Government College for Women(A), Guntur.

COURSE INFORMATION BOOKLET

2023-2024

DEPARTMENT OF MATHEMATICS

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Vision and Mission of the Department

Vision

To provide exemplary mathematics education to female students, integrating a skill-focused and globally aligned curriculum, and employing learner-centric approaches to cultivate mathematical thinking while upholding moral and ethical responsibilities.

Mission

1. To create a comprehensive learning environment to cultivate a deep and well-rounded understanding of Mathematics.
2. To Foster skill mastery through the practical application of Mathematical concepts in real-world scenarios, including projects and problem-solving.
3. To integrate a global perspective into the curriculum, exposing students to diverse mathematical applications and challenges from around the world.
4. To embrace innovative and learner-centric teaching methods, fostering curiosity, creativity, and critical thinking in the internalization of mathematical concepts.
5. To instill moral and ethical values, guiding students to become proficient Mathematicians and ethical leaders by emphasizing integrity, accountability, and social responsibility in academic and professional pursuits.

Mathematics Programme Aim:

The aim of the B.Sc Mathematics program is to deliver students a comprehensive Mathematics education, with a pronounced emphasis on the cultivation of 21st-century global skills.

Objectives for a B.Sc. Mathematics programme:

- Provide students with a comprehensive understanding of fundamental mathematical theories, principles, and concepts across various branches, ensuring a strong foundation in core mathematical concepts.
- Develop students' problem-solving skills by engaging them in a variety of mathematical exercises, applications, and real-world scenarios, fostering the ability to independently analyse and solve complex problems.
- Integrate information technology tools and platforms into the curriculum to enhance students' proficiency in utilizing technology as an aid to solve mathematical problems, ensuring readiness for the digital age.

- Cultivate effective communication skills, both written and verbal, enabling students to articulate mathematical concepts clearly, present logical arguments, and communicate their findings.
- Encourage a research-oriented mind set among students, promoting the exploration and synthesis of advanced mathematical concepts. Develop their ability to formulate clear and accurate mathematical arguments, conjectures, and draw meaningful conclusions.

Program Specific outcomes of B.Sc. Mathematics

PSO	After completion of the B.Sc. Mathematics programme, students will be able to
PSO 1	Demonstrate in depth knowledge and understanding of various areas of undergraduate Mathematics curriculum and be able to communicate effectively
PSO 2	Develop a wide range of generic, thinking and problem solving skills by utilizing their Mathematical domain knowledge to independently solve diverse real world problems
PSO 3	Proficiently apply and synthesize core Mathematical concepts, using information technology as an aid to solve problems, formulate clear and accurate Mathematical arguments, conjectures and be able to draw meaningful conclusions from their analysis.

List of Programmes offered by the Department

S. No	Title of the programme
1	B. Sc., Mathematics Major
2	B.Sc. Mathematics, Physics, Chemistry
3	B.Sc. Mathematics, Physics, Computer Science
4	B. Sc. Mathematics, Statistics, Computer Science
5	B.Sc. Mathematics, Electronics, Computer Science
6	B. Sc. Mathematics, Multimedia, Computer Science
7	B.Sc. Mathematics, Cloud Computing, Computer Science
8	B.Sc. Mathematics, Electronics, Physics

B.Sc Mathematics course structure (Three major system)

Semester	Paper	Title of the course	Course code
I	1	Differential Equations	MAT 301-1
II	2	Solid Geometry	MAT 301-2
Community Service Project			
III	3	Abstract Algebra	MAT 301-3
IV	4	Real Analysis	MAT 301-4
	5	Linear Algebra	MAT 301-5
Short term internship			
V	6A	Numerical Methods using Scilab	MAT 301-6A
	7A	Computational Mathematics using Scilab	MAT 301-7A
	6B	Vector Calculus	MAT 301-6B
	7B	Integral Transforms with Applications	MAT 301-7B
	6C	Mathematical Special functions	MAT 301-6C
	7C	Number theory	MAT 301-7C
VI		Semester end Internship	

B.Sc., Mathematics course structure: (Single major system)

Year	Semester	Course number	Title of the course	Course code
I	I	1	Essentials of Mathematical, Physical and Chemical Sciences	H301-1
		2	Applications of Mathematical, Physical and chemical Sciences	H301-2
	II	3	Differential Equations	H301-3
		4	Solid Geometry	H301-4
	Community Service project			
II	III	5	Group theory	
		6	Numerical Methods	
		7	Laplace Transforms	
		8	Special functions	
	IV	9	Ring theory	
		10	Introduction to Real Analysis	
		11	Integral Transforms	
		12	Linear Algebra	
		13	Vector Calculus	

III	V	14	Function of a complex variable (or) Advanced Numerical Methods	
		15	Number theory (or) Mathematical Statistics	
	VI		Semester Internship/ Apprenticeship	
IV	VII	16	Algebra (or) Classical Mechanics	
		17	Real Analysis (or) Discrete Mathematics	
		18	Basic Topology (or) Cryptography	
		19	Lattice theory & Boolean Algebra (or) Finite Element Analysis	
		20	Graph Theory (or) Mathematical Finance	
	VIII	21	Advanced Algebra (or) Elements of Elasticity & Fluid Dynamics	
		22	Advanced Analysis (or) Advanced Linear Algebra	
		23	Advanced Topology (or) Differential Geometry	
		24	Ordinary Differential Equations (or) Applications of Algebra	
		25	Operational Research (or) Mathematical Modelling	

List of LDCs & SDCs offered by the Department:

Course wise Syllabus with Outcomes

Single Major System

SEMESTER – I

PAPER – I

Course title: Essentials and Applications of Mathematical, Physical and Chemical Sciences

Course code: H301-1

SYLLABUS

UNIT – I: Essentials of Mathematics:

Complex numbers: Introduction of new symbol I – General form of complex number – Modulus – Amplitude(polar) form and conversions

Trigonometric ratios: Trigonometric ratios and their relations – Problems on calculation of angles

Vectors: Definition of vector addition – Cartesian form – Scalar and Vector product and problems

Statistical measures: Mean, Median and Mode of the data and problems

UNIT – IV: Applications of Mathematics, Physics and Chemistry

Applications of Mathematics in Physics and Chemistry: Calculus, Differential equations and complex analysis

Prescribed Text book:

1. A text book of Essentials and Applications of Mathematical, Physical and Chemical Sciences by Deepak Garg, A Pragati Edition

2. A text book of B.Sc. Mathematics, published by S. Chand & Company.

Reference Books:

1. Functions of one complex variable by John. B. Comway, Springer-verlag

2. Elementary trigonometry by HS Hall and SR Knight

3. Vector algebra by AR Vasishta, Krishna Prakasan media Pvt. Ltd

4. Basic Statistics by BL Agarwal, New age International Publishers

SEMESTER – I

PAPER – II

Course title: Advances in Mathematical, Physical and Chemical Sciences

Course code: H301-2

SYLLABUS

CO1: demonstrate proficiency in understanding and applying fundamental concepts in basic mathematics

UNIT – I: Advances in Basic Mathematics

Straight lines: Different forms – Reduction of general equation into various forms – Point of intersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function – Problems on product rule and quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of Integration

Matrices: Types of Matrices – Scalar multiple of a matrix – Multiplication of Matrices – Transpose of a matrix and determinants

UNIT – IV: Advanced Applications of Mathematics, Physics and Chemistry

Mathematical modelling applications in Physics and chemistry

Prescribed Text book:

1. A text book of Advances in Mathematical, Physical and Chemical Sciences by Deepak Garg, A Pragati Edition

Reference Books:

1. Coordinate Geometry by SL Lony, Arihanth Publications

2. Calculus by Thomas and Finny

3. Matrices by AR Vasishta and AK Vasishta, Krishna Prakasan Media Pvt. Ltd.

SEMESTER – II
PAPER – III
Course title: Differential Equations

Course code: H301-3

Course Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Apply insights from derivatives and integration to define and solve differential Equations	L3, L4

CO - 2	Classifies the Differential equations with respect to their order and linearity and be able to solve them	L2, L3, L4
CO - 3	Select appropriate method and use it to solve a given Differential Equation	L5, L3
CO - 4	Develop a way of thinking that underlines an understanding of the concept of various differential equations	L6

SYLLABUS

UNIT – I

Differential equations of first order and first degree:

Linear Differential Equations – Bernoulli's equation - Differential equations reducible to linear form - Exact differential equations; Integrating factors – Inspection method, $(ii)\frac{1}{Mx-Ny}$ $(iii)\frac{1}{Mx+Ny}$.

UNIT – II

Differential equations of first order but not first degree:

Equations solvable for p, solvable for y, solvable for x. Clairaut's equation.

Orthogonal trajectories.

Two types – Cartesian and polar form.

UNIT – III

Higher order linear differential equations Part - 1:

Solution of homogeneous linear differential equations of order n with constant coefficients. Solution of the non-homogeneous linear differential equations with constant coefficients by means of polynomial operators. General solution of f(D)y = 0, General solution of f(D)y = Q where Q is a function of x. $\frac{1}{f(D)}$ is expressed as partial fractions.

P.I. of f(D)y = Q when Q= be^{ax} ,

P.I. of f(D)y = Q when Q is b sin ax or b cos ax.

UNIT – IV

Higher order linear differential equations Part - II:

Solutions of the non-homogeneous linear differential equations with constant coefficients.

P.I. of f(D)y = Q, when Q = $b\ x^k$,

P.I. of f(D)y = Q, when Q = e^{ax} V, where V is function of x,

P.I. of f(D)y = Q, when Q = xV, where V is function of x,

UNIT – V

Higher order linear differential equations with non constant coefficients

The Cauchy-Euler Equation, Legendre's linear equations Method of variation of parameters

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Prescribed Text book:

1. A text book of B.Sc. Mathematics, published by Deepthi Publications

2. A text book of B.Sc. Mathematics, published by S. Chand & Company.

Reference Books:

1. Differential Equations and Their Applications by Zafar Ahsan, published by Prentice Hall of India Pvt. Ltd, New Delhi-Second edition.
2. A text book of Mathematics for B.A/B.Sc, Vol 1, by N. Krishna Murthy & others, published by S.Chand& Company, New Delhi.
3. Ordinary and Partial Differential Equations by Dr. M.D,Raisinghania, published by S. Chand &Company, New Delhi.
4. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha-Universities Press.
5. Differential Equations -Srinivas Vangala&Madhu Rajesh, published by Spectrum University Press

SEMESTER – II
PAPER – IV
Course Title: Analytical Solid geometry

Course Code: H301-4

Course Learning Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate a comprehensive understanding of mathematical concepts related to planes, lines, spheres, and cones, encompassing different types of surfaces and equations, determination under given conditions	L1, L2
CO - 2	Students will skillfully apply the concepts learned about the lines, planes, spheres and cones to solve pro problems lying in the course	L3
CO - 3	Analyze geometric concepts from all units, including planes, lines, spheres, and cones, demonstrating a sophisticated understanding of their interconnections and applying critical thinking to solve complex problems in three-dimensional space.	L4
CO - 4	Masterfully synthesize concepts across all units, integrating knowledge of planes, lines, spheres, and cones to create sophisticated solutions for intricate mathematical problems and demonstrate advanced evaluative skills in analyzing the interrelationships between different geometric elements, showcasing a high level of proficiency in three-dimensional geometry.	L5, L6

SYLLABUS

UNIT - I

The plane:
Equations of plane – different types - determination of a plane under given conditions – equation of a plane in terms of its intercepts on the axes equations of the plane through three given points – normal form – general equation - transformation to the normal form system of planes – two sides of a plane – length of the perpendicular from a given point to a given plane – bisectors of angles between two planes; combined equation of two planes, Orthogonal projection on a plane.

