examples.	[3L]
Module 3	Testing of hypothesis - I (Large sample tests)	[18L]
Learning Objective		
<ol style="list-style-type: none">1. To discuss the concept of the Testing of Hypothesis & different terms of the Testing of Hypothesis.2. To discuss hypothesis testing for large sample.		
Learning Outcomes:		
At the end of this module the learner will be able to		
<ol style="list-style-type: none">1. Understand the concept of hypothesis and its testing and applications in various fields.2. Identify the components of a classical hypothesis test, including the parameter of interest, the null and alternative hypotheses, type I error and type II error, Critical region of the test.3. Understand testing of hypothesis for large sample.		



3.1	Define terms: Parameter, Statistic, Sampling distribution of a statistic, Standard error, Hypothesis, Statistical hypothesis, Null and alternative hypothesis, Simple and composite hypothesis, Level of significance, Type I and Type II errors, Power of a test, Rejection region, Critical value, Test statistic, Two-tailed and One-tailed test, Degrees of freedom, P value.	[6L]
3.2	Procedure for testing of hypothesis.	[2L]
3.3	Tests of significance for Large sample tests: <u>Tests of attributes:</u> (i) Test of significance for single proportion, (ii) Test of significance for the difference of proportions. Applications of above topics with numerical examples.	[4L]
3.4	<u>Tests of variables:</u> (i) Test of significance for single mean, (ii) Test of significance for the difference of means, (iii) Test of significance for the difference of standard deviations. Applications of above topics with numerical examples.	[6L]
Module 4	Testing of hypothesis - II (Small sample tests)	[10L]
Learning Objective		
1. To introduce the basic concepts of hypothesis testing for Small sample test. 2. To apply application of the small sample test with testing of hypothesis.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Understand the difference between large sample and small sample test. 2. Understand the concept of testing of hypothesis for small test and its applications in various fields.		
4.1	<u>Chi square test:</u> Chi square variate, Assumptions of Chi square test. <u>Applications:</u> (i) To test the 'goodness of fit', (ii) To test the independence of attributes (iii) To test a specified value of the variance of the population.	[4L]
4.2	<u>t- Test:</u> <ul style="list-style-type: none">▪ t- statistic, Assumptions of t - test.▪ Applications:<ul style="list-style-type: none">▪ (i) Test for single mean, (ii) Test for difference of means: For independent samples and for dependent samples, (iii) Test the significance of an observed sample correlation coefficient.	[5L]
4.3	<u>F- Test:</u> <ul style="list-style-type: none">▪ F- statistic, Assumptions of F - test.▪ Application: Test for equality of two population.	[1L]



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1. S. C. Gupta, V. K. Kapoor: Fundamentals of Mathematical Statistics -12^e, Sultan Chand & Sons
2. Goon A.M., Gupta M. K. and Dasgupta: Fundamentals of Statistics, Vol. I, 8^e the world press, Kolkata.
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Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Identify the real-life situations to apply discrete probability distributions like Uniform, Bernoulli, Binomial, Poisson and Geometric Probability distributions and compute related probabilities & properties.	X	X	X		X	
Identify the real-life situations to apply Continuous probability distributions like Normal, Exponential and Gamma probability distributions and compute related probabilities & properties.	X	X	X		X	
Identify the real-life situations to apply large sample tests with Testing of hypothesis.	X	X	X		X	
Identify the real-life situations to apply small sample tests with Testing of hypothesis.	X	X	X		X	
Understand the p value approach in statistical test of significance.	X	X	X			



Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total Marks
I	10%	25%	40%	-	25%	-	100%
II	10%	25%	40%	-	25%	-	100%
III	20%	20%	30%	30%	-	-	100%
IV	20%	20%	30%	30%	-	-	100%



S.Y. B. Sc. (Mathematics) Semester-III

Skill Enhancement Course - III

COURSE TITLE: Vedic Mathematics and its Techniques- III

COURSE CODE: MHSEC-S3PR1-2CR25 [CREDITS - 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Develop conceptual knowledge of mathematical concepts by applying Vedic Mathematics techniques practically.
2. Enhance computational proficiency and think critically and correlate their mathematical concepts through practical.
3. Use Vedic Mathematics concept in various areas of Mathematics such as Geometry, Coordinate Geometry etc. through practical approach.
4. Understand base method of multiplication of the numbers just below and above the base and the numbers near different bases.
5. Obtain multiplication of two digits numbers by two digits numbers, three digits numbers by three digits numbers multiplication and also find multiplication by repeating numbers.
6. Identify digit sums and understand the concept of remove the bar numbers and create the bar numbers.
7. Apply the concepts of Triples in Triple geometry to obtain angle between two lines and rotation using triples to rotate the points.
8. Use of triples in Coordinate Geometry to find gradients and solving circle problems.

PRACTICAL (MHSEC-S3PR3-2CR25) (Lab Course - SEC)

[60L]

1. Obtain multiplication near a base as a special method of multiplication using Nikhilam sutra.
2. Obtain multiplication of the numbers less than (just below) the base using Nikhilam sutra.
3. Obtain multiplication of the numbers more than (above) the base using Nikhilam sutra.
4. Find multiplication of the numbers one more and one less than the base (a number above and below the base) using Nikhilam sutra.
5. Obtain multiplication of the numbers near different bases using Anurupyena sutra.
6. Problems based on multiplying two digits numbers by two digits numbers, if left hand digits should be the same and the total of right-hand digits should be 10 by using Urdhvatiryagbhyam Sutra.



7. Problems based on multiplying three digits numbers by three digits numbers, if the first two digits on the left side should be the same and the total of right-hand digits should be 10 using Urdhvatiiryagbhyam Sutra.
8. Examples based on multiplication where the first digits remain the same but the total of the last digits is less than 10.
9. Examples based on multiplication by repeating numbers such as 101, 1001, 10101, 1010101 etc. and proportionately.
10. Calculate digit sums and remove the bar numbers and create the bar numbers by using Nikhilaam sutra.
11. Obtain triples, triples for 45° , 30° and 60° and triple addition and subtraction.
12. Sketch triples by using variation of 3, 4, 5.
13. Calculate Double angle, triple angle and half angle.
14. Examples based on Rotation using triples to rotate the points.
15. Problems based on applications of Triples: Triple geometry and obtain angle between two lines.
16. Problems based on applications of triples in Coordinate Geometry: gradients and solving circle problems.

References:

1. Sri Bharatikrishna Tirthaji: Vedic Mathematics, 17/e, Published by Motilal Banarsidass, 1965.
2. Vedic Mathematics: Sixteen Simple Mathematical formulae from the Vedas, Jagadguru Swami Sri Bharati Krishna Trithaji, Motilal Banarasidas, New Delhi, 2015.
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Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Develop conceptual knowledge of mathematical concepts by applying Vedic Mathematics techniques practically.	X	X	X	X	X	
Enhance computational proficiency and think critically and correlate their mathematical concepts through practical.	X	X	X	X	X	
Use Vedic Mathematics concept in various areas of Mathematics such as Geometry, Coordinate Geometry etc. through practical approach.	X	X	X	X	X	X
Understand base method of multiplication of the numbers just below and above the base and the numbers near different bases.	X	X	X	X	X	
Obtain multiplication of two digits numbers by two digits numbers, three digits numbers by three digits numbers multiplication and also find multiplication by repeating numbers.	X	X	X	X	X	
Identify digit sums and understand the concept of remove the bar numbers and create the bar numbers.	X	X	X	X	X	
Apply the concepts of Triples in Triple geometry to obtain angle between two lines and rotation using triples to rotate the points.	X	X	X	X	X	X
Use of triples in Coordinate Geometry to find gradients and solving circle problems.	X	X	X	X	X	X



.Y. B. Sc. (Mathematics) Semester-III

Skill Enhancement Course - III

COURSE TITLE: Linear Programming

COURSE CODE: MHSEC-S3PR2-2CR25 [CREDITS - 02]

Course learning outcome

At the end of this course, Students will be able to

1. Identify decision variables, formulate objective functions, and construct constraints for real-world optimization scenarios.
2. Apply graphical methods, the Simplex method, the Two-Phase method, and the Big-M method to solve linear programming problems and find optimal solutions.
3. Understand and solve dual problems, analyze the relationship between primal and dual solutions, and apply duality principles to optimization tasks.
4. Implement slack, surplus, and artificial variables to transform inequalities into standard form and solve LPP systematically.
5. Apply linear programming techniques to address complex decision-making problems in various domains such as business, transportation, resource allocation, and logistics.

PRACTICAL MHSEC-S3P1-2CR25

[60L]

- 1 Formulation of Linear Programming Model-1
- 2 Formulation of Linear Programming Model-2
- 3 Graphical Solution of LPP (Maximization Case)
- 4 Graphical Solution of LPP (Minimization Case)
- 5 Computational Procedure: Simplex Algorithm for Maximization Case-1
- 6 Computational Procedure: Simplex Algorithm for Maximization Case-2
- 7 Computational Procedure: Simplex Algorithm for Minimization Case-1
- 8 Computational Procedure: Simplex Algorithm for Minimization Case-2
- 9 Computational Procedure: Two-Phase Method for Maximization Case-1
- 10 Computational Procedure: Two-Phase Method for Maximization Case-2
- 11 Computational Procedure: Two-Phase Method for Minimization Case-1



12	Computational Procedure: Two-Phase Method for Minimization Case-2
13	Computational Procedure: The Big-M Method for Maximization Case-1
14	Computational Procedure: The Big-M Method for Maximization Case-2
15	Computational Procedure: The Big-M Method for Minimization Case-1
16	Computational Procedure: The Big-M Method for Minimization Case-2

Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Identify decision variables, formulate objective functions, and construct constraints for real-world optimization scenarios.	X	X	X		X	
Apply graphical methods, the Simplex method, the Two-Phase method, and the Big-M method to solve linear programming problems and find optimal solutions.	X	X	X	X	X	
Understand and solve dual problems, analyze the relationship between primal and dual solutions, and apply duality principles to optimization tasks.	X	X	X	X	X	
Implement slack, surplus, and artificial variables to transform inequalities into standard form and solve LPP systematically.	X	X	X	X	X	
Apply linear programming techniques to address complex decision-making problems in various domains such as business, transportation, resource allocation, and logistics.	X	X	X	X	X	

References:

1. Kanti Swaroop, P. K. Gupta & Man Mohan: Operations Research, S. Chand & Sons, New Delhi, 1998.
2. G. Hadley: Linear Programming, Narosa Publishing House, New Delhi, 1995.
3. J. K. Sharma: Operations Research: Theory & Applications, McMillan India Ltd., 1998.
4. K. V. Mittal & L. Mohan: Optimization methods in O.R. and System Analysis, New Age International Publications. 5/e.



S.Y.B.Sc. (Mathematics) Semester-III

IKS in Mathematics

COURSE TITLE: Ancient Indian Mathematics

COURSE CODE: MHIKS-S3P1-2CR25 [CREDITS - 02]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> 1. Have the knowledge of history and development of Indian Mathematics. 2. Discuss the rich heritage of mathematical temper of Ancient India. 3. Apply the knowledge of Indian Mathematics in solving day to day problems in an easier way. 4. Appreciate the Mathematical advancements of Ancient India. 5. Relate the ancient and modern mathematics. 6. Have the fair idea about Ramanujan and his work. 		
Module 1	Mathematics in Ancient India : An overview	[15L]
<p>Learning Objective</p> <p>This module is intended to</p> <ol style="list-style-type: none"> 1. To make the present generations aware about the history of Indian Mathematics. 2. To bring forward the radiant culture of Ancient Indian Mathematics so that this mathematical knowledge from past can benefit the people at large. 3. Foster the love for mathematics by creating a positive attitude through Ancient Indian Mathematics. 		
<p>Learning Outcomes:</p> <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Have the knowledge of history and development of Indian Mathematics. 2. Discuss the rich heritage of mathematical temper of Ancient India. 3. Relate the ancient and modern mathematics. 4. Know about the contribution of Indian Mathematician Srinivasa Ramanujan and proofs in Indian Mathematics. 		
1.1	Mahaviracharya on the all-pervasiveness of Ganita and the algorithmic approach of Indian Mathematics	[3L]
1.2	Development of Indian Mathematics I: Ancient and Early Classical Period (till 500 CE)	[2L]
1.3	Development of Indian Mathematics II: Later Classical Period (500 -1250)	[2L]
1.4	Development of Indian Mathematics III: Medieval Period (1250 - 1850)	[2L]
1.5	The genius of Srinivasa Ramanujan (1887-1920)	[3L]
1.6	Proofs in Indian Mathematics, Lessons from History	[3L]



Module 2 Mathematics in the Vedas and Sulba Sutra		[15L]
Learning Objective This module is intended to <ol style="list-style-type: none">1. Understand the basic concept of mathematics in Vedas and meaning of the word 'Sulbasutra' in detail.2. Help students appreciate ancient Indian Mathematics and its contribution to the world.		
Learning Outcomes: At the end of this module the learner will be able to <ol style="list-style-type: none">1. Apply the knowledge of Indian Mathematics in solving day to day problems in an easier way.2. Appreciate the Mathematical advancements of Ancient India.3. Find the cardinal directions and obtain perpendicular bisector.4. Use Bodhayana method of constructing a square and understand the concept of Baudhayana(Pythagoras) theorem (The Sulba theorem).		
2.1	Mathematical references in Vedas	[2L]
2.2	Sulbasutra texts, the meaning of word 'Sulbasutra' , Qualities of a Sulbasutra	[2L]
2.3	Finding the cardinal directions, Methods for obtaining perpendicular bisector	[2L]
2.4	Bodhayana method of constructing a square	[3L]
2.5	Concept of Baudhayana (Pythagoras) theorem (The Sulba theorem)	[2L]
2.6	Applications of Sulba theorem	[4L]