UNIT – II

The Straight line:
Equations of a line – angle between line and plane; condition that a given line may lie in a given plane; condition that two given lines are coplanar -Image of a line in a plane, foot of the perpendicular from a point on a line - number of arbitrary constants in the equations of a straight line – sets of conditions which determine a line. The shortest distance between two lines – the length and equations of the line of shortest distance between two straight lines – length of the perpendicular from a given point to a given line.

UNIT – III

The sphere I:
Definition and equation of the sphere – equation of the sphere through four given points. Plane sections of a sphere – intersection of two spheres – equation of a circle. Sphere through a given circle – intersection of a sphere and a line. Power of a point – tangent plane – plane of contact. Polar plane – pole of plane, conjugate points, conjugate planes

UNIT – IV

The sphere II:
Angle between two intersecting spheres. Conditions for two spheres to be orthogonal. Radical plane – coaxial system of spheres – simplified form of coaxial system of spheres**.** Limiting points.

UNIT – V

Cone:
Definition of a cone – vertex, guiding curve, generators – equation of the cone with a given vertex and guiding curve – Equation of cone with vertex at origin are homogeneous. Condition that the general equation of the second degree should represent a cone.

Enveloping cone of sphere. – condition that a cone may have three mutually perpendicular generators. Intersection of a line and quadric cone. Tangent lines and tangent plane at a poin **.**– right circular cone. Equation of the right circular cone with a given vertex, axis and semi vertical angle.

Prescribed books:
A text book of B.Sc. Mathematics, published by Deepthi Publications

A text book of B.Sc. Mathematics, published by S.Chand& Company

Reference Books:

1. Analytical Solid Geometry by Shanti Narayan and P.K. Mittal, published by S. Chand & Company Ltd. 7th Edition.
2. A text book of Mathematics for BA/B.Sc Vol 1, by V Krishna Murthy & Others, published by S. Chand & Company, New Delhi.
3. A text Book of Analytical Geometry of Three Dimensions, by P.K. Jain and Khaleel Ahmed, published by Wiley Eastern Ltd., 1999.
4. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K.Y. Subrahmanyam, G.R. Venkataraman published by Tata-MC Gran-Hill Publishers Company Ltd., New Delhi.
5. Solid Geometry by B.Rama Bhupal Reddy, published by Spectrum University Press.

SEMESTER – III
PAPER - III
Course Title: Abstract Algebra
Course Code: MAT301-3

Course Learning Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate knowledge and understanding of various principles, theorems and results within abstract algebra	L1, L2
CO - 2	Apply a variety of proven results, theorems, properties studied in abstract algebra to solve problems in Groups, Rings, Fields and Ideals and analyse and formulate obtained results.	L3, L4
CO - 3	Differentiate the various of algebraic structures based on their properties in abstract algebra.	L5
CO - 4	Make conjectures related to a given set of information	L5, L6

SYLLABUS

UNIT I:

Groups:

Binary operations- Algebraic structure – Semi group – Monoid – Group definition and elementary properties – Finite and Infinite groups – Examples – order of a group – composition tables with examples.

Subgroups:

Definition of complex and properties – Multiplication of two complexes – Inverse of a complex - definition of sub-group – Examples – criterion for a complex to be a subgroup – Criterion for the product of subgroups to be a subgroup - Union and intersection of sub-groups.

UNIT II:

Cosets and Lagrange's theorem

Definition of coset - Properties of cosets – Index of a subgroup of a finite group - Lagrange's theorem

Normal subgroups:

Definition of Normal subgroup – Proper and improper normal subgroups- Hamilton Group – Criterion for a subgroup to be a normal subgroup - Intersection of normal subgroups - Subgroup of index 2 - simple group, quotient group – criteria for the existence of a quotient group

UNIT III:

Homomorphism of groups: Definition of homomorphism, monomorphism, endomorphism, isomorphism, automorphism and their properties – Image of Homomorphism - Elementary properties of Homomorphism - Kernel of a homomorphism – Fundamental theorem on homomorphism of groups.

Permutations and Cyclic groups: (16 hours)

Definition of permutation and properties – Permutation multiplication – Inverse of a permutation – Cyclic permutations – Transpositions - even and odd permutations – Cayley's theorem

Cyclic groups:

Definition of cyclic group – Elementary properties – Classification of Cyclic groups

UNIT IV:

Rings:

Definition of a ring and basic properties – Boolean rings, Divisors of Zero and cancellation laws in Rings – Integral domains, Division ring and Fields – Characteristic of a ring – The Characteristic of an Integral Domain - Characteristic of a field - – Subrings

UNIT V:

Ideals:

Left, Right and two sided ideals – Algebra of ideals – Ideal generated by a subset – Principal ideal – Principal ideal Ring – Quotient ring – Maximal ideal – Prime ideal.

SEMESTER – IV

PAPER - IV

Course Title: Real Analysis

Course Code: MAT301-4

Course Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate the knowledge and understanding of many properties of the Real line R and be able to apply them in proving theorems	L1, L2, L3
CO - 2	Choose and make use of a range of theorems, results and skill to solve and analyze problems in the areas: sequences and series, continuous functions, uniformly continuous functions, differentiation of functions and Riemann integration of functions	L3, L4
CO-3	Analyze mathematical scenarios involving sequences, derivatives, Riemann integration, interpret the behavior of convergence of sequences and series, derivability and integrability of functions. Make informed decisions based on mathematical analysis to draw conclusions about the mathematical scenarios under consideration.	L5
CO - 4	Interpret geometrically, the concepts in real analysis for a variety of functions beyond those which they have studied during the course and formulate their observations.	L5, L6
CO - 5	Create solutions to mathematical problems that involve sequences, series, continuity, differentiability, and integration, demonstrating a comprehensive understanding of the entire syllabus and its practical applications.	L6

SYLLABUS

UNIT – I

Real numbers:

cThe algebraic and order properties of R – Absolute value and Real line – Completeness property of R – Applications of Supremum property – Intervals (2 hours)

Note: No question to be set in examination question paper from this part.

Sequences:

Definition of sequence, subsequence, range of sequence, boundedness of a sequence – properties, limit of a sequence and convergent sequence, divergent sequence,sandwich theorem, monotone sequences and applications, Cauchy's first and second theorems, properly

divergent sequences, properties, limit point of a sequence – properties, Bolzano-Weierstrass theorem, Cauchy's sequence, Cauchy's general principle of convergence.

UNIT – II

Infinite series:
Definition of series, convergence of series, Cauchy' general principle of convergence, series of noon-negative terms, Geometric series test, p – series test, comparison tests, Cauchy's n^{th} root test, D'Alembert's ratio test, Alternating series, Leibnitz test, absolute convergence and conditional convergence.

UNIT – III

Limits and Continuity:
Real valued functions, Boundedness of a function, limit of a function, Some extension of limit concept, Infinite limits, limits at infinity.

(No question will be set from this portion)

Continuous functions:

Continuity of a function at a point, continuity in an interval, discontinuity – types, algebra of continuous functions, properties of continuous functions on a closed interval, Borel's theorem, boundedness property, Intermediate value property, Intermediate value property, uniform continuity of a function.

UNIT – IV

Differentiation:
Derivability of a function at a point, derivability and continuity of function, graphical meaning of derivative, Mean-value theorems-, Role's theorem - applications, Lagrange's mean value theorem – applications, Cauchy's mean value theorem – applications.

UNIT – V

Riemann integration:
Partition of a closed interval, upper and lower sums, upper and lower Riemann integrals, the Riemann integral, Riemann integrable functions, Necessary and sufficient condition for R Integrability, Properties of integrable functions, fundamental theorem of integral calculus, mean value theorems – applications.

Prescribed books:

A text book of B.Sc. Mathematics, published by Deepthi Publications
A text book of B.Sc. Mathematics, Volume II, published by S.Chand & Company

Reference Books:

1. A course of Mathematical Analysis, Shanti Narayan and P.K. Mittal
2. Mathematical Analysis by S.C.Malik and SavitaArora.
3. Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, published by John

SEMESTER – IV
PAPER – V
Course Title: Linear Algebra
Course Code: MAT301-5

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate a comprehensive understanding of fundamental concepts in Linear Algebra including vector spaces, Linear Transformations, Matrices and Inner product spaces.	L1, L2
CO - 2	Apply critical thinking and problem solving skills to analyze and solve a variety of mathematical problems related to vector spaces, Linear transformations, Matrices and Inner product spaces.	L3, L4
CO - 3	Effectively communicate Mathematical ideas and solutions related to Linear Algebra using appropriate Mathematical language and notation	L4, L5
CO- 4	Enhance problem solving skills and conceptual understanding in Linear Algebra by effectively Utilizing information technology and Mathematical software tools for problem solving, visualizing and conceptual exploration	L5, L6

SYLLABUS

UNIT - I

Vector spaces: Part – 1

Vector Spaces, General properties of vector spaces, n-dimensional Vectors, addition and scalar multiplication of Vectors, internal and external composition, Null space, Vector subspaces, Algebra of subspaces, Linear Sum of two subspaces, linear combination of Vectors, Linear span Linear independence and Linear dependence of Vectors.

UNIT – II

Vector spaces: Part – 2

Basis of Vector space, Finite dimensional Vector spaces, basis extension, co-ordinates, Dimension of a Vector space, Dimension of a subspace, Quotient space and Dimension of Quotient space.

UNIT – III

Linear Transformations:

Linear transformations, linear operators, Properties of linear transformations, sum and product of linear transformations, Algebra of Linear Operators, Range and null space of linear transformation, Rank and Nullity of linear transformations, Rank – Nullity Theorem, Singular and nonsingular linear transformations, Invertible operators

UNIT – IV

Matrices and Linear operators:
Matrix representation of a linear transformation and linear operator, Change of Basis, Matrices, Elementary Properties of Matrices, Rank of Matrix, Polynomials of matrices and Linear operators, Characteristic Roots, Characteristic Values & Vectors of square Matrix, Cayley – Hamilton Theorem and finding inverse of a matrix using Cayley Hamilton theorem.