References:

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2. A Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi.
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10. C.S. Seshadri, Ed., Studies in History of Indian mathematics, Hindustan Book Agency, Delhi, 2010.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Have the knowledge of history and development of Indian Mathematics.	X	X	X		X	X
Discuss the rich heritage of mathematical temper of Ancient India.	X	X	X	X	X	X
Apply the knowledge of Indian Mathematics in solving day to day problems in an easier way.	X	X		X	X	X
Appreciate the Mathematical advancements of Ancient India.	X	X	X		X	
Relate the ancient and modern Mathematics.	X	X	X		X	
Have the fair idea about Ramanujan and his work.	X	X	X		X	X



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Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	30%	40%	30%	-	-	-	100%
II	20%	40%	30%	-	10%	-	100%



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Semester-IV



S.Y.B.Sc. (Mathematics) Semester-IV

Major Course- VIII

COURSE TITLE: Numerical Methods-II

COURSE CODE: MHMJ-S4P8-2CR25 [CREDITS - 02]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> 1. Develop a thorough understanding of least squares curve fitting techniques, including fitting straight lines, multiple linear regression, and nonlinear models using polynomials and sums of exponentials. 2. Learn the principles and applications of numerical differentiation, focusing on the calculation of first and second-order derivatives. 3. Gain expertise in numerical integration methods, including the Trapezoidal Rule, Simpson's 1/3 Rule, and Simpson's 3/8 Rule, and understand their applications in solving real-world problems. 4. Apply various numerical methods for solving ordinary differential equations, including Taylor's series, Picard's approximation, Euler's method, Modified Euler's method, and the Runge-Kutta (2nd and 4th order) methods. 		
Module 1	Curve fitting	[15L]
<p>Learning Objective</p> <ol style="list-style-type: none"> 1. Understand and apply the least squares method for fitting straight lines and multiple linear models to data. 2. Learn the process of linearizing nonlinear relationships and applying them in curve fitting. 3. Gain proficiency in fitting curves using polynomial models and sums of exponentials. 		
<p>Learning Outcomes:</p> <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Implement least squares curve fitting techniques for both simple and multiple linear regression problems. 2. Linearize nonlinear equations and apply them effectively to fit data. 3. Use polynomial and exponential models to fit data and analyze the best-fit solutions. 		
1.1	Least squares Curve fitting procedures, Fitting a straight line, Multiple Linear least squares.	[6L]
1.2	Linearization of nonlinear laws	[3L]
1.3	Curve fitting by polynomials	[3L]
1.4	Curve fitting by sum of exponentials	[3L]



Module 2 Numerical Differentiation and Integration		[15L]
Learning Objective <ol style="list-style-type: none">1. Understand and implement numerical differentiation techniques.2. Derive and apply numerical integration formulas.3. Compare different numerical integration methods for accuracy.4. Understand the need for numerical solutions to ordinary differential equations.5. Derive and apply various numerical methods for solving ODEs.6. Analyze the accuracy and efficiency of different numerical methods.		
Learning Outcomes: <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none">1. Compute numerical derivatives using finite differences.2. Apply numerical integration techniques to approximate definite integrals.3. Evaluate the efficiency of different numerical integration methods.4. Solve ODEs using Taylor's series, Picard's approximation, and Euler's method.		
2.1	Numerical Differentiation: First and Second-Order Derivatives	[4L]
2.2	General Integration Formula	[1L]
2.3	Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule	[4L]
2.4	Solution of Ordinary Differential Equations by Taylor's series method, Picard's approximation method, Euler's Method, Modified Euler's method, R-K Method (2 nd and 4 th).	[6L]

References:

1. James I. Buchanan, Peter R. Turner: Numerical Methods and Analysis, Mc Graw Hill Book Co., London., 1992.
2. S. S. Sastry: Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 5/e.
3. Kaiser A. Kunz: Numerical Analysis, Mc Graw Hill Book Co., London., 2011.
4. Goel, Mittal: Numerical Analysis, Pragati Prakashan, Meerut.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Develop a thorough understanding of least squares curve fitting techniques, including fitting straight lines, multiple linear regression, and nonlinear models using polynomials and sums of exponentials.	X	X	X			
Learn the principles and applications of numerical differentiation, focusing on the calculation of first and second-order derivatives.	X	X	X	X		
Gain expertise in numerical integration methods, including the Trapezoidal Rule, Simpson's 1/3 Rule, and Simpson's 3/8 Rule, and understand their applications in solving real-world problems.	X	X	X	X		
Apply various numerical methods for solving ordinary differential equations, including Taylor's series, Picard's approximation, Euler's method, Modified Euler's method, and the Runge-Kutta (2nd and 4th order) methods.	X	X	X		X	

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total Marks
I	10%	-	50%	-	40%	-	100%
II	10%	-	50%	-	40%	-	100%



S.Y.B.Sc. (Mathematics) Semester-IV

COURSE TITLE: MAJOR LAB COURSE

COURSE CODE: MHMJ-S4PR8-2CR25 [Credit- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Demonstrate Mathematical skills.
2. Correlate their Mathematical theory concepts through practical.

PRACTICAL Major MHMJ-S4PR8-2CR25 (Lab Course - VIII)

- 1 Lagrange 's Interpolation Formula
- 2 Newton's Divided Difference Interpolation Formula
- 3 1st and 2nd order derivatives based on Newton's forward difference interpolation formula
- 4 1st and 2nd order derivatives based on Newton's backward difference interpolation formula
- 5 Numerical Integration: Trapezoidal Rule
- 6 Numerical Integration: Simpson's I/3-Rule, Simpson's 3/8-Rule
- 7 Solution of ordinary Differential Equations by Taylor's series method
- 8 Solution of Ordinary Differential Equations by Picard's approximation method and Euler's method



S.Y.B.Sc. (Mathematics) Semester-IV

Major Course- IX

COURSE TITLE: Multivariate Integral Calculus

COURSE CODE: MHMJ-S4P9-2CR25 [CREDITS - 02]