UNIT – V
Inner product spaces:
Inner product spaces, Euclidean and unitary spaces, Norm or length of a Vector, Schwartz inequality, Triangle in Inequality, Parallelogram law, Orthogonality, Orthonormal set, complete orthonormal set, Gram – Schmidt orthogonalisation process. Bessel's inequality and Parseval's Identity.

Prescribed books:
1. A text book of B.Sc. Mathematics, published by Deepthi Publications
2. A text book of B.Sc. Mathematics, published by S.Chand & Company
3. E content developed

Reference Books:
1. Theory and problems of Linear Algebra by Seymour Lipschutz published by Schaum's outline series, Mc Graw Hill.
2. Linear Algebra by J.N. Sharma and A.R. Vasista, published by Krishna Prakasha Mandir, Meerut.
3. Matrices by Shanti Narayana, published by S.Chand Publications.
4. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson Education
5. Linear Algebra by Stephen H. Friedberg et al published by Prentice Hall of India Pvt. Ltd. 4th Edition2007.

SEMESTER V
Paper-6A
Numerical Methods using Scilab
Skill Enhancement Course (Elective)

CO. No	**Upon the successful completion of the course, students will be able to**	**Bloom's taxonomy cognitive domain**
CO - 1	Demonstrate knowledge and understanding of basic numerical formulae in iterative methods, interpolation formulae, numerical differentiation and numerical integration.	L1, L2
CO - 2	Select and use a range of established techniques, formulae and a reasonable level of skill in calculation to solve problems in interpolation, inverse interpolation, extrapolation, numerical differentiation, numerical integration	L3, L4

CO - 3	Apply the concepts and principles in Numerical Methods to some real data sets showing the ability to solve, evaluate and compare critically the appropriateness of various methods they have studied in the course.	,L5, L6
CO - 4	Demonstrate the ability to select and effectively utilize appropriate Scilab commands to implement Numerical Methods, fostering global competencies in applying advanced computational techniques to solve complex real-world problems.	L5, L6

SYLLABUS

Unit – 1: Interpolation and Prediction: Interpolation with Equal intervals and Unequal intervals

1. Introduction, Finite differences, Forward differences, Backward differences, Central Differences
2. Newton's forward and backward formulae for interpolation
3. Newton's divided difference formula, Lagrange's interpolation formula for unequal intervals

Unit – 2: Interpolation and prediction: Central difference interpolation formulae

1. Gauss's Forward interpolation formula
2. Gauss's backward interpolation formula
3. Stirling's formula
4. Bessel's formula.

Unit -3: Errors and their accuracy, Inverse interpolation and Extrapolation

Errors and their accuracy:

1. Inherent errors
2. Rounding errors
3. Truncation errors
4. Absolute, relative and percentage errors

Inverse interpolation

1. Lagrange's method
2. Iteration or successive approximation
3. Reversion of series method

Extrapolation

Introduction, Basic methods for extrapolation

Unit – 4: Numerical Differentiation

1. Derivative using Newton's forward difference formula
2. Derivative using Newton's backward difference formula
3. Derivative using Sterling's interpolation formula
4. Derivative using Newton's divided difference formula

5. Maximum and minimum values of a tabulated function.

Unit – 5: Numerical Integration

1. General quadrature formula for equidistant ordinates
2. Trapezoidal rule,
3. Simpson's1/3– rule
4. Simpson's 3/8 – rule
5. Weddle's rules,
6. Euler – McLaurin Formula of summation and quadrature
7. Boole's rule

References:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt. Ltd., NewDelhi-110001, 2006.
2. P.Kandasamy, K.Thilagavathy, Calculus of Finite Differences and Numerical Analysis. S. Chand & Company, Pvt. Ltd., Ram Nagar, New Delhi-110055.
3. R.Gupta, Numerical Analysis, Laxmi Publications (P) Ltd., New Delhi.
4. H.C Saxena, Finite Differences and Numerical Analysis, S. Chand & Company Pvt. Ltd., RamNagar, New Delhi-110055.
5. S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr.V.Ramesh Babu, Numerical Analysis, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.

SEMESTER V
Paper 7 A
Computational Mathematics using Scilab
Course Code: MAT 301-7A

Course outcomes

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate knowledge and understanding of basic numerical formulae in solving ODE, Algebraic and Transcendental equations, simultaneous system of linear equations, finding inverse of a matrix, eigen values and eigen vectors	L1, L2
CO - 2	Select and use a range of established techniques, formulae and a reasonable level of skill in calculation to solve problems in ODE, Algebraic and Transcendental equations, simultaneous system of linear equations, inverse of a matrix, eigen values and eigen vectors	L3, L4
CO - 3	Apply the concepts and principles in computational Methods to some real data sets showing the ability to solve, evaluate and compare critically the appropriateness of various methods they	L5, L6

	have studied in the course.	
CO - 4	Demonstrate the ability to select and effectively utilize appropriate Scilab commands to implement Numerical Methods, fostering global competencies in applying advanced computational techniques to solve complex real-world problems.	L5, L6

Introduction to Scilab commands

Some basic Scilab operations – Numbers and numeric formats, Arithmetic operations - Mathematical functions - vectors - Matrics - Matrix operations - String and printing (No question is to be set for semester end examination from this unit)

SYLLABUS

Unit 1

Numerical solution of ordinary differential equations

1. Introduction, Solution by Taylor's Series
2. Picard's method of successive approximations
3. Euler's method
4. Modified Euler's method
5. Runge – Kutta methods.

Programming in Scilab (for internal exam only)

Unit 2

Solution of Algebraic and Transcendental Equations-I:

Introduction

1. Direct method
2. Bisection method
3. Regula Falsi method
4. Fixed point Iteration method
5. The Secant Method

Programming in Scilab (for internal exam only)

Unit 3

Solution of Algebraic and Transcendental Equations – II:

1.Newton's Rapson method

2.Newton's generalised method

Solutions of system of nonlinear Equations:

1. Method of iteration
2. Newton's Rapson method

Programming in Scilab (for internal exam only)

Unit 4

Solution of Simultaneous Linear system of equations:

Introduction

1. Direct methods

i. Gauss elimination method

ii. Gauss Jordon method

iii. Method of factorization

2. Iterative methods

ii. Gauss Jacobi iterative method

iii. Gauss Seidel iterative methods

Programming in Scilab (for internal exam only)

Unit 5

Matrix inversion

1. Triangularization method
2. Crout's method
3. Doolittle method
4. Choleski's method
5. Iterative method

Eigen values and Eigen vectors

1. Iterative method for dominant latent root - Power series method
2. Jacobi's method

Programming in Scilab (for internal exam only)

Prescribed books :

1. A text book of B.Sc. Mathematics, published by Deepthi Publications
2. A text book of B.Sc. Mathematics, published by S.Chand& Company

Reference Books :-

1. Calculus of finite differences and Numerical Analysis by P.P. Gupta, G.S. Malik, Krishna Prakasan media (Pvt. Ltd.)
2. Scope as in Introductory methods of Numerical Analysis by S.S. Sastry, Prentice Hall India (4th edition).
3. Finite Differences and Numerical Analysis by H.C. Saxena, published by S.Chand and Company.
4. Introduction to Numerical Analysis using MATLAB by Rizwan Butt, Infinity Science press L.L.C

SEMESTER V

Paper 6B

Vector calculus

Skill Enhancement Course - Elective

Course outcomes

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate knowledge and understanding of derivatives, integration and vector operators concepts in vector calculus, applying established formulae to solve problems within the scope of vector calculus.	L1, L2
CO - 2	Apply knowledge and understanding of various vector operators to analyze and solve problems, theorems, and	L3, L4

	results in vector calculus, demonstrating the ability to use these concepts in diverse mathematical scenarios.	
CO - 3	Evaluate mathematical problems involving derivatives and integration, demonstrating a critical analysis of solutions and making informed judgments about the appropriateness and accuracy of the results.	L3, L4, L5
CO - 4	Apply vector integrations to synthesize knowledge, converting line integrals to surface integrals, surfaces to volume integrals, and line integrals to volume integrals, showcasing the ability to integrate multiple concepts within vector calculus to solve complex problems.	L4, L5

Unit – 1: Differentiation and Integration of vectors

Vector function of a single scalar variable, limit of a vector function, continuity of a vector function, derivative of a vector function, geometrical interpretation of the derivative, successive derivative, rules of differentiation, partial derivatives. Integration of vector function, results on integration, definite integral

Unit – 2: Differential Operators: gradient, Divergence and Curl - I

Scalar and vector point function, scalar and vector field, vector differential operator del (∇), the operator **a.** ∇ , **a** being any vector, gradient of a scalar point function, divergence of a vector point function, curl of a vector point function, Laplacian operator, vector identities involving differential operators

Unit – 3: Differential Operators: gradient, Divergence and Curl – II

Level surfaces, directional derivatives of a scalar point function, to determine the equations of the tangent plane and normal to the surface $\phi(x_1, y_1, z_1) = c$ at a given point $P_0(x_0, y_0, z_0)$, to determine the equations of the tangent line and normal plane at a given point $P_0(x_0, y_0, z_0)$ of the curve represented by the intersecting surfaces $\phi(x, y, z) = c_1$ and $\psi(x, y, z) = c_2$, invariance of grad ϕ , div **f** and curl **f** .

Unit – 4: Line, Surface and Volume Integrals:

Line integrals, Surface integrals and volume integrals

Unit - 5: Vector integration applications

1. Gauss theorem and applications of Gauss theorem.
2. Green's theorem in plane and applications of Green's theorem.
3. Stokes's theorem and applications of Stokes theorem.

Prescribed text book:

1. A text book of Mathematics Elective B, Multiple integrals and applications of Vector calculus by Deepti Publications

2. Simplified course in Vector Calculus by M. D. Raisinghania, H.C. Saxena, H.K.Dass, S Chand publications.

Reference Books:

1. Dr.M Anitha, Linear Algebra and Vector Calculus for Engineer, Spectrum University Press, SR Nagar, Hyderabad-500038, INDIA.

2. Dr.M.Babu Prasad, Dr.K.Krishna Rao, D.Srinivasulu, Y.AdiNarayana, Engineering Mathematics-II, Spectrum University Press, SR Nagar, Hyderabad-500038,INDIA.

3. V.Venkateswararao, N. Krishnamurthy, B.V.S.S.Sarma and S.Anjaneya Sastry, A text Book of B.Sc., Mathematics Volume-III, S. Chand & Company, Pvt. Ltd., Ram Nagar,NewDelhi-110055.