Course learning outcome		
At the end of this course, Students will be able to		
<ol style="list-style-type: none"> 1. Apply double integrals in polar coordinates for solving integration problems. 2. Evaluate triple integrals in Cartesian, cylindrical, and spherical coordinate systems. 3. Apply the Jacobian determinant to transform integrals into more convenient coordinate systems. 4. Utilize the Fundamental Theorem for Line Integrals to evaluate path-independent integrals in conservative vector fields. 5. Use Green's Theorem to convert line integrals into double integrals and compute areas. 		
Module 1	Double and Triple Integrals	[15L]
Learning Objective		
<ol style="list-style-type: none"> 1. Evaluate double integrals over rectangular and non-rectangular regions. 2. Apply double integrals in polar coordinates for solving integration problems. 3. Compute triple integrals over parallelepipeds and other solid regions. 4. Evaluate triple integrals in cylindrical and spherical coordinate systems. 5. Apply the change of variables technique in double and triple integrals for simplification. 		
Learning Outcomes:		
At the end of this module the learner will be able to		
<ol style="list-style-type: none"> 1. Explain the significance of double and triple integrals in calculus. 2. Evaluate double integrals over both rectangular and non-rectangular regions. 3. Apply triple integration to find volumes of different solid regions. 4. Compute volumes of three-dimensional regions using triple integrals. 5. Evaluate triple integrals in cylindrical and spherical coordinates. 6. Apply the Jacobian determinant for changing variables in multiple integrals. 		
1.1	Double integration over rectangular and nonrectangular regions	[3L]
1.2	Double integrals in polar coordinates	[3L]
1.3	Triple integral over a parallelepiped and solid regions	[2L]
1.4	Volume by triple integral	[3L]
1.5	Triple integration in cylindrical and spherical coordinates	[2L]
1.6	Change of variables in double and triple integrals.	[2L]



Module 2		Line Integral	[15L]
Learning Objective <ol style="list-style-type: none">1. explore the applications of line integrals in calculating mass and work.2. Understand the Fundamental Theorem for Line Integrals and its relation to conservative vector fields.3. Understand and apply Stokes' Theorem in vector calculus.4. explore the Gauss Divergence Theorem and its applications in fluid flow and electromagnetism.			
Learning Outcomes: <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none">1. Use line integrals to calculate physical quantities such as mass and work.2. Apply the Fundamental Theorem for Line Integrals to evaluate path-independent integrals in conservative vector fields.3. Use Green's Theorem to convert line integrals into double integrals and compute areas.4. Apply Stokes' Theorem to relate surface integrals of curl fields to line integrals.5. Use the Gauss Divergence Theorem to compute flux integrals			
2.1	Line integrals - Introduction and Applications of line integrals: Mass and Work		[3L]
2.2	Fundamental theorem for line Integrals and Conservative vector fields		[3L]
2.3	Green's theorem and Area as a line integral.		[2L]
2.4	Surface integrals and integrals over parametrically defined surface.		[3L]
2.5	Stokes' theorem.		[1L]
2.6	Gauss divergence theorem.		[3L]

References:

1. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). Calculus (3rd ed.) Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.
2. A.K. Sharma, Text book of Multiple Integrals, Discovery Publishing House, New Delhi, 2005.
3. David V. Widder: Advanced Calculus, PHI Learning Pvt. Ltd, New Delhi.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Apply double integrals in polar coordinates for solving integration problems.	X	X			X	
Evaluate triple integrals in Cartesian, cylindrical, and spherical coordinate systems.	X	X	X		X	
Apply the Jacobian determinant to transform integrals into more convenient coordinate systems.	X	X	X		X	
Utilize the Fundamental Theorem for Line Integrals to evaluate path-independent integrals in conservative vector fields.	X	X			X	
Use Green's Theorem to convert line integrals into double integrals and compute areas	X	X	X	X	X	

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	20%	40%	-	30%	-	100%
II	10%	20%	40%	-	30%	-	100%



S.Y.B.Sc. (Mathematics) Semester-IV

COURSE TITLE: MAJOR LAB COURSE-IX

COURSE CODE: MHMJ-S4PR9-2CR25 [Credit- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Demonstrate Mathematical skills.
2. Correlate their Mathematical theory concepts through practical.

PRACTICAL Major MHMJ-S4PR9-2CR25 (Lab Course - IX)

- 1 Evaluation of Double Integrals Over Rectangular and Non-Rectangular Regions
- 2 Computation of Double Integrals in Polar Coordinates
- 3 Volume Calculation Using Triple Integrals in Cartesian, Cylindrical, and Spherical Coordinates
- 4 Change of Variables in Double and Triple Integrals Using the Jacobian Determinant
- 5 Evaluation of Line Integrals in Scalar and Vector Fields with Applications to Mass and Work
- 6 Verification of Green's Theorem and its Application in Computing Areas
- 7 Computation of Surface Integrals Over Parametrically Defined Surfaces
- 8 Verification and Application of Stokes' Theorem and Gauss Divergence Theorem in Vector Fields



S.Y.B.Sc. (Mathematics) Semester-IV

Major Course - X

COURSE TITLE: Linear Algebra-II

COURSE CODE: MHMJ-S4P10-4CR25 [CREDITS - 04]

Course learning outcome		
At the end of this course, Students will be able to		
<ol style="list-style-type: none"> Understand the concept of linear transformations as a tool to provide an elementary knowledge of Linear Algebra. Prove basic results in linear algebra using appropriate proof-writing techniques such as properties of linearity, injectivity and surjectivity of functions, Properties of Inner product spaces. Understand the proof of Rank-Nullity theorem, consequences of Rank-Nullity theorem, the space $L(U, V)$ and study the inverse of linear transformation. Study the concept of composition of linear transformations and how matrix and linear transformations are associated with each other. Understand some mathematical problems which can be solved by some advanced concepts in linear Algebra such as Least Square Approximation method, linear transformation of quadratic form and canonical forms or sum of squares using linear and orthogonal transformations respectively. 		
Module 1	Linear Transformation	[15L]
Learning Objective		
This module is intended to		
<ol style="list-style-type: none"> Explore the concept of Linear transformations as a tool to provide an elementary knowledge of Linear Algebra. Use of Linear map to compute range and kernel of a linear transformation. 		
Learning Outcomes:		
At the end of this module the learner will be able to		
<ol style="list-style-type: none"> Understand the concept of linear transformations as a tool to provide an elementary knowledge of Linear Algebra. Apply the use of linear map to compute range and kernel of a linear transformation. 		
1.1	Definition of Linear transformation, examples and results	[4L]
1.2	Operations and theorems on Linear transformation	[5L]
1.3	Range of a Linear transformation and examples	[3L]
1.4	Kernel of a Linear transformation and examples	[3L]



Module 2 Rank-Nullity Theorem		[15L]
<p>Learning Objective This module is intended to</p> <ol style="list-style-type: none"> 1. Study the proof of Rank-Nullity theorem, consequences of Rank-Nullity theorem and the space $L(U, V)$ in the context of Linear transformation. 2. Introduce the concept of Inverse linear transformation with theory and its illustrations. 		
<p>Learning Outcomes: At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Prove basic results in linear algebra using appropriate proof-writing techniques such as properties of linearity, injectivity and surjectivity of functions. 2. Understand the proof of Rank-Nullity theorem, consequences of Rank-Nullity theorem, verification of Rank-Nullity theorem and the space $L(U, V)$ in the context of linear transformation. 3. Understand the concept of Inverse linear transformation with theory and its illustrations in detail. 		
2.1	Rank and Nullity of a Linear transformation	[3L]
2.2	Rank-Nullity theorem and examples of Rank-Nullity theorem, verification	[3L]
2.3	Consequences of Rank-Nullity Theorem	[3L]
2.4	The Space $L(U, V)$ and examples	[2L]
2.5	Inverse of a Linear transformation	[4L]
Module 3 Relation between Matrix and Linear transformations		[15L]
<p>Learning objectives: This module is intended to</p> <ol style="list-style-type: none"> 1. Study the concept of composition of linear transformations, how to compute matrix for given linear transformation and vice-versa. 2. Discuss Rank-Nullity theorem of matrices and verification of Rank-Nullity theorem for matrices. 		
<p>Learning outcome: At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Study the concept of composition of linear transformations and how matrix and linear transformations are associated with each other. 2. Apply the concept of Rank-Nullity theorem of matrices along with verification of Rank-Nullity theorem for matrices. 3. Range, Rank, Kernel and Nullity using Rank-Nullity theorem for matrices. 		
3.1	Composition of Linear transformations	[3L]
3.2	Matrix Associated with a Linear map and examples	[4L]



3.3	Linear Map Associated with a Matrix and examples	[4L]
3.4	Rank and Nullity of matrices and verification of Rank-Nullity theorem for matrices	[4L]
Module 4	Least Square approximations	[15L]
Learning objectives: This module is intended to <ol style="list-style-type: none">1. Identify some mathematical problems which can be solved by some advanced concepts in linear Algebra such as Least Square Approximation method.2. Study and use of linear transformation to compute quadratic form and canonical forms or sum of the squares using linear transformations and orthogonal transformations respectively.		
Learning outcome: At the end of this module the learner will be able to <ol style="list-style-type: none">1. Compute some mathematical problems using Least Square Approximation method.2. Compute linear transformation of quadratic form and Index and signature of the quadratic form.3. Apply linear transformations and orthogonal transformations to compute Canonical forms or sum of the squares.		
4.1	Least Square Approximations	[3L]
4.2	Approximation to an Inconsistent System	[2L]
4.3	Linear transformation of a quadratic form	[2L]
4.4	Canonical form or Sum of the squares form using Linear transformation	[3L]
4.5	Canonical form or Sum of the squares form using orthogonal transformation	[3L]
4.6	Index and signature of the quadratic form	[2L]



References:

1. V. Krishnamurthy, V. P. Mainra & J. L. Arora: An Introduction to Linear Algebra, Affiliated East-West Press Prv. Ltd., New Delhi. Edition 2019 (Reprint).
2. H. Anton and C. Rorres: Elementary Linear Algebra with supplemental applications, International Student Version, Wiley India Prv. Ltd, New Delhi, 11/e, 2023 (Reprint).
3. David C. Lay: Linear Algebra and its applications, Pearson Education, Inc. and Dorling Kindersley Publishing Inc, 3/e, 2003.
4. S. Kumaresan: Linear Algebra: A Geometric Approach, Prentice Hall of India, 2004.
5. G. Strang : Linear Algebra and its applications, Brooks/Cole, a part of Cengage Learning India Private Ltd., New Delhi, 4/e, 2008 (Reprint).
6. Serge Lang: Introduction to Linear Algebra, Springer, India. Addison-Wesley Publication Co. (Student Edition).
7. Balakrishnan: Linear Algebra, Tata-McGraw Hill Edition.
8. I. H. Sheth :Linear Algebra, Nirav Prakashan.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Prove basic results in linear algebra using appropriate proof-writing techniques such as properties of linearity, injectivity and surjectivity of functions, Properties of Inner product spaces.	X	X	X	X	X	
Understand the proof of Rank-Nullity theorem, consequences of Rank-Nullity theorem, the space $L(U, V)$ and study the inverse of linear transformation.	X	X	X	X	X	
Study the concept of composition of linear transformations and how matrix and linear transformations are associated with each other.	X	X	X	X		
Study the properties of inner product spaces and apply Gram-Schmidt's process to orthogonalize sets and use orthogonal and orthonormal bases to solve application problems.	X	X	X	X	X	
Understand some mathematical problems which can be solved by some advanced concepts in linear Algebra such as Least Square Approximation method, linear transformation of quadratic form and canonical forms or sum of squares using linear and orthogonal transformations respectively.	X	X	X	X	X	



Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	30%	-	30%	-	100%
II	10%	40%	30%	-	20%	-	100%
III	10%	30%	30%	-	30%	-	100%
IV	10%	20%	20%	-	50%	-	100%



S.Y.B.Sc. (Mathematics) Semester-IV

Minor Course- III

COURSE TITLE: Differential Calculus of Several Variables

COURSE CODE: MHMN-S4P3-2CR25 [CREDITS - 02]

Course learning outcome		
<ol style="list-style-type: none"> Define and use fundamental concepts of Differential Calculus of multivariate variables including limits, continuity and differentiability along with Domain and Range, Graphs Level Curves. Recognize mathematical formulae and methods of derivation of multivariable functions. Evaluate partial derivatives and understand various applications of partial differentiation. Apply and use the concept of an applications of partial differentiation to solve some practical problems involving partial differentiation to estimate maxima and minima of multivariable function. To understand the method of Lagrange's multipliers and to find Taylor's and Maclaurin's series expansions of multivariable function. 		
Module 1	Limits, Continuity and Partial Derivatives	[15L]
<p>Learning Objective</p> <p>This module is intended to</p> <ol style="list-style-type: none"> Provide students with fundamental concepts and techniques of multivariable calculus. Study the limit of a Bivariate function and verify continuity of function for two variables. Understand partial derivatives and establish the relationship between partial derivative of a function and the product of functions with its degree. 		
<p>Learning Outcomes:</p> <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> Define and use fundamental concepts of Differential Calculus of multivariate variables including limits, continuity and differentiability along with Domain and Range, Graphs Level Curves. Recognize mathematical formulae and methods of derivation of multivariable functions. Evaluate partial derivatives and examples based on it. 		
1.1	Functions of Several Variables: Functions of two variables, Domain and Range, Graphs, Level Curves, Functions of Three or More Variables.	[3L]



1.2	Limits and Continuity of functions of two variables.	[3L]
1.3	Partial derivatives -Definition and examples, Mixed derivative theorem, Differentiability for function of two variables,	[4L]
1.4	Chain Rule, Implicit and Explicit functions, composite functions, Total Differential.	[5L]
Module 2	Euler's theorem and Extreme Values	[15L]
Learning Objective This module is intended to 1. Understand partial derivatives and establish the relationship between partial derivative of a function and the product of functions with its degree. 2. Develop student understanding and skills for applications of partial differentiation to other areas.		
Learning Outcomes: At the end of this module the learner will be able to 1. Evaluate partial derivatives and understand various applications of partial differentiation. 2. Apply and use the concept of an applications of partial differentiation to solve some practical problems involving partial differentiation to estimate maxima and minima of multivariable function. 3. To understand the method of Lagrange's multipliers and to find Taylor's and Maclaurin's series expansions of multivariable function.		
2.1	Homogeneous Functions, Euler's theorem.	[3L]
2.2	Necessary conditions for extreme values, Extreme values of functions of two variables for the functions of two variables.	[4L]
2.3	Method of Lagrange Undetermined Multipliers.	[3L]
2.4	Taylor's series and Maclaurin's series for the functions of two variables.	[5L]