4. R.Gupta,Vector Calculus, Laxmi Publications.

5. P.C.Matthews, Vector Calculus, Springer Verlag publications.

Semester V
Paper-7B
Integral transforms with applications

Skill Enhancement Course - Elective
Course code: MAT 301 – 7B

Course Learning Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Demonstrate knowledge and understanding of various properties of Laplace transforms, inverse Laplace transforms, Laplace transforms of derivative, Laplace transforms of integrals and Fourier transforms	L1, L2
CO - 2	Evaluate Laplace transforms, inverse Laplace transforms of certain functions, Laplace transforms of derivatives, Laplace transforms of integrals	L3, L4
CO - 3	Solve ordinary differential equations with constant/ variable coefficients by using Laplacetransform method and be able to explain the procedure of solving ODE	L3, L4, L5
CO - 4	Comprehend the properties of Fourier transforms and solve problems related to finite Fourier transforms	L4, L5

SYLLABUS

Unit – 1: Laplace transforms- I

1. Definition of Laplace transform, linearity property-piecewise continuous functi

2. Existence of Laplace transform, functions of exponential order and of class A.
3. First shifting theorem, second shifting theorem and change of scale property.

Unit – 2: Laplace transforms- II

1. Laplace Transform of the derivatives, initial value theorem and final value theorem. Laplace transforms of integrals.
2. Laplace transform of t^n. f (t), division by t, evolution of integrals by Laplace transforms.
3. Laplace transform of some special functions-namely Dirac delta function, error function,Bessel function and Laplace transform of periodic function.

Unit – 3: Inverse Laplace transforms

1. Definition of Inverse Laplace transform, linear property, first shifting theorem, secondshifting theorem, change of scale property, use of partial fractions**.**
2. Inverse Laplace transforms of derivatives, inverse, Laplace transforms of integrals,multiplication by powers of 'p', division by 'p'.
3. Convolution, convolution theorem proof and applications.

Unit – 4: Applications of Laplace transforms

1. Solutions of differential equations with constants coefficients, solutions of differentialequations with variable coefficients.
2. Applications of Laplace transforms to integral equations- Abel's integral equation.
3. Converting the differential equations into integral equations, converting the integralequations into differential equations

Unit – 5: Fourier transforms

1. Integral transforms, Fourier integral theorem (without proof), Fourier sine and cosineintegrals.
2. Properties of Fourier transforms, change of scale property, shifting property, modulationtheorem. Convolution.
3. Convolution theorem for Fourier transform, Parseval's Identify, finite Fourier transforms.

Prescribed Textbook:

1. A textbook of B.Sc. Mathematics, Integral transforms with Applications by Deepti Publications

Reference Books:

1. Dr. S.Sreenadh, S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr. V.Ramesh Babu, Fourier series and Integral Transforms, S. Chand & Company, Pvt. Ltd., Ram Nagar, New Delhi-110055.

2. A.R. Vasistha, Dr. R.K. Gupta, Laplace Transforms, Krishna Prakashan Media Pvt. Ltd.Meerut.

3. M.D.Raisinghania, H.C. Saxsena , H.K. Dass, Integral Transforms, S. Chand & CompanyPvt. Ltd., Ram Nagar, New Delhi-110055.

4. Dr. J.K. Goyal, K.P. Gupta, Laplace and Fourier Transforms, Pragathi Prakashan, Meerut.

5. Shanthi Narayana , P.K. Mittal, A Course of Mathematical Analysis, S. Chand &

CompanyPvt.Ltd. Ram Nagar, New Delhi-110055.

Semester – V

Course-6C: Mathematical Special Functions

Skill Enhancement Course (Elective)
Course code: MAT 301-6C

Course Learning Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Understand the Beta and Gamma functions, their properties and relation between these twofunctions, understand the orthogonal properties of Chebyshev polynomials and recurrence relations.	L1, L2
CO - 2	Find power series solutions of ordinary differential equations.	L3, L4
CO - 3	solve Hermite equation and write the Hermite Polynomial of order (degree) n, also find the generating function for Hermite Polynomials, study the orthogonal properties of Hermite Polynomials and recurrence relations.	L3, L4
CO - 4	Solve Legendre equation and write the Legendre equation of first kind, also find the generating function for Legendre Polynomials, understand the orthogonal properties ofLegendre Polynomials.	L3, L4
CO - 5	Solve Bessel equation and write the Bessel equation of first kind of order n, also find thegenerating function for Bessel function understand the orthogonal properties of Bessel unction.	L3, L4

SYLLABUS

Unit – 1: Beta and Gamma functions, Chebyshev polynomials

1. Euler's Integrals-Beta and Gamma Functions, Elementary properties of GammaFunctions, Transformation of Gamma Functions.
2. Another form of Beta Function, Relation between Beta and Gamma Functions.
3. Chebyshev polynomials, orthogonal properties of Chebyshev polynomials, recurrencerelations, generating functions for Chebyshev polynomials.

Unit – 2: Power series and Power series solutions of ordinary differential equations

1. Introduction, summary of useful results, power series, radius of convergence, theoremson Power series
2. Introduction of power series solutions of ordinary differential equation
3. Ordinary and singular points, regular and irregular singular points, powerseries solution.

Unit – 3: Hermite polynomials

1. Hermite Differential Equations, Solution of Hermite Equation, Hermite polynomials, generating function for Hermite polynomials.
2. Other forms for Hermite Polynomials, Rodrigues formula for Hermite Polynomials, to find first few Hermite Polynomials.
3. Orthogonal properties of Hermite Polynomials, Recurrence formulae forHermite Polynomials.

Unit – 4: Legendre polynomials

1. Definition, Solution of Legendre's equation, Legendre polynomial of degreen, generating function of Legendre polynomials.
2. Definition of $P_n(x)$ and $Q_n(x)$, General solution of Legendre's Equation (derivations not required) to show that $Pn(x)$ is the coefficient of h^n, in the expansion.
3. Orthogonal properties of Legendre's polynomials, Recurrence formulas for Legendre'sPolynomials.