References:

1. James Stewart, Multivariable Calculus, Brooks/Cole, 7/e, Cengage Learning, 2012.
2. T.M. Apostol, Calculus Vol. II, 2/e, John Wiley, New York, (1967).
3. Basic Multivariable Calculus, J. E. Marsden, A. J. Tromba, A. Weinstein, Springer Verlag (Indian Edition).
4. Shanti Narayan, R.K. Mittal, Differential Calculus, S. Chand and Company.
5. N. S. Piskunov, Differential and Integral Calculus, CBS Publishers and Distributors, India, 1969.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Define and use fundamental concepts of Differential Calculus of multivariate variables including limits, continuity and differentiability along with Domain and Range, Graphs Level Curves.	X	X	X		X	
Recognize mathematical formulae and methods of derivation of multivariable functions.	X	X	X		X	
Evaluate partial derivatives and understand various applications of partial differentiation.	X	X	X			
Apply and use the concept of an applications of partial differentiation to solve some practical problems involving partial differentiation to estimate maxima and minima of multivariable function.	X	X	X		X	
To understand the method of Lagrange's multipliers and to find Taylor's and Maclaurin's series expansions of multivariable function.	X	X	X		X	

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	20%	40%	-	30%	-	100%
II	10%	20%	40%	-	30%	-	100%



S.Y.B.Sc. (Mathematics) Semester-IV

COURSE TITLE: MINOR LAB COURSE

COURSE CODE: MHMN-S4PR3-2CR25 [Credit- 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Demonstrate Mathematical skills.
2. Correlate their Mathematical theory concepts through practical.

PRACTICAL Major MHMJ-S4PR3-2CR25 (Minor Lab Course)

- 1 Exploration of Functions of Two Variables: Domain, Range, Graphs, and Level Curves
- 2 Limits and Continuity of Functions of Two Variables: Analysis and Visualization
- 3 Calculation and Interpretation of Partial Derivatives, Mixed Derivative Theorem, and Differentiability for Functions of Two Variables
- 4 Application of Chain Rule, Implicit and Explicit Functions, and Total Differential in Multivariable Calculus
- 5 Analysis of Homogeneous Functions and Application of Euler's Theorem
- 6 Identification and Calculation of Extreme Values for Functions of Two Variables
- 7 Application of Lagrange's Method of Undetermined Multipliers in Optimization Problems
- 8 Expansion of Functions of Two Variables Using Taylor's and Maclaurin's Series



S.Y.B.Sc. (Mathematics) Semester -IV

Minor Course- III (Statistics)

COURSE TITLE: Probability functions & Discrete Probability distributions

COURSE CODE: STMN-S4P3-2CR25 [CREDITS - 02]

Course learning outcome

At the end of this course, Students will be able to

1. Apply the idea of random variables and their expected values to study the behaviour of random phenomenon occurring in business, industry and daily life activities.
2. Demonstrate the skill of finding moment generating function of different probability distributions.
3. Demonstrate the skill of finding function of random variables and finding their measure of central tendency and measure of dispersion.
4. Apply Bernoulli and Binominal Probability Distribution and compute related probabilities, expected values, M.G.F, and limiting form.
5. Apply Poisson & Geometric Probability Distribution and compute related probabilities & expected values M.G.F, and limiting form.
6. Apply Negative Binominal & Hyper Geometric Probability Distribution and compute related probabilities, expected values, and limiting form.

Module 1	Random Variable, Probability functions and Moment generating function	[15L]
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Learning Objective

1. Understand basic concept of random variables.
2. Know about Probability mass function (p.m.f), Probability density function (p.d.f) and Cumulative distribution function (c.d.f.) and Moments generating function (M.G.F).
3. Understand Bivariate random variable and properties.
4. Learn Mathematical Expectation & various types of Measure of central tendency, Measure of dispersion and Moments.

Learning Outcomes:

At the end of this module the learner will be able to

1. Distinguish between random and non-random experiments.
2. Identify Random variable and their mathematical expectation.
3. Interpret the expectation, variance and standard deviation of a discrete and continuous random variable.
4. Understand measure of central tendency and measure of dispersion related to random variables.
5. Obtain different moments of a probability distribution.



6. Understand joint, marginal and conditional p.m.f. and p.d.f. of two random variables.		
7. Obtain moment generating function of a probability function.		
1.1	Probability: Basic concept, Theorem of probability (without proof), Numerical Examples based on probability. Random variables: Discrete and Continuous.	[3L]
1.2	Probability functions: Probability mass function (p.m.f), Probability density function (p.d.f) and Cumulative distribution function (c.d.f.) with properties. Mathematical expectation and standard deviation with properties.	[3L]
1.3	Bivariate Random Variables: Joint, marginal and conditional p.m.f. and p.d.f. of two random variables, Independence of two random variables, Bivariate Mathematical expectation and standard deviation with properties.	[3L]
1.4	Moments (of a random variable): Raw moments, Central moments with relationship. Moment generating function (m.g.f.) about origin and mean with properties and their relationship.	[3L]
1.5	Measure of Central tendency: Mean, Mode, Median, Harmonic mean and Geometric mean. Measure of Dispersion: Range, Quartile deviation, Mean deviation, Standard deviation.	[3L]
Module 2	Discrete Probability distributions	[15L]
Learning Objective		
1. To apply standard discrete probability distribution to different situations. 2. To learn different properties of discrete probability distribution.		
Learning Outcomes:		
At the end of this module the learner will be able to		
1. Know the applications of discrete probability distribution in different situations. 2. Understand some standard discrete probability distributions such as Binomial, Poisson, Geometric, Hyper geometric, Negative binomial, with real life situations.		
2.1	Bernoulli distribution: Definition, Mean, Variance, M.G.F. about origin and mean, β_1 , β_2 , γ_1 and γ_2 , Additive property. Binomial Distribution: Definition, Condition for application of it, Uses, Mean, Variance, M.G.F. about origin and mean, β_1 , β_2 , γ_1 and γ_2 , Additive property, Limiting form.	[4L]



2.2	Poisson Distribution: Definition, Condition for application of it, Uses, Mean, Variance, M.G.F. about origin and mean, β_1 , β_2 , γ_1 and γ_2 , Additive property.	[3L]
2.3	Geometric distribution: Definition, Condition for application of it, Applications, Mean, Variance, M.G.F. about origin.	[3L]
2.4	Hyper geometric distribution: Definition, Condition for application of it, Applications, Mean, Variance.	[2L]
2.5	Negative-Binomial distributions: Definition, Condition for application of it, Applications, Mean, Variance, M.G.F. about origin.	[3L]