Unit – 5: Bessel's equation

1. Definition, Solution of Bessel's equation, Bessel's function of the first kind oforder n, Bessel's function of the second kind of order n.
2. Integration of Bessel's equation in series form=0, Definition of $J_n(x)$ recurrence formulae for $J_n(x)$
3. Generating function for $J_n\square x\square$, orthogonally of Bessel functions.

Reference Books:

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & CompanyPvt. Ltd., Ram Nagar, New Delhi-110055.
2. J.N.Sharma and Dr.R.K.Gupta, Differential equations with special functions, KrishnaPrakashan Mandir.
3. Shanti Narayan and Dr.P.K.Mittal, Integral Calculus, S. Chand & Company Pvt. Ltd., RamNagar, New Delhi-110055.
4. George F.Simmons, Differential Equations with Applications and Historical Notes, TataMcGRAW-Hill Edition, 1994.
5. Shepley L.Ross, Differential equations, Second Edition, John Willy & sons, New York,1974.
6. Web resources suggested by the teacher and college librarian including reading material.

Course-7C: Number theory

Skill Enhancement Course (Elective)

Course code: MAT 301 – 7C

Course Code: MAT 301-7C

1. Learning Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
CO - 1	Find quotients and remainders from integer division, study divisibility properties of integers and the distribution of primes.	L1, L2
CO - 2	Demonstrate Dirichlet multiplication which helps to clarify interrelationship betweenvarious arithmetical functions.	L2
CO - 3	Comprehend the behavior of some arithmetical functions for large n.	L3, L4,
CO - 4	the concepts of congruencies, residue classes and complete residues systems.	L2
CO - 5	Comprehend the concept of quadratic residues mod p and quadratic non-residues mod p.	L3

Syllabus

Unit – 1: Divisibility

1. Introduction, Divisibility, Greatest Common Divisor.
2. Prime numbers, The fundamental theorem of arithmetic, The series of reciprocals of theprimes.
3. The Euclidean algorithm, The greatest common divisor of more than two numbers.

Unit – 2: Arithmetical Functions and Dirichlet Multiplication

1. Introduction, The Mobius functionμ(n), The Euler totient functionφ(n), A relationconnecting φ and μ , A product formula for φ(n).
2. The Dirichlet product of arithmetical functions, Dirichlet inverses and Mobius inversionformula, The Mangoldt functionΛ(n).
3. Multiplicative functions, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function λ(n), The divisorfunctions $\sigma_\alpha(n)$.

Unit – 3: Averages of Arithmetical Functions

1. Introduction, The big oh notation. Asymptotic equality of functions, Euler's summationformula, some elementary asymptotic formulas.
2. The average order of d(n), The average order of the divisor functions$\sigma_\alpha(n)$, The averageorder of φ(n).
3. The average order of μ(n) and Λ(n), The partial sum of a Dirichlet product, Applicationsof μ(n) and Λ(n).

Unit – 4: Congruences

1. Definition and basic properties of congruence, Residue classes and complete residuesystems.
2. Linear congruence, reduced residue systems and the Euler-Fermat theorem. Polynomial congruencemodulo p. Lagrange's theorem.
3. Applications of Lagrange's theorem, Simultaneous linear congruence. The Chineseremainder theorem. Applications of the Chinese remainder theorem.

Unit – 5: Quadratic Residues and the Quadratic Reciprocity Law

1. Quadratic Residues, Legendre's symbol and its properties, Evaluation of (-1/p) and (2/p),Gauss lemma,
2. The Quadratic reciprocity law, Applications of the reciprocity law, The Jacobi Symbol.
3. Gauss sums and the quadratic reciprocity law, the reciprocity law for quadratic Gausssums. Another proof of the quadratic reciprocity law.

III. Reference Books:

1. Tom M.Apostol, Introduction to Analytic Number theory, Springer International StudentEdition.
2. David, M. Burton, Elementary Number Theory, 2nd Edition UBS Publishers.
3. Hardy & Wright, Number Theory, Oxford Univ, Press.
4. Dence, J. B & Dence T.P, Elements of the Theory of Numbers, Academic Press.
5. Niven , Zuckerman &Montgomery, Introduction to the Theory of Numbers.

List of LDCs, SDCs offered by the Department

ANALYTICAL SKILLS

Syllabus **Total 30 Hrs**

Course Objective: Intended to inculcate quantitative analytical skills and reasoning as an inherent abilityin students.

Course Outcomes:

CO. No	Upon the successful completion of the course, students will be able to	Bloom's taxonomy cognitive domain
1	Understand the basic concepts of arithmetic ability, quantitative ability, logical reasoning, businesscomputations and data interpretation and obtain the associated skills.	L2, L3
2	Acquire competency in the use of verbal reasoning.	L4
3	Apply the skills and competencies acquired in the related areas	L4, L5
4	Solve problems pertaining to quantitative ability, logical reasoning and verbal ability inside and outsidethe campus.	L4, L5

UNIT – 1: (10 Hours)

Arithmetic ability: Algebraic operations BODMAS, Fractions, Divisibility rules, LCM & GCD (HCF).

Verbal Reasoning: Number Series, Coding & Decoding, Blood relationship, Clocks, Calendars.

UNIT – 2: (10 Hours)

Quantitative aptitude: Averages, Ratio and proportion, Problems on ages, Time-distance – speed.

Business computations: Percentages, Profit & loss, Partnership, simple compound interest.

UNIT – 3: (07 Hours)

Data Interpretation: Tabulation, Bar Graphs, Pie Charts, line Graphs. Venn diagrams.

Text Book:

Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.

Reference Books

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar,New Delhi-110055
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw HillPublications.

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