References:

1. S. C. Gupta, V. K. Kapoor: Fundamentals of Mathematical Statistics -12/e, Sultan Chand & Sons
2. Gupta S.P: Statistical Methods -34/e, S. Chand & Sons., New Delhi.
3. Goon A.M., Gupta M. K. and Dasgupta 8: Fundamentals of Statistics, Vol I., 8/e, The world press, Kolkata.
4. Neil Weiss: Introductory Statistics – 10/e, Pearson.
5. Roxy Peck, Chris Olsen, Jay L. Devore: Introduction to Statistics and Data Analysis – 5/e, Cengage Learning

Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Apply the idea of random variables and their expected values to study the behaviour of random phenomenon occurring in business, industry and daily life activities.	X			X	X	X
Demonstrate the skill of finding moment generating function of different probability distributions.			X		X	X
Demonstrate the skill of finding function of random variables and finding their measure of central tendency and measure of dispersion.	X					
Apply Bernoulli and Binominal Probability Distribution and compute related probabilities, expected values, M.G.F, and limiting form.		X	X		X	
Apply Poisson & Geometric Probability Distribution and compute related probabilities & expected values M.G.F, and limiting form.		X	X		X	
Apply Negative Binominal & Hyper Geometric Probability Distribution and compute related probabilities, expected values, and limiting form.		X	X		X	



Sir P. T. Sarvajani College of Science (Autonomous)
Surat-395001
(Affiliated with Veer Narmad South Gujarat University, Surat)



Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total Marks
1	10%	30%	25%	-	35%	-	100%
2	15%	25%	35%	-	25%	-	100%



S.Y. B. Sc. (Mathematics) Semester-IV

Skill Enhancement Course-I

COURSE TITLE: Mathematical Modelling

COURSE CODE: MHSEC-S4P1-2CR25 [CREDITS - 02]

Course learning outcome

At the end of this course, Students will be able to

1. Apply ODEs to model the growth of populations, the spread of infectious diseases, and the diffusion of technological innovations.
2. Develop and solve models based on the logistic law of population growth and other related biological phenomena.
3. Apply mathematical modelling techniques to simulate real-world processes such as the spread of technological innovations and infectious diseases.
4. Analyze complex systems, formulate differential equations to represent them, and interpret the results to solve real-world problems.

PRACTICAL SEC (MHSEC-S4P1-2CR25)

[60L]

- 1 Modelling Linear Growth Using First-Order Differential Equations
- 2 Modelling Linear Decay with First-Order Differential Equations
- 3 Mathematical Modelling for Growth of Science and Scientists
- 4 Non-Linear Growth and Decay Models Using Differential Equations
- 5 Modelling Population Growth Using the Logistic Law
- 6 Mathematical Modelling of the Spread of Technological Innovation
- 7 Modelling the Spread of Infectious Diseases Using Differential Equations
- 8 Simulating Exponential Growth and Decay in Biological Systems
- 9 Solving Simple Geometrical Problems Using Ordinary Differential Equations
- 10 Mathematical Modelling of Orthogonal Trajectories
- 11 Modelling the Paths of Curves and Their Tangents Using ODEs
- 12 Exploring Geometrical Properties of Families of Curves via First-Order ODEs
- 13 Solving Problems of Curvature and Radius Using Differential Equations
- 14 Orthogonal Trajectories in Heat Transfer Problems
- 15 Modelling Physical Systems Involving Geometrical Constraints Using ODEs
- 16 Using ODEs to Solve Problems in Engineering with Geometrical Relationships



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Apply ODEs to model the growth of populations, the spread of infectious diseases, and the diffusion of technological innovations.	X		X	X	X	
Develop and solve models based on the logistic law of population growth and other related biological phenomena.	X	X	X	X	X	
Apply mathematical modelling techniques to simulate real-world processes such as the spread of technological innovations and infectious diseases.	X	X	X	X	X	
Analyze complex systems, formulate differential equations to represent them, and interpret the results to solve real-world problems.	X	X	X	X	X	

References:

1. J. N. Kapoor: Mathematical Modelling, New Age international Publishers, New Delhi, 2/e, 2012.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley. New York, 10/e 2023.
3. J. K. Shama: Operations Research Theory & Applications, Trinity Press, 6/e, 2017.
4. G. Hadley: Linear Programming, Narosa Publishing House, New Delhi, 1995.



S.Y. B. Sc. (Mathematics) Semester-IV

Skill Enhancement Course-II

COURSE TITLE: Vedic Mathematics and its Techniques - IV

COURSE CODE: MHSEC-S4P2-2CR25 [CREDITS - 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Develop conceptual knowledge of mathematical concepts by applying Vedic Mathematics techniques practically.
2. Enhance computational proficiency and think critically and correlate their mathematical concepts through practical.
3. Use Vedic Mathematics concept in various areas of Mathematics such as Triple trigonometry, Calculus etc. through practical approach.
4. Use applications of triples in Coordinate Geometry to find the length of a perpendicular from a point onto a line, equation of line and obtain complex numbers to find products, quotients and square roots of complex numbers.
5. Obtain Compound angles by using triple trigonometry to solve various trigonometric problems, inverse functions and the use of general triple as applications of triple trigonometry.
6. Understand the concept of divisibility by 2, 5, 10, 3, 9, 4, 8 and 11, prime numbers and composite numbers.
7. Apply technique of Vedic Mathematics in Calculus to obtain Partial Fractions, Integration by 'parts', derivate of product and derivative of Quotient and solve differential equations.
8. Solve simple equations, general solution of simultaneous equations and solve equation as a common factor, as the product of the independent terms as the sum of the denominators and as a combination or total by using various vedic sutras.

PRACTICAL (MHSEC-S4P2-2CR24) (Lab Course - SEC)

[60L]

1. Problems based on applications of triples in Coordinate Geometry: Find the length of a perpendicular from a point onto a line.
2. Problems based on applications of triples in Coordinate Geometry: Find Equation of line.
3. Applications of triples to obtain complex numbers: products, quotients and square roots of complex numbers.
4. Calculate Compound angles by using triple trigonometry to solve various trigonometric problems.
5. Solve the trigonometric equations giving the answers as triples alongwith special case.
6. Obtain inverse functions and the use of general triple to prove examples based on triple trigonometry.
7. Examples based on divisibility by 2, 5, 10, 3, 9, 4, 8 and 11.
8. Examples based on divisibility by prime numbers and divisibility by composite numbers.



9. Problems based on applications of Vedic Mathematics in Calculus: Obtain Partial Fractions.
10. Problems based on applications of Vedic Mathematics in Calculus: Find Integration by 'parts'.
11. Problems based on applications of Vedic Mathematics in Calculus: Obtain derivate of product and derivative of Quotient.
12. Problems based on applications of Vedic Mathematics in Calculus: Solve differential equations using vertically and crosswise Vedic mathematics technique.
13. Solve simple equations, more than one x-term and general solution of simultaneous equations by using Paravartya Yojayet vedic sutra.
14. Solve Quadratic equations, one in ratio the other one zero and mergers by using transpose and apply.
15. Solve equations by using Samuccaya as a common factor and Samuccaya as the product of the independent terms.
16. Solve equations by using Samuccaya as the sum of the denominators and Samuccaya as a combination or total.

References:

1. Sri Bharatikrishna Tirthaji: Vedic Mathematics, 17/e, Published by Motilal Banarsidass, 1965.
2. Vedic Mathematics: Sixteen Simple Mathematical formulae from the Vedas, Jagadguru Swami Sri Bharati Krishna Trithaji, Motilal Banarasidas, New Delhi 2015.
3. Williams K.R.: Discover Vedic Mathematics, Vedic Mathematics Research Group, 1984. (Revised edition)
4. Wiliams K.R. and M. Gaskell: The Cosmic Calculator, 1/e, Motilal Banarsidass, 2002. (Revised 2005)
5. Nicholas A. P., Williams, J. Pickles: Vertically and Crosswise, 2/e, Inspiration books, 1984.
6. Kenneth R. Williams: Vedic Mathematics- Teacher's manual. (Elementary and Advanced level), 1/e, Inspiration books, 2002, (Revised 2009).
7. Vandana Singhal: Vedic Mathematics for all ages-A beginner's guide, 2/e, Motilal Banarsidass Publishers, 2014.
8. The Essential of Vedic Mathematics, Rajeshkumar Thakur, Rupa publications, New Delhi, 2019.
9. Learn Vedic Speed Mathematics Systematically, Chaitnaya A. Patil 2018.
10. Enjoy Vedic Mathematics, S M Chauthaiwale, R Kollaru, The Art of Living, Bangalore.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Develop conceptual knowledge of mathematical concepts by applying Vedic Mathematics techniques practically.	X	X	X	X	X	
Enhance computational proficiency and think critically and correlate their mathematical concepts through practical.	X	X	X	X	X	
Use Vedic Mathematics concept in various areas of Mathematics such as Triple trigonometry, Calculus etc. through practical approach.	X	X	X	X	X	X
Use applications of triples in Coordinate Geometry to find the length of a perpendicular from a point onto a line, equation of line and obtain complex numbers to find products, quotients and square roots of complex numbers.	X	X	X	X	X	X
Solve the trigonometric equations giving the answers as triples along with special case.	X	X	X	X	X	
Understand the concept of divisibility by 2, 5, 10, 3, 9, 4, 8 and 11, prime numbers and composite numbers.	X	X	X	X	X	
Apply technique of Vedic Mathematics in Calculus to obtain Partial Fractions, Integration by 'parts', derivate of product and derivative of Quotient and solve differential equations.	X	X	X	X	X	X
Use of triples in Coordinate Geometry to find gradients and solving circle problems.	X	X	X	X	X	X



S.Y.B.Sc. (Mathematics) Semester-IV

Indian Knowledge System- IV

COURSE TITLE: Ancient Indian Mathematicians

COURSE CODE: MHIKS-S4P2-2CR25 [CREDITS - 02]

Course learning outcome		
<p>At the end of this course, Students will be able to</p> <ol style="list-style-type: none"> 1. Have the knowledge of contribution of great Ancient Indian Mathematicians. 2. Expand understanding of contributions of Ancient Indian mathematicians in various branches of Mathematics. 3. Discuss the rich heritage of mathematical temper of Ancient India. 4. Apply the knowledge of Indian Mathematics in solving day to day problems in an easier way. 5. Appreciate the Mathematical advancements of Ancient Indian Mathematicians. 		
Module 1	Contribution of Indian Mathematicians (In light of Arithmetic and Algebra)	[15L]
<p>Learning Objective</p> <p>This module is intended to</p> <ol style="list-style-type: none"> 1. Make the present generations aware about contributions of great Indian Mathematicians to the world. 2. Familiarize the students to ancient Indian Mathematicians and stimulate an interest for their contributions in the field of Mathematics. 3. Foster the love for Mathematics by creating a positive attitude through the work of Ancient Indian Mathematicians. 		
<p>Learning Outcomes:</p> <p>At the end of this module the learner will be able to</p> <ol style="list-style-type: none"> 1. Have the knowledge of Indian Mathematicians and their contributions to the society and the world. 2. Discuss the rich heritage of knowledge about Indian Mathematicians. 3. Expand understanding of contributions of Ancient Indian mathematicians in various branches of Mathematics. 		
1.1	Aryabhatta I and II	[3L]
1.2	Brahmagupta	[3L]
1.3	Mahaveeracharya	[2L]
1.5	Varahmihir	[3L]
1.6	Neelkanth Somayya	[2L]



1.7	Narayan Pandita	[2L]
1.1	Aryabhatta I and II	[3L]
Module 2	Contribution of Indian Mathematicians (In light of Algebra, Geometry and Trigonometry)	[15L]
Learning Objective Understand This module is intended to 1. Make the present generations aware about contributions of great Indian Mathematicians to the world. 2. Familiarize the students to ancient Indian Mathematicians and stimulate an interest for their contributions in the field of Mathematics. 3. Foster the love for Mathematics by creating a positive attitude through the work of Ancient Indian Mathematicians.		
Learning Outcomes: At the end of this module the learner will be able to 1. Have the knowledge of Indian Mathematicians and their contributions to the society and the world. 2. Discuss the rich heritage of knowledge about Indian Mathematicians. 3. Expand understanding of contributions of Ancient Indian mathematicians in various branches of Mathematics.		
2.1	Bhaskaracharya I and II(In light of Algebra and Geometry)	[3L]
2.2	Madhavan	[2L]
2.3	Parmeshvaran	[2L]
2.4	Baudhayana	[2L]
2.5	Bharti Krishna Tirtha (In light of Arithmetic, Algebra and Geometry)	[3L]
2.6	Lilavati	[3L]

References:

1. Venugopal D. Heroor, The History of Mathematics and Mathematicians of India, Vidya Bharati, Bangalore, 2006.
2. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.
3. Beejganitam, Chokhambba Vidya Bhavan, Varanasi.
4. Leelavati, Chokhambba Vidya Bhavan, Varanasi.



Mapping of COs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Have the knowledge of contribution of great Ancient Indian Mathematicians.	X	X	X	X	X	
Expand understanding of contributions of Ancient Indian mathematicians in various branches of Mathematics.	X	X	X	X	X	
Discuss the rich heritage of mathematical temper of Ancient India.	X	X		X	X	
Apply the knowledge of Indian Mathematics in solving day to day problems in an easier way.	X	X	X	X	X	
Appreciate the Mathematical advancements of Ancient Indian Mathematicians.	X	X	X	X		X

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	30%	30%	20%	-	20%	-	100%
II	30%	20%	30%	-	20%	-	100%